NOTICE OF PROPOSED COST PASS-THROUGH FOR NETWORK SUPPORT FOR DEFERRAL OF THE WESTERN 500kV CONVERSION

Notice and explanatory material

13th March 2008

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NOTIFICATION OF PROPOSED COST PASS-THROUGH FOR NETWORK SUPPORT SERVICE

In accordance with clause 6.2.4(b) of the National Electricity Code, the Australian Competition and Consumer Commission (ACCC), in a Decision dated 27 April 2005, set a revenue cap to apply to TransGrid for the regulatory control period from 1 July 2004 to 30 June 2009.

The *National Electricity (South Australia) (New National Electricity Law) Amendment Act* 2005 was passed in connection with the transfer of functions from the ACCC to the AER and section 10 of that Act provided for the making of regulations to address transitional issues. Clause 13 of Schedule 2 of the *National Electricity (South Australia) Regulations* in effect puts the AER in the shoes of the ACCC for the purposes of the ACCC's Decision.

Appendix A of the Decision contains Pass-Through Rules (the Pass-Through Rules) to apply as part of the Revenue Cap.

The Pass-Through Rules provide that a Pass-Through Event can be a Network (Grid) Support Event and that:

> A Network (Grid) Support Event occurs where the cost of network support becomes materially higher or lower than the per annum cost of network support (if any) provided by the ACCC in the Revenue Cap.[1]
>
> Pass-Through Amount means a variation to the TNSP's Maximum Allowed Revenue as a result of a Pass-Through Event determined in accordance with these Pass-Through Rules (which form part of the TNSP's Revenue Cap). A Pass-Through Amount may be positive or negative.

In accordance with clause 3.2 of the Pass-Through Rules, TransGrid provides the following Notice of Proposed Pass-Through:

Table 1: Notice of Proposed Pass-Through

Notice Requirement (see cl 3.2 of the Pass-Through Rules)	TransGrid Notification
(a) description of the relevant Pass-Through Event	TransGrid has agreed to purchase services (including options for TransGrid to call for generation or demand side management) from generators, customers and other similar parties to effect the efficient operation, maintenance or development of its transmission system as contemplated by the definition of Network (Grid) Support Event in section 4.2 of the Pass-Through Rules. The materially higher cost incurred by TransGrid for network support results from the existing obligation and potential future obligations to make estimated payments to (Commercial-in-Confidence) of \$21,409,500 between 26/02/2008 and May 2009 for Network Support.

[1] Example (a) in the definition of "A Network (Grid) Support Event" is relevant in the current circumstances.

Notice Requirement (see cl 3.2 of the Pass-Through Rules)		TransGrid Notification
(b)	the date on which the relevant Pass-Through Event took effect or will take effect	26/02/2008
(c)	if Notice of Proposed Pass-Through is provided under clause 3.1(d), the date on which the TSNP first became aware that the Pass-Through Event had taken effect or will take effect.	Not applicable. Notice of the Proposed Pass-Through is not provided under clause 3.1(d).
(d)	the estimated financial effect of the Pass-Through Event on the TNSP's provision of *prescribed services* (being the proposed Pass Through Amount)	$21,904,164 in the 2008/09 financial year
(e)	the proposed period over which the Pass-Through Amount should apply	The financial year 1 July 2008 to 30 June 2009
(f)	if the proposed period over which the Pass-Through Amount should apply consists of two or more financial years, the proposed allocation of the Pass-Through Amount over the financial years	Not applicable. The proposed period does not consist of two or more financial years.
(g)	the supporting information referred to in clauses 3.3(a) and (b)	See Table 2

Table 2: Supporting Information Required by the Pass-Through Rules to Accompany the Notice

Supporting Information (see cl 3.3 (a) and (b) of the Pass-Through Rules)		TransGrid Information
(a)	The TNSP must attach to its Notice of Proposed Pass-Through such information and documentation as the AER requires to enable the AER to form an opinion as to:	
(i)	whether the Pass-Through Event did take effect or will take effect	TransGrid has a contractual obligation to make payments to (Commercial-in-Confidence) and potential future obligations to make payments to (Commercial-in-Confidence) for provision of network support in the 2004-2009 Regulatory Period. Appendix 9 shows the estimated payment amounts and dates for these payments. This information should be treated as "Commercial-in-Confidence".
(ii)	if the Notice of Proposed Pass-Through is provided under clause 3.1(d), whether the TNSP complied with the requirement to give promptly such Notice to the AER.	Not applicable. Notice of the Proposed Pass-Through is not provided under clause 3.1(d).

Supporting Information (see cl 3.3 (a) and (b) of the Pass-Through Rules)		TransGrid Information
(iii)	whether, and to what extent, the TNSP's MAR should be varied as a result of the Pass-Through Event (being the Pass-Through Amount).	Amounts to be paid to (Commercial-in-Confidence) for network support and associated TransGrid costs as set out in Table 1, Item(d): $21,904,164. Amount provided for in the ACCC Revenue Cap for network support: Nil Material increase: $21,904,164.
(iv)	the period over which the Pass-Through Amount should apply	The Agreement with (Commercial-in-Confidence) was executed on 26/02/2008. The costs of the Pass-Through Event will be incurred in the 2007-2008 and 2008-2009 financial years and these can passed through in the 2008-2009 financial year.
(v)	if the proposed period over which the Pass-Through Amount should apply consists of two or more financial years, how the Pass-Through Amount should be allocated over the financial years	Not applicable. The proposed period does not consist of two or more financial years.
(b)	Without limiting the generality of the obligation in clause 3.3(a), the supporting information must include, where the Pass-Through amount is:	
(i)	a Change in Taxes Event…	Not applicable. This is not a Change in Tax Event.
(ii)	an Insurance Event…	Not applicable. This is not an Insurance Event.
(iii)	a Network (Grid) Support Event – if applicable, the relevant decision of NEMMCO or other Authority before the Network (Grid) Support Event and the relevant decision of NEMMCO or other Authority implementing the Network (Grid) Support Event.	Not applicable. The Network (Grid) Support Event did not occur because of a decision by NEMMCO or another authority. Neither NEMMCO nor other Authority is required to make a decision in relation to this Network (Grid) Support Event.
(iv)	a Service Standards Event…	Not applicable. This is not a Service Standard Event.

EXPLANATORY MATERIAL

This explanatory material does not form part of the Notification of Proposed Cost Pass-through for Network Support Service, but is provided to assist the AER's understanding of the need for, and nature of, the Network Support Service

1. Summary of the need for Network Support Payments

TransGrid is implementing an integrated set of capital works known collectively as the "Western 500kV Conversion" project. This project will maintain the ability of TransGrid's transmission network to transfer sufficient power from power stations within and outside NSW to meet the forecast peak power demands in the Newcastle, Sydney and Wollongong urban complex from 2008/09. In particular the project will allow more power to be transmitted to this urban complex from power stations that are located in the north of NSW, and in Queensland. Having regard for the demand and the location of the available power sources TransGrid has assessed that if this project is not implemented there will be insufficient power available to the urban complex from all sources under probable generator dispatch conditions from that date onwards.

The Western 500kV Conversion project comprises a large number of inter-related works that will raise the operating voltage of a major transmission path within TransGrid's network from 330kV to 500kV. This transmission path extends from Bayswater in the north to Bannaby, near Marulan. The works include 500/330kV substations that will create interfaces between the new 500kV network and the existing 330kV network.

The option that satisfied the regulatory test included Network Support in 2008/09. This Network Support will allow deferral of the network component of the option until 2009/10. This Network Support has been secured via an open tendering process and comprises a combination of local generation and load reductions.

The option that satisfied the regulatory test also included transfer of the connection point for Macquarie Generation's Bayswater Power Station Units 3 and 4 from the Bayswater 330kV Switchyard to Bayswater 500kV Switchyard. This reconnection necessitated the replacement of the generator transformers associated with these units. As these transformers are not owned by TransGrid, TransGrid is required to reimburse Macquarie Generation for the costs associated with this work. These costs cannot be included in TransGrid's asset base and can only be recovered via the Pass-Through process. Consequently, TransGrid submitted a Pass-Through Notice to the AER for the costs associated with this work on 7th December 2007 and The AER made a determination on this Notice on 24th January 2008 (see AER web site).

The two forms of Network Support discussed above are separate elements of the Western 500kV Conversion project. The amount of Network Support provided by each is independent of the Network Support provided by the other.

The National Electricity Code provided that a TNSP can implement a non network option as an alternative to network augmentation. Where the cost of a network support service is not included in the Revenue Cap it can be passed-through under the Pass-Through Rules set out at Appendix A to TransGrid's Revenue Cap Decision.

The mechanism for recovery of these costs under the regulatory arrangements is therefore for them to be recognised as a Network Support service. The payments will then be classed as an operating expense that will be passed through to network customers through TransGrid's transmission network service charges.

2. Purpose of this explanatory material

TransGrid has aimed to assemble and present to the AER information that will allow it to understand the background to the Western 500kV Conversion project as a whole, so as to place the Pass-through Notification into perspective. TransGrid does not expect that the AER will review the merits of the project as a whole, for which TransGrid relies entirely on the existing ex ante capex arrangements that currently apply to it.

The background material therefore explains TransGrid's assessment of its ability to meet its reliability requirements as demand increases into the future, and the role that the Network Support that is the subject of this Notification will play. In addition the document includes appendices that are mostly extracts from publicly-available papers that summarise the processes that TransGrid has undertaken.

3. TransGrid's Regulatory Framework

As a transmission network service provider, TransGrid is subject to two forms of regulation:

1 Jurisdictional arrangements and the National Electricity Rules (the Rules) that set minimum reliability standards that must be met. Investment to met these standards is subject to economic discipline as investment must be undertaken at a reasonable cost; and

2 Rate of return regulation that allows a TNSP to invest in the network but only where it is economically justifiable based on a Regulatory Test.

Minimum reliability standards are set by each jurisdiction having regard for its assessment of the importance of electricity to the economy. Network owners are required to meet these reliability standards.

Investment required to meet those standards is not second guessed within the regulatory structure except to the extent that the least cost means of achieving reliability should be adopted. This requirement is set out in the reliability limb of the regulatory test.

TransGrid seeks to meet its reliability standards efficiently. The background material explains TransGrid's assessment of its ability to meet its reliability requirements where demand is increasing into the future.

In particular, the appendices to this Explanatory Material summarise the network planning process whereby TransGrid has:

1 forecast demand;

2 assessed the ability of its transmission network capability to meet forecast demand;

3 identified limitations in the network;

4 considered options to relieve limitations and meet forecast demand;

5 undertaken a more detailed analysis of practicable options;

6 applied the regulatory test to the practicable options; and

7 taken steps to implement the least cost option.

The regulatory process ensures that these steps have been subject to checks and balances including consulting all Registered Participants, NEMMCO and interested parties in accordance with clause 5.6.6 of the Rules. The findings in TransGrid's' Final Report were not disputed or referred to the AER. A copy of TransGrid's Final Report can be found in Appendix 10 or on TransGrid's web site http://www.transgrid.com.au/trim/trim224993.pdf .

4. Background to the Western 500kV Conversion Project

4.1. Load disposition and growth in NSW

The Newcastle – Sydney – Wollongong area that is referred to in this document includes the Sydney CBD and the major industrial areas of Sydney, Newcastle and Wollongong. This is the major commercial and political hub of NSW.

At the time of peak NSW demand the load in this area accounts for over 75% of the State's power demand. The area also accounts for about a third of the total demand in the interconnected southeast Australian (NEM) system.

The consumption of energy and the maximum demand for electricity in NSW have both shown a steady growth over the last 60 years - driven by population growth and increasing per capita electricity usage. Even allowing for new consumption management initiatives being identified by the community and implemented to slow the rate of growth, TransGrid has forecast, on the basis of authoritative economic forecasts, that both energy consumption and maximum demand will continue to increase for the foreseeable future.

Details of forecasting process, the NSW demand forecast and existing and forecast demand in the Newcastle – Sydney – Wollongong area can be found in Appendix 1.

4.2. TransGrid's transmission development obligations

TransGrid has obligations under the National Electricity Rules and jurisdictional requirements to develop the NSW electricity transmission system to ensure that there is sufficient transmission capacity to meet the NSW State demand at an acceptable standard of reliability from the output of generators within the State and from interconnection capacity. In doing so, it is essential that the transmission system be developed so that in the longer term it can manage a range of generation development and market dispatch scenarios.

Details of the criteria that TransGrid uses in planning its transmission network can be found in Appendix 2.

The planning criteria that apply to the NSW main system, including the western 500kV conversion project, are set out in TransGrid's APR. The criteria are essentially 'N-1' taking into account the manner in which the interconnected system is operated by NEMMCO.

In summary the criteria are categorised into a set of criteria that apply at the 50% probability of exceedence load forecast level and a set that apply at the 10% probability of exceedence load forecast level, as follows:

> Peak demand at or exceeding a one in two year probability of occurrence (50% probability of exceedence)
> The system will be able to operate securely[2] under all reasonably probable patterns of generation dispatch or interconnection power flow.
>
> In the event of a forced outage of any single item of plant[3], the system will be able to be re-secured by the re-dispatch of generation but without load shedding.
>
> In planning reactive plant installations provision is made for the prior outage of a single capacitor bank.

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[2] The term "securely" here is the common interpretation of system security by power system planners – it implies that in anticipation of the next most critical contingency all network elements are loaded to within their thermal ratings, voltages are stable and there is an adequate margin from the point of voltage instability, the system is transiently stable and the modes of oscillation are adequately damped.

[3] In this context a single item of plant is defined as a single transmission circuit, a single generating unit, a single transformer or a single item of reactive plant.

Peak demand at or exceeding a one in ten year probability of occurrence (10% probability of exceedence)

The system will be able to operate securely under a limited set of patterns of generation dispatch or interconnection power flow.

In the event of a forced outage of any single item of plant, the system will be able to be re-secured by the re-dispatch of generation but without load shedding.

The non-network alternatives to supply reinforcement to meet the above criteria include load control, which can take the form of load shedding in anticipation of a contingency or in response to a contingency. In these cases a contractual arrangement is put in place, together with automatic or manual control schemes (or System Protection Schemes) to give effect to the load shedding. The contractual arrangement provides for the financial compensation to the owner of the load for providing the load control service. There is no conflict here with the need to satisfy the 'N-1' criteria.

These criteria ensure that there is sufficient transmission capacity so that load will not be pre-emptively shed in anticipation of a contingency or shed following a first contingency. They relate to the way in which the system is operated by NEMMCO.

NEMMCO's Operating Practice

These criteria directly relate to NEMMCO's operating practice with respect to ensuring that the system is secure (refer to the National Electricity Rules). NEMMCO's practice is to re-secure the system through the re-dispatch of generation or load shedding following a contingency, with the use of load shedding as the last resort. The difference between TransGrid's planning criteria and NEMMCO's security criteria is that TransGrid applies the above as reliability criteria, with the need to ensure that pre-emptive load shedding is not required.

4.3. Description of the "core" NSW transmission network

The "core" portion of the NSW transmission network that is identified in Diagram 1 on the next page supplies the Newcastle – Sydney – Wollongong load area, which is also identified. The main energy sources for this area are the power stations that are located to the north, west and south of Sydney. These power stations comprise:

- In the north: Bayswater and Liddell power stations, together with some smaller stations and transfer from Queensland;
- In the west: Mt Piper and Wallerawang power stations, plus some small hydro and wind generators;
- In the south: the Snowy power stations, some smaller hydro and wind generators, and transfer from Victoria.
- Within the load area, on the central coast between Newcastle and Sydney: Vales Point, Munmorah and Eraring Power Stations.

The core transmission network comprises high capacity 330kV transmission lines using both single circuit and double circuit construction, together with three very high capacity double circuit 500kV lines, one of which operates at its design voltage, while two others operate at 330kV.

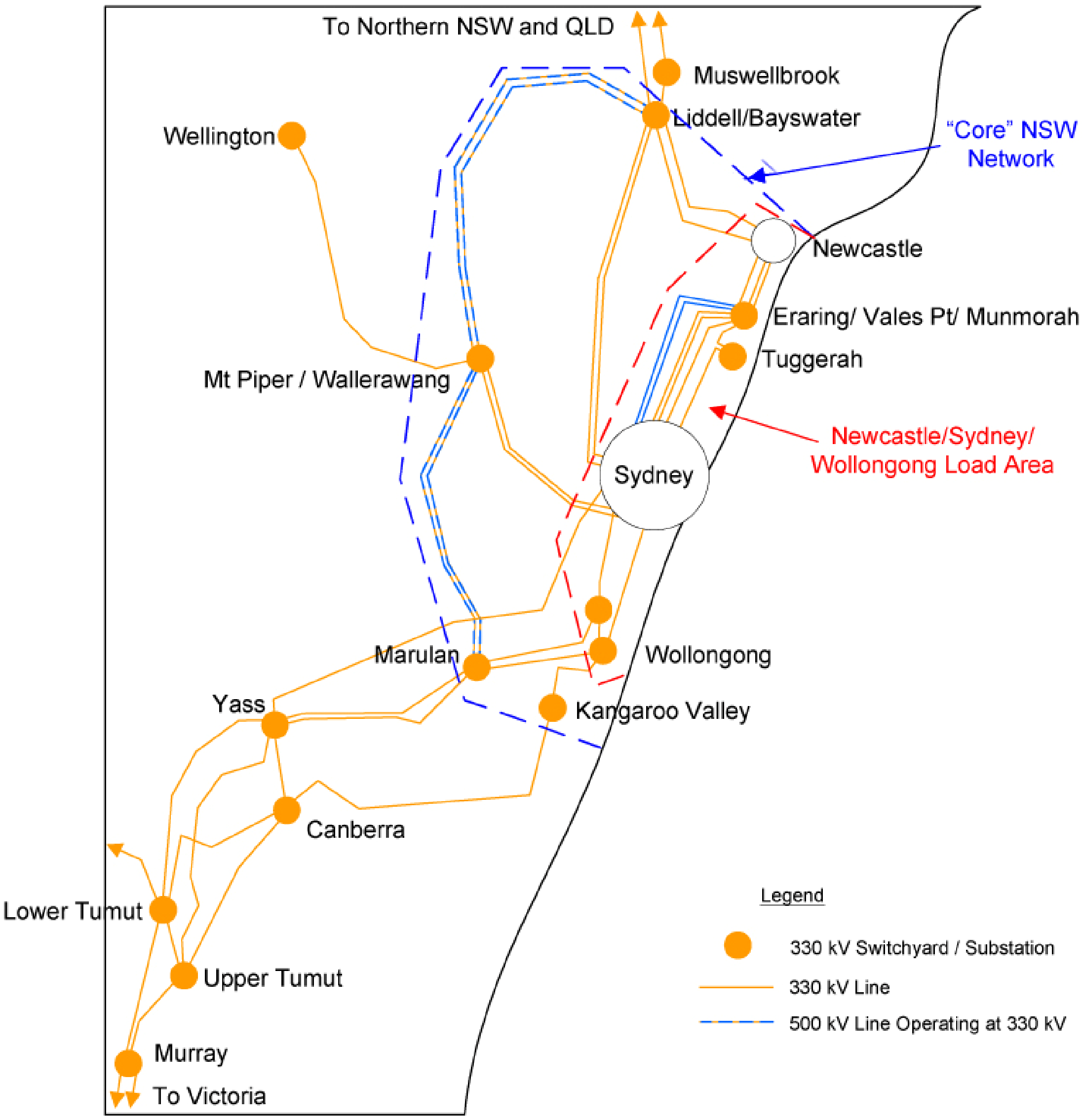


Diagram 1 – Portion of the NSW Network showing the "core" and the Newcastle – Sydney – Wollongong Area

At periods of high demand in the load area the power transfer on these lines is predominantly in the direction from the power stations towards the load area. The relative amounts of transfer on the various transmission paths that can be seen on this diagram depends upon the electrical characteristics of the paths and the output powers of the stations as determined by NEMMCO's central dispatch.

As a consequence some of these paths carry more power relative to the capacity of the transmission lines than others. At times the dispatch patterns of generators might need to be changed to prevent one path from being overloaded, while others still have the capacity to accept additional power transfer.

There are a number of locations in NSW where the short circuit level is high and approaching the rating of substation plant. This will need to be addressed as new generating capacity is added to the network. This is particularly the case at the Bayswater and Liddell 330kV switchyards. The conversion of the western lines to 500kV operation marginally increases the short circuit levels at the switchyards, but the transfer of Bayswater generating units to the 500kV network will reduce them.

4.4. TransGrid's long-term transmission planning concept

There are environmental and social constraints on new line development in NSW. TransGrid is required to act in an environmentally and socially responsible manner. The principles that TransGrid applies for the augmentation of transmission capacity are:

- The development should be consistent with the outline plan for the system, in order to minimise the proliferation of lines;
- National parks will be avoided where other reasonable options exist, as this is not considered environmentally responsible and it is also not considered feasible to obtain environmental approval for such developments;
- It is necessary to avoid multiple disturbances to an area;
- Maximum use should be made of scarce line routes;
- Substation development is preferred over line development; and
- The relatively high cost of line development should be deferred as much as possible by the use of reactive plant;

The concept of developing a strong 500kV ring around Newcastle – Sydney – Wollongong area was developed in the 1970s and partially implemented through the 1980s and early 1990s. The aim of the concept is to provide for substantial future needs to transmit power from remote power stations to load areas, while minimising transmission line routes into the Sydney basin and effectively managing technical constraints (fault levels) on switch gear.

Three stages of the 500kV development have already been completed. The first stage was the construction of the Eraring to Kemps Creek 500kV double circuit line, which provided for the reliable connection of Eraring Power Station to Sydney. The next stage of the 500kV network development was construction of the Bayswater to Mt Piper 500kV line, which was required to connect Bayswater Power Station in the mid to late 1980s. The third stage of the 500kV network was construction of the Mt Piper to Marulan 500kV line to match the commissioning of the Mt Piper Power Station in the early 1990s.

At the time of construction it was most efficient for the Bayswater to Mt Piper and the Mt Piper to Marulan 500kV lines to be connected to operate initially at 330kV. However provision was made for their operation at the design voltage when justified by network requirements.

TransGrid considers that new lines would not be able to be developed to address the immediate needs of the supply to the Newcastle/ Sydney/ Wollongong load corridor, while ever there is another option available. However as the load grows and is to be met by generation development outside of the load corridor it is inevitable that new line development will eventually be required.

TransGrid is undertaking the conversion of the western 500kV system from 330kV to 500kV operation as this requires substation development with no new line developments. This conversion project will maximize the capability of the existing transmission network.

As a part of the overall strategy for a 500kV ring network the western 500kV conversion project is underpinning further network developments to accommodate the following generation developments:

- Hunter Valley generation and generation north of the Hunter Valley;
- Western generation developments;
- Generation developments in the Marulan area or further south;
- Increased power transfers over the NSW – Queensland interconnection; and
- Increased transfers over the NSW – Snowy – Victoria interconnections

The need for further reinforcement of supply to the load corridor would be deferred only by significant committed generation or demand management development within the load corridor.

For the Revenue Reset in 2008 a large number of new future generation planting and load growth scenarios are being assessed. These all show the need for reinforcement of the transmission network to supply to the Newcastle - Sydney - Wollongong load corridor.

4.5. *Forecast onset of network constraints*

In its current configuration the NSW electricity transmission network has limited capacity to provide reliable access to load centres from additional generation that will need to be installed in the future to meet the NEM reliability standards. At periods of peak summer demand in the near future generating units connected outside the Newcastle - Sydney - Wollongong load centres will more frequently be constrained off by the limitations in transmission line capacity to these major load centres. The connection of additional generators within this load area is also severely restricted by the fault interrupting capability of the major equipment within those areas, and in practical terms by the environmental constraints on significant quantities of new (non-distributed) generation being sited on the coastal strip.

The transmission capability within the “core” NSW network is limited by two factors:

- The thermal rating of the transmission lines, particularly under high ambient temperature conditions; and

- The ability to control voltage at all points on the network to within acceptable limits for customers and to maintain the integrity of the overall system.

In particular the existing “core” NSW electricity transmission network is reaching the limit of its capacity to reliably supply power to the Newcastle - Sydney - Wollongong load area under high load conditions. The two limitations being addressed by the Western 500kV conversion project are:

- The thermal rating of the Liddell – Newcastle / Tomago 330kV line. Under peak summer demand and credible dispatch conditions the outage of either of the lines leads to a high loading on the remaining line. As the net input to the load corridor grows as a result of growth in the load corridor the loading on the remaining line increases. The time is about to be reached when the thermal rating of the line is reached, and with additional growth the line rating would be exceeded. In this case load will need to be shed if the network is not augmented.

- Voltage control limitations. The transfer of increasing levels of power into the load corridor causes a reduction the ability to adequately control voltage levels across the NSW main system and particularly in the Sydney area. When the maximum power transfer capability is reached it is necessary to shed load to maintain the integrity of the supply system.

These network limitations are illustrated in Diagram 2.

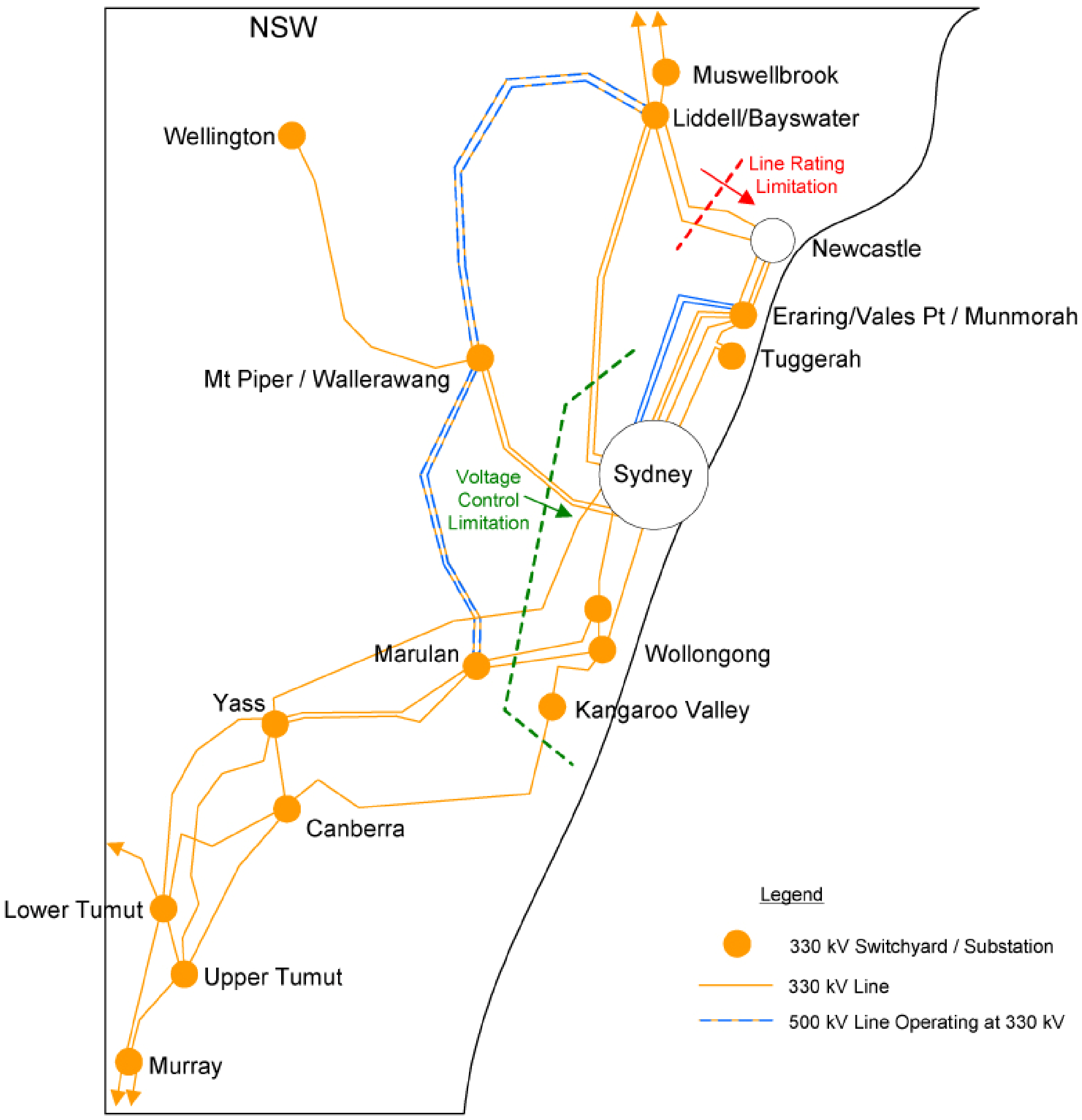


Diagram 2 - Transmission Network Limitations

There are three paths for power transfer from the northern power stations[4] towards the load area: a direct route to Sydney, a route via Newcastle and the central coast power stations, and a route to the west on the 500kV lines that operate at 330kV.

The power transfer on these paths is not proportional to the relative transmission capacity on these routes, but is determined by the electrical characteristics of the paths and physical laws. It is also affected by the distribution of the demand within the load area, and the dispatch of all the generation.

The 330kV transmission line rating between Liddell and Newcastle becomes especially critical when the following conditions arise:

- The demand in the load area is at or near the summer peak, so that
- There is a need to dispatch most of the generation that is available to the load area; but
- One or more of the central coast generating units is unavailable, or the power output is significantly reduced for technical reasons, causing the net load that is required to be supplied via the transmission network to increase.

If one of the two 330kV lines from Liddell to Newcastle was to come out of service under these conditions all the power that it was carrying will transfer to the other transmission paths. However

[4] Liddell and Bayswater power stations plus smaller stations and Queensland import

because of the physical characteristics most of it will transfer to the parallel line, so causing it to become overloaded. To avoid this condition the NEMMCO central dispatch system will automatically limit the output of the northern generators to a safe level.

Hence the unavailability of the central coast generating unit will be exacerbated by a limitation on the output of the northern generation to avoid the line overload. If the load and generation combination is near that which is set by the NEM reliability criterion for the NSW region there will be insufficient transmission capacity to supply the area load, thus violating the reliability requirements set by the NSW jurisdiction.

TransGrid must plan to develop its transmission network so that this condition will be avoided.

More detail of these constraints is given in Appendix 3.

4.6. Planned transmission network augmentation

As the load continues to grow, augmentation of this network is required to provide reliable supply to the Newcastle - Sydney - Wollongong area. The further development of the strong 500kV ring around this area is now planned to address the emerging transmission constraints. This development will alter power flow sharing between the paths to reduce the loading on the 330kV lines between the Hunter Valley power stations and the Newcastle area.

TransGrid's Western 500kV conversion development will change the electrical characteristics of the western path so that it will carry a much larger share of the total output of the northern power stations. This will avoid overload of the line to Newcastle and allow the full output of the northern and western power stations to be dispatched irrespective of the availability or dispatch status of the central coast power stations.

The proposed development is the fourth stage of the establishment of a strong 500kV ring around the load area. It does not require the construction of new 500kV lines, but involves the conversion of two existing transmission lines that are currently operating at 330kV (Bayswater - Mt Piper and Mt Piper - Marulan), to their design operating voltage of 500kV.

To achieve this conversion the 500kV lines must be interfaced with the 330kV system. The development therefore includes:

- The construction of 500kV switchyards and 500/330kV tie transformers adjacent to Bayswater and Mt Piper power stations,
- The construction of a 500/330kV substation at Wollar to augment supply to the west of the State, and
- The construction of a 500/330kV substation at Bannaby (near Marulan) to give access to lines towards Sydney from the south.

It is a significant investment in transmission infrastructure with an estimated total cost of approximately $370 million and with completion planned for 2009-10.

This development also supports voltages in the Newcastle - Sydney - Wollongong area, which was identified in the previous section as another emerging limitation to power transmission. It achieves this by reducing reactive power losses, providing additional "line charging" and increasing access to the reactive power capability of power stations in the Hunter Valley and in the Mt Piper/ Wallerawang area.

The Western 500kV Conversion will significantly increase the capacity of the core NSW transmission system to deliver power to the State.

It will also ensure that efficient and competitive National Electricity Market (NEM) operation is maintained, although this factor is not considered within the reliability limb of the Regulatory Test.

4.7. Application of the Regulatory Test

In developing this project TransGrid has considered a number of non-network and network options to address the forecast reliability issues, as required by Clause 5.6.6 of the Rules. Details of the options considered are given in Appendix 4.

TransGrid engaged NERA Consulting to apply the regulatory test to these alternatives. Because the primary driver for the development is the reliability of transmitted supply to the Newcastle - Sydney - Wollongong load area NERA applied the reliability limb of the Test. Details of the application of the test by NERA are in Appendix 5.

When applying the regulatory test, NERA Consulting found that only two options would meet the minimum network performance requirements across a range of realistic market development scenarios. Both options involve the conversion of the Bayswater – Mount Piper – Bannaby system to operate at its design voltage of 500kV (Western 500kV Conversion).

Both options include elements of Network Support Service that would defer the 500kV conversion works for one or two years. Because an increased amount of this service is required for the second year of deferral the conclusion of the test is that a one year deferral is the best-ranked option under the test. The Network Support included as part of these options is the Network Support referred to in this Notice.

The network development component for the best-ranked option in the majority of scenarios (NERA Option B) is shown in Diagram 3.

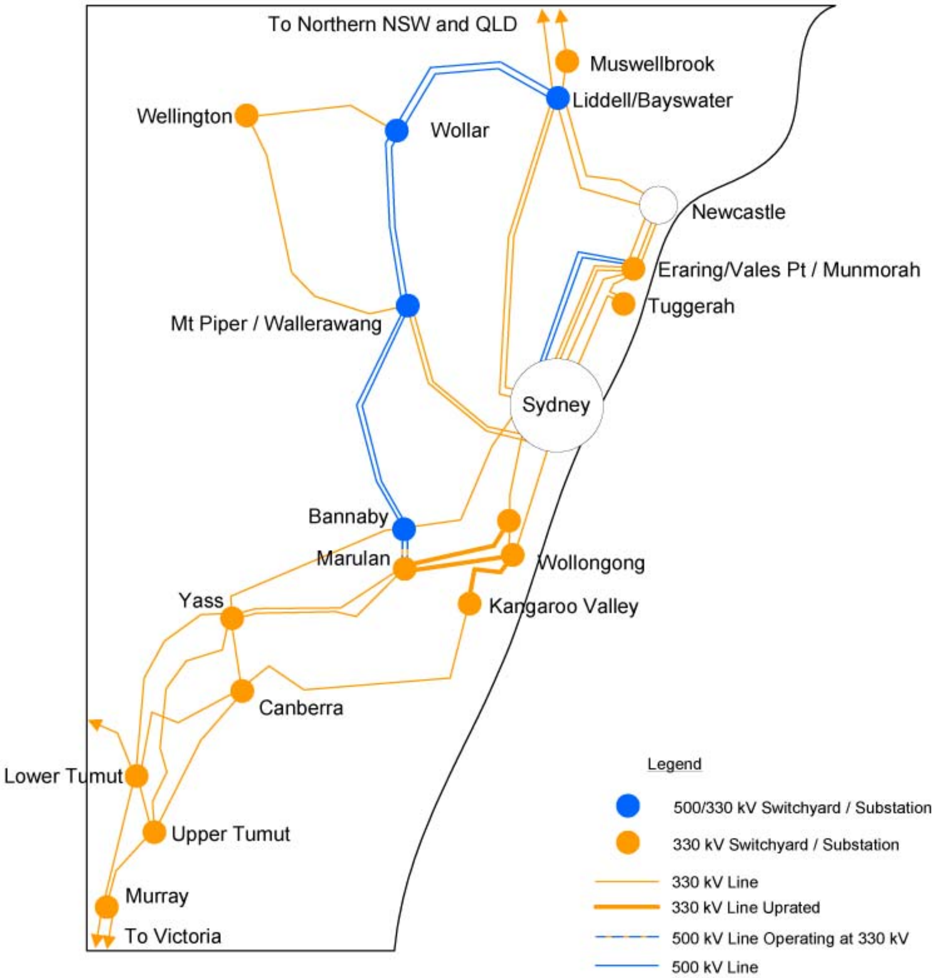


Diagram 3 – Network upon completion of "The Western 500kV Conversion"

A copy of NERA's Report can be found in full in Appendix 11 or on TransGrid's web site http://www.transgrid.com.au/trim/trim224991.pdf .

5. The Network Support Proposal

5.1. Need for the Proposal

Section 4 describes in detail the need for the Western 500kV Conversion Project. The regulatory test that was applied to this project showed that optimum solution is a combination of network and non-network alternatives. The non network component of the alternative that satisfied the regulatory test involves use of local generation and load control in the Newcastle - Sydney - Wollongong area.

5.1.1. System Risks & Inability to Meet Reliability Obligations

Based on current load forecast there are 65 days during which there is a risk of TransGrid not being able to meet its reliability obligations if no action is taken over summer 2008/09, as completion of the relevant parts of the 500kV Conversion are scheduled for summer 2009/10. On the occurrence of a summer with high loads (a 10% PoE summer) there is a risk of possible shedding of up to 350MW in the Newcastle, Central Coast, Sydney, Wollongong and South Coast areas is required in order to meet reliability standards.

The days at risk where TransGrid may not be able to meet its reliability obligations are working days between 17 November 2008 and 14 March 2009, excluding the Christmas period and the first half of January 2009. Due to the nature of the system constraints it is necessary that the generation be dispatched or the load reduced be made in anticipation of, not following, a contingency. Accordingly, generation and/or load reduction would be required for all those mentioned days, when the system is loaded beyond defined threshold levels.

It is also appropriate to emphasize that the Regulatory Test for the project took into account the basis for TransGrid's forecast of 10% PoE demands. This approach is consistent with the planning criteria adopted. It would therefore, be appropriate to contract the capacity required for summer 2008/09. Entering into a network support contract agreement would ensure that TransGrid manages its reliability risks effectively and efficiently.
The cost payable under a network support contract would consist of an availability component (certainty) and a dispatch component (payable only if and when load management/generation is dispatched). Should a proponent not be available when called upon to dispatch, as a penalty that proponent would not receive an availability fee for the particular month.

5.2. Alternative for Network Support

The regulatory test evaluated a number of network and non-network alternatives. Details are provided in Appendix 4.

5.2.1. Types of Non-Network Solutions Envisaged

TransGrid sought non-network solutions that in aggregate would provide network support in the Newcastle – Sydney – Wollongong area such that capacity of the current system:

- will remain sufficient to meet the remaining aggregate customer peak demand in the Newcastle - Sydney - Wollongong area for an additional year; and
- may enable deferral of the 330kV to 500kV conversion.

It was envisaged that these non-network solutions could include:

- reductions in end-use demand, either in the Proponent's facility or in the facilities of other end-users as arranged by the Proponent, including the use of standby generators located within these facilities, whether or not the generators are synchronised with the grid;
- local generation projects (also referred to as embedded generation) connected to the lower voltage networks supplying end-use Proponents;
- larger generation projects which may connect to TransGrid's 330kV network or to the underlying networks owned by EnergyAustralia, Integral Energy or Country Energy; and/or
- operational changes and/or plant expansions whereby existing larger generation plant already connected within the constrained area could produce additional output.

Non-network services may be provided by either new generation within the Sydney/Newcastle/Wollongong load area, by load that can be shed within the same area or a combination of the two. Both have the affect of reducing the load to be supplied from power stations outside the main transmission ring around the Sydney/Newcastle/Wollongong area into this load centre.

(Commercial-in-Confidence)

5.3. Description of Network support

Details of network support proposals can be found in section 8 of the RFP. A copy of the Request For Proposals (RFP) is attached in Appendix 12. This includes geographic locations requiring network support, magnitude of support by location and timing, frequency and duration. That section also lists equations that provide values of support as function of the location of support and nature of constraint. Also included in Section 8 of the RFP (page 18) is an indicative process relating to notification and dispatch of support.

5.3.1. Magnitude of Network Support Required (by Location)

Network support in each of the load areas described in the RFP contributes to managing two emerging system limitations (line rating and voltage control) to varying degrees. These variations are described in the two equations below (reproduced from the RFP). These equations reflect the impact of changes in the total flows into the Newcastle - Sydney - Wollongong area as well as changes in "sharing" of these flows between the different transmission lines, due to reductions in load at particular locations. The network support referred to in the equations can be provided by a suite of either demand response, embedded generation, or even new major generation.

Transmission Line Rating Limitation
Port Macquarie network support (in MW) x 1.1 + Taree network support (in MW) x 1.5 + Newcastle network support (in MW) x 1.9 + Central Coast network support (in MW) x 1.63 + Sydney network support (in MW) x 1.17 + Wollongong network support (in MW) x 1.08 ≥ Threshold

Voltage Control Limitation
Port Macquarie network support (in MW) x 0.45 + Taree network support (in MW) x 0.62 + Newcastle network support (in MW) x 0.77 + Central Coast network support (in MW) x 1.00 + Sydney network support (in MW) x 1.00 + Wollongong network support (in MW) x 0.63 ≥ Threshold

Where Threshold is equal to 350MW for summer 2008/09.

The original request for support during summer 2009/10 and 2010/11 were dropped as a result of not cost effective proposals.

It should be noted that these thresholds are presented from TransGrid's perspective. No single Proponent needs to meet these thresholds and, even if the network support of all Proponents in aggregate do not satisfy the equations above, non-network solutions may still be effective in meeting TransGrid's needs in combination with other initiatives that might be undertaken outside this Proposal process, such as the establishment of new major generation or, for the voltage control limitation, installation of additional reactive plant in the Sydney area.

5.3.2. Timing, Frequency and Duration of the Need for Network Support

Network support is most likely to be required during periods of extremely high system demand, which tend to occur on working weekdays (i.e. as opposed to weekends or public holidays) in the period from mid November to mid March, excluding the period from 24 December through mid January. The network support period for summer 2008/9 is from 17 November 2008 and ends on 12 March 2009. The 24 December 2008 to 19 January 2009 is not included.

Periods of extremely high demand are often correlated with sustained periods of high temperature. Such weather conditions tend to be relatively short lived (generally less than three days). It is unlikely that such a three day weather pattern would occur more than twice in a single summer season. It is more likely that a particular summer season will have one such three-day stretch of extreme weather conditions, and several one or two-day stretches.

Network support would be required during the time of highest system loading. The duration over which network support may be required on any given day depends on the level of load reduction required. That is, the greater the reduction required, the longer the period during the day that the network support will be needed. The periods for which network support may be required on any one day to achieve particular levels of load reduction are shown in Table 5.1.

Table 5.1: Anticipated Duration Required for Network Support, as a Function of the Percentage of Maximum Demand Needing to be Reduced

Demand Reduction (% of Maximum)	Approximate network support (MW)[5]	Period for which Demand Reductions may be Required
Up to 2%	Up to 250	Midday to 6 pm
2% to 4%	250 to 500	11 am to 6 pm
4% to 6%	500 to 750	10 am to 7 pm
6% to 8%	750 to 990	9 am to 8 pm
8% to 10%	990 to 1,240	9 am to 9 pm

Based on the information provided in section 8 of the RFP, it is likely that network support in 2008/09 will probably be required from 11 am to 6 pm.

5.3.3. Summary of Operating Capacity Parameters

Table 5.2 summarises the operating parameters non-network solutions will be expected to meet over summer 2008/09.

Table 5.2: Contractual Operating Parameters

Parameter	Contractual Requirement
Calendar period during which network support must be available	Working weekdays from mid November to mid March, excluding Christmas eve to mid January
Times of day during which network support must be available	11 am to 6 pm
Maximum number of hours of continuous network support over a day	7 hours
Maximum number of days in the 4-month period on which the offered network support can be called	8 days
Maximum number of hours of network support over the 4-month period	56 hours
Maximum number of consecutive days over which network support could be required	3 days
Maximum dispatch notification lead time(s) TransGrid can provide	22 hours

The RFP indicated to Proponents that the amount of network support offered does not necessarily need to be the same on each of the three consecutive days. Proponents were required to provide a schedule indicating the amount of network support they are committing to provide for each day when system demand reductions are required over three consecutive days. All Proponents were asked to comply with all applicable codes, license and other requirements (including all applicable NER requirements) pertaining to them and to their Proposals.

In fact two proponents offered blocks of support (magnitude is function of lead time) and one offered support up to a maximum value. The block offers reflect the nature of the plant operational conditions.

[5] The approximate levels of capacity support required (in MW) are based on the 10% PoE forecast demand for Summer 2008/09. The capacity support requirements for subsequent summers are larger as the forecast maximum demands for those summers are higher.

6. Achieving efficient costs

6.1. External Advice and Assistance

In September 2005, the market was advised through a "Needs Paper" (October 2005) and subsequently published documents on TransGrid's website of the objective "to identify genuine projects which provide realistic options with sufficient capacity, either alone or in combination with others, to consider deferral of network augmentation option." The Needs Paper was titled "Emerging Major Transmission network limitations in supplying the Newcastle – Sydney –Wollongong Load area". Approval was sought from the Managing Director to approve the engagement of a consultant to assist TransGrid with obtaining non-network solutions for the 500kV project in order to include these alternatives in the regulatory test covering the project.

TransGrid advertised (CON 144 September 2005) seeking assistance with the project. No utility in NSW and Australia had undertaken a similar project in magnitude of network support, to TransGrid's knowledge. It was recognised that there was not sufficient experience in TransGrid at the time; having not been involved in similar projects, TransGrid decided to seek assistance from the market by means of open tender. In response to the advertisements, there was one applicant – (Commercial-in-Confidence). TransGrid also advised a number of agencies including DEUS, Total Environmental Centre, Energy Users Association of Australia of the advertisement seeking assistance with managing a large scale non-network solutions project. (Commercial-in-Confidence) proposal was evaluated and on the basis of their recent experience in Western Australia, they were appointed.

(Commercial-in-Confidence) proposed a plan and submitted to TransGrid for approval. Discussions were held and a program was agreed to. After the appointment, (Commercial-in-Confidence) made contact with a number of potential proponents which included all NSW distributors and generators, embedded generators and aggregators. These were advised of TransGrid's investigation in relation to non-network alternatives. The assistance to TransGrid included: a program design, a preliminary Expressions of Interest (EOI) package and a non-network option contract, advertising the dissemination of EOI/RFP documents, answer questions from potential bidders, develop scoring template, assisting clarifying and subsequently evaluating initial proposals, developed verification plans and initial contract negotiations with proponents.

Prior to the preparation of a request for proposals (RFP), (Commercial-in-Confidence) conducted a briefing session of members of the Executive and staff involved in the project. The RFP document was jointly prepared in consultation with TransGrid's Material Supply Group's staff and in compliance with NSW Government Code of Practice for Procurement. Part of the package is a draft Network Support Agreement. The preparation of the documentation was completed after thorough internal and external review (legal and commercial).

6.2. RFP / Competitive Tendering Process

TransGrid and (Commercial-in-Confidence) joined forces and prepared a plan of action that would seek through open competitive tender network support services. (Commercial-in-Confidence) wrote to Distributors, Generators and Aggregators advising that TransGrid will be seeking network support. (Commercial-in-Confidence) assisted TransGrid with preparation of RFP. Based on their experience, the consultant advised that in order to get responses, it would be practical not to include penalties; rather a condition stipulating that should a proponent not be available when called to dispatch, the monthly availability fee would be forfeited.

On 16 August 2006, TransGrid published a request for proposal (attached) for non-network alternatives that could provide network support to meet TransGrid's reliability obligations for up to three years starting from summer 2008/9. Submissions closed on 13th September 2006.

In addition to providing advance information to the Market on the nature and location of emerging network constraints, TransGrid is also required to evaluate non-network solutions (including demand management and embedded generation) as alternatives to network augmentations. These options are to be considered on an equal footing with network options when applying the AER Regulatory Test.

In preparation for the release of the RFP, an internal workshop attended by TransGrid's Material Supply, Corporate Lawyer, Regulatory Affairs, Customer Relations and Planning staff as well as legal and commercial advisers was held. The forum agreed to include in the RFP selection criteria, that the minimum offers for generation be set at 30MW (to match capacity of NEMMCO's registered generators), regulatory framework for network support and to protect TransGrid's interests.

In accordance with the terms of the RFP, each proponent was required amongst other matters to specify the amount of network support offered (MW), the location of the network support, the availability charge for the service (to have the service in place for summer 2008/09 so that it may be called upon if required) and a dispatch cost (which would be a variable cost based upon the amount the service was actually used during that summer). Assessment of proposals was made on that basis and any contracts to be entered into would reflect this structure.

For technical reasons, the effectiveness of non-network offers at different locations on the system in the Newcastle - Sydney - Wollongong area varies. This information was included in the RFP. Accordingly, each proponent's offered capacity was modified to provide an "effective capability" to accurately reflect the technical effectiveness of the offered network support capacities in various parts of the network. This process ensured that the benefits offered by different non-network solutions were being compared on an equitable basis measured against the network need for summer 2008/09.

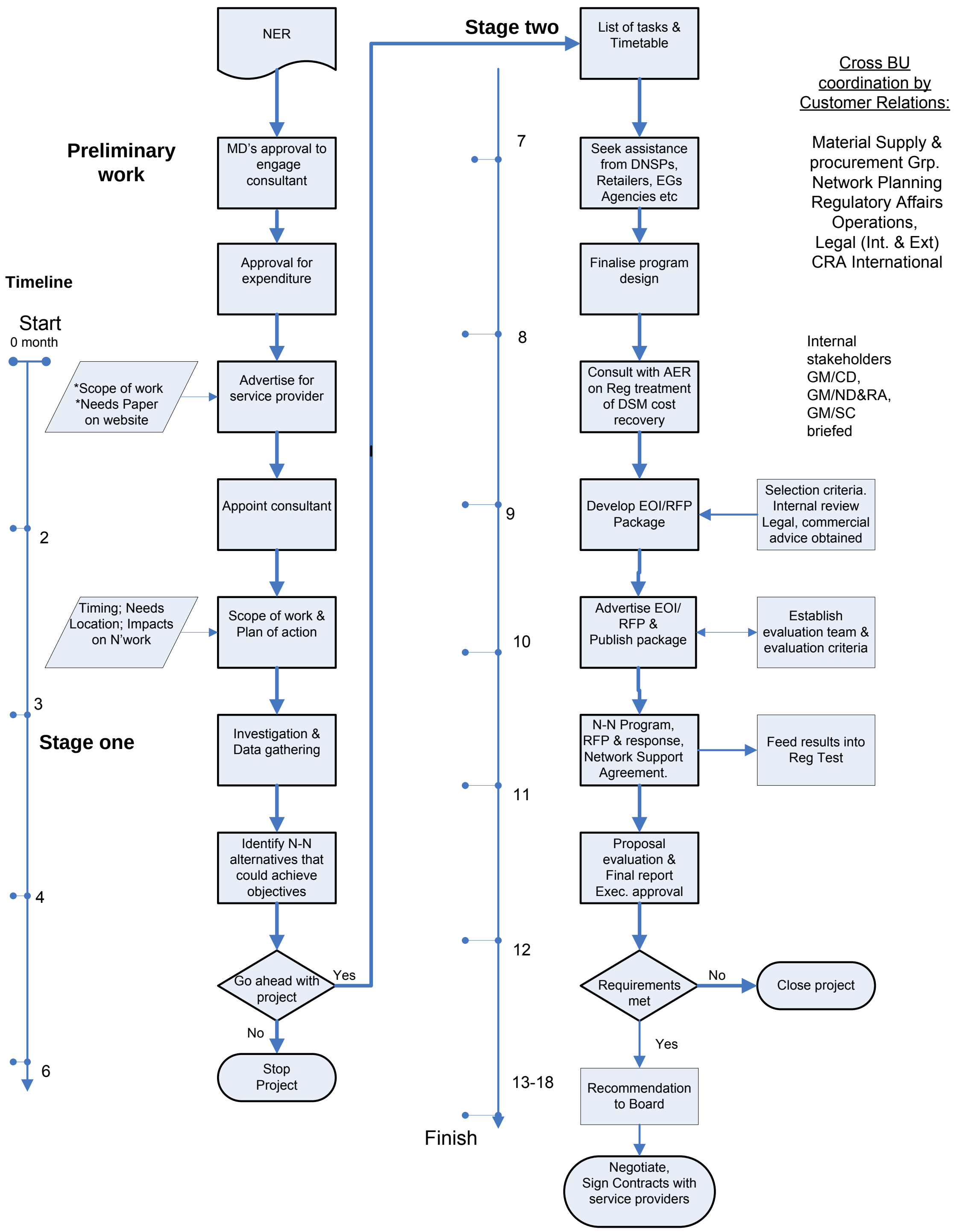
Responses to the RFP were received from seven proponents. Two proposals were subsequently withdrawn by the proponents. A third proposal did not address the specific emerging limitations, but had been submitted as an expression of interest for future opportunities. One proponent offered two amounts of support.

The remaining four proposals were found to be technically feasible and were assessed in detail.

Diagram 4 shows the process used by TransGrid to procure Non -Network solutions.

Diagram 4

500kV Upgrade: Non-network solutions - Request for Proposals
Flowchart of Process



6.3. Tender Analysis

The evaluation was based on the mandatory and desirable criteria published in the RFP. This took account of technical and commercial components of each submission. Subsequent to the closing of tenders all proponents were invited to meetings to provide and seek clarifications. The evaluation report (Commercial-in-Confidence) is attached in Appendix 13.

The most cost effective proposal was found to be that of (Commercial-in-Confidence) (which is currently building a peaking power plant near Wollongong). However, this offer by itself was insufficient to meet the target of 350MW (effective) of network support. A summary of the proposals is given Table 6.1 below:

Table 6.1: Summary of Network Support Proposals

Proponent	Offered Capability	Effective Capability	Type of Service
(Commercial-in-Confidence)	(Commercial-in-Confidence)	(Commercial-in-Confidence)	(Commercial-in-Confidence)
(Commercial-in-Confidence)	(Commercial-in-Confidence)	(Commercial-in-Confidence)	(Commercial-in-Confidence)
(Commercial-in-Confidence)	(Commercial-in-Confidence)	(Commercial-in-Confidence)	(Commercial-in-Confidence)
(Commercial-in-Confidence)	(Commercial-in-Confidence)	(Commercial-in-Confidence)	(Commercial-in-Confidence)

As the individual proposals were not able to fully meet the requirements of the RFP, a number of portfolios made up of combinations of the four proposals were considered. The 350MW of network support could be made up of the following combinations of effective capacity:

(Commercial-in-Confidence)

Two portfolios were identified as potentially least cost solutions, depending upon the level of dispatch assumed during summer 2008/09.

Actual dispatch will be determined principally by the prevailing weather conditions during the summer of 2008/09. A hot summer will require a significantly higher level of dispatched non-network support than a mild summer. The 350MW non-network capability requirement was determined by using “one year in ten” adverse weather conditions, consistent with that applied for main interconnected network planning decisions.

It is noted that if TransGrid enters one or more contracts for non-network support the availability charge will be committed irrespective of the need for actual dispatch. Exception being if a proponent fails to provide support when ordered to, availability for that month is forfeited.

6.4. Negotiations between TransGrid and (Commercial-in-Confidence)

Since July 2007 there have been several meetings with the three proponents whose submissions were considered to form the most cost effective solution with the lowest risk.

The RFP asked proponents to provide two components to their offers – an availability charge covering a nominated period in summer 2008/09 (mid November 2008 to mid March 2009) and a dispatch charge should support be requested. Negotiations were around contractual arrangements including payments and principles leading to forfeiting availability charges as well as support orders. Draft network support agreements were exchanged and amended several times. The agreement documents have been prepared with the assistance of legal advisors.

The agreements also describe different ways for support alerts and orders as well as their potential amendment or cancellation and associated lead times with each one of the support providers.

6.5. Agreements with (Commercial-in-Confidence)

The three companies selected for network support have different characteristics as far the type of support they proposed:

(Commercial-in-Confidence)

The discussions covered costs (availability, dispatch, performance based penalties and liability to parties. As the network support documents indicates, support orders and relating matters were discussed at length and the former show the differences as related to the different support providers. This different nature of the proposals is reflected in the three agreement documents.

The network support agreements include clauses dealing with development plans relating to not yet commissioned facilities, testing of facilities and verification (metering the dispatch). Also, communications protocols are being agreed to between the parties.

The manner in which availability payments are proposed to be made also differs between proponents. The individual Network Support Agreements (NSA) provide all details regarding availability and dispatch payments.

6.6. Dispatch

The following describes the methodology TransGrid will use in dispatching the Network Support:

1. Despatch will be based on NEMMCO's day ahead forecast of the NSW demand. Network studies will be carried out to determine the critical demand level (above which the network supplying the Newcastle/Sydney/Wollongong area becomes insecure).

   The studies will consider different generation patterns. If necessary, a despatch matrix, with different trigger demand levels for different generation patterns, will be established.

2. Non-network providers would be notified of the level of support required of them in accordance with their Network Support Agreements.

3. Verification of delivery would be by the method(s) specified in the Network Support Agreements (generally metering of loads and generation).

The dispatch patterns and associated costs are different for each one of the proponents. These reflect the nature of the support offered as well as risk management measures.

TransGrid has not yet experienced a situation which requires this nature of dispatch of network support. Therefore, it is proposed that a trial be carried out prior to summer 2008/09 at time of low or shoulder loading in order to test the communication channels, dispatch, metering and verification processes, thus minimising operational risk if and when proponents are called upon to provide network support at times of peak loading in summer 2008/09.

6.7. Estimated costs

Table 6.2 indicates individual proposals as well as the total expected payments for a 10% POE forecast load.

Table 6.2 Expected Payments - Summary

Proponent	**Capacity Offered (MW) (A)**	**Availability Cost ($) (B)**	**Dispatch ($)Cost/hr (C)**	**Dispatch Cost ($) (For 56 hr) D=A*C*56**	**Total ($) E=B+D**
(Commercial -in- Confidence)	(Commercial-in- Confidence)	(Commercial -in- Confidence)	(Commercial -in- Confidence)	(Commercial -in- Confidence)	(Commercial -in- Confidence)
(Commercial -in- Confidence)	(Commercial-in- Confidence)	(Commercial -in- Confidence)	(Commercial -in- Confidence)	(Commercial -in- Confidence)	(Commercial -in- Confidence)
(Commercial -in- Confidence)	(Commercial-in- Confidence)	(Commercial -in- Confidence)	(Commercial -in- Confidence)	(Commercial -in- Confidence)	(Commercial -in- Confidence)
Sub-total		10,717,500		10,192,000	20,909,500
Contingency and provision of trial					500,000
				Total	**21,409,500**

Details of monthly payments to the Network Support Service Providers are provided in Appendix 9. This information is to be treated as "Commercial-in-Confidence".

Table 6.2 is based on a 10% POE forecast load. However, at a 50% POE forecast load it is unlikely that there will be a need to dispatch any Network Support.

As indicated earlier the cost payable under a network support contract would consist of an availability component (certainty) and a dispatch component (payable only if and when load management/generation is dispatched). Should a proponent not be available when called upon to dispatch, as a penalty, that proponent would not receive an availability fee for the particular period.

6.8. TransGrid Costs

As detailed in Section 7, no allowance was made in the ACCC's Revenue Reset Determination for the 2004 - 2009 Regulatory Period for Opex associated with recovery of expected Network Support payments or TransGrid expenses associated with procurement or ongoing operation of this Network Support. Consequently, it is appropriate for TransGrid to recover its cost associated with this Network Support as a Pass-Through.

TransGrid's costs only include costs associated with the Request For Proposals, contract negotiation and the application for Pass-Through. They do not include any cost associated with TransGrid's regular system planning, load forecasting or application of the regulatory test.

TransGrid has costs associated with its administration of the contract and pass-through arrangements. There are two components as summarised in Table 6.3:

Description		**Cost $M (note 3)**
Financing charges (note 1)		$ 21,226
Operating charges (note 2)		$ 473,438
	Total	**$** 494,664

Table 6.3: Summary of TransGrid's costs associated with the pass-through arrangements

Note 1. Financing Charges
TransGrid will recover some the Pass-Through amounts before payments to (Commercial-in-Confidence) commence. TransGrid's financing charges take into account the time cost of money and have been calculated using 6.39% interest rate. This was the 2007 annual average of the daily cash rate published by the Reserve Bank of Australia. The ACCC has previously endorsed the annual average daily cash rate for a pass-through of similar duration. The use of this rate was agreed by the ACCC in its letter to TransGrid dated 14th May 2003 (see Appendix 8).

Note 2. Operating Charges
TransGrid has already, and will in the future, incur cost related to the administration of the agreements with (Commercial-in-Confidence). TransGrid's operating charges are made up actual and estimated expenses incurred procuring outside consultants and legal advisers as well as TransGrid labour. TransGrid labour is recorded against a unique job number relating specifically to the procurement of the Network Support that is the subject of this Pass-Through Notice.

Note 3: Rounding
All cost figures have been rounded to the nearest dollar.

Appendix 7 provides details of TransGrid's calculation of the pass-through amount for its costs.

7. Treatment of the Western 500kV Conversion in TransGrid's Revenue Reset Applications

In September 2003 TransGrid applied to the ACCC for a Revenue Reset Determination for the 2004 - 2009 Regulatory Period. This application was made under the ex-post regulatory regime for capex that existed at that time.

In this Application the Western 500 kV conversion was treated as a contingent project, and hence there was no allowance included in the ACCC's determination for any expenditure.

While the ACCC was considering TransGrid's application the regulatory framework was under review. During the review process, TransGrid became aware that the ACCC intended to change the regulatory framework for future capital expenditure to an ex-ante regime.

TransGrid wrote to the ACCC on 12th March 2004 (see Appendix 15) requesting permission to resubmit its Capex application in line with the proposed future regulatory regime. On 30th March 2004, the ACCC replied (see Appendix 15) and agreed to consider a revised Capex submission from TransGrid. At this time neither the ACCC nor TransGrid considered reopening TransGrid's Opex application.

Subsequently, in November 2004, TransGrid submitted a revised Application, which included a revised Transmission Capital Investment Program. In this program the western 500 kV conversion was included as a planned project, and the Revised Application provided for the estimated efficient capex for these TransGrid works. As the Opex component of TransGrid's Revenue Reset Application was not reopened, no allowance was made in the Opex for recovery of expected Network Support payments or TransGrid expenses associated with procurement or ongoing operation of this Network Support.

8. Additional Comments

As part of the wider regulatory process, TransGrid has considered the issues of materiality, efficiency and reasonableness. TransGrid considers the pass-through costs are:

- **Material**
  TransGrid has negotiated an agreements with (Commercial-in-Confidence) for provision of network support. The network support is provided by local generation that can be brought on-line or local load that can be reduced when required.

  Payments of $21,409,500 to (Commercial-in-Confidence), as well as TransGrid's own costs, amount to **$**494,664 in the 2008 - 2009 Regulatory Year. This amount was not allowed for in TransGrid's revenue cap for that period. The amount is material and represents a material portion of the opex budget.

  This amount is considered material.

- **Efficient**
  TransGrid has applied the regulatory test to the Western 500kV Conversion and the proposed network support is a component of the least cost option (NERA Option B) that satisfied that regulatory test.

  As described above TransGrid carried out a public tender process as well as extensive and rigorous negotiations with (Commercial-in-Confidence) to ensure that cost of provision of the network support were minimised.

  TransGrid considers this expenditure is efficient.

- **Reasonable**
  This Network Support is an integral part of the Option that has satisfied the regulatory test. The alternatives, while technically feasible, would be more expensive.

  TransGrid considers it is reasonable to seek recovery of the expenditure associated with this network support.

A1 Appendix 1 - Existing and Forecast Demand in the Newcastle - Sydney - Wollongong Area

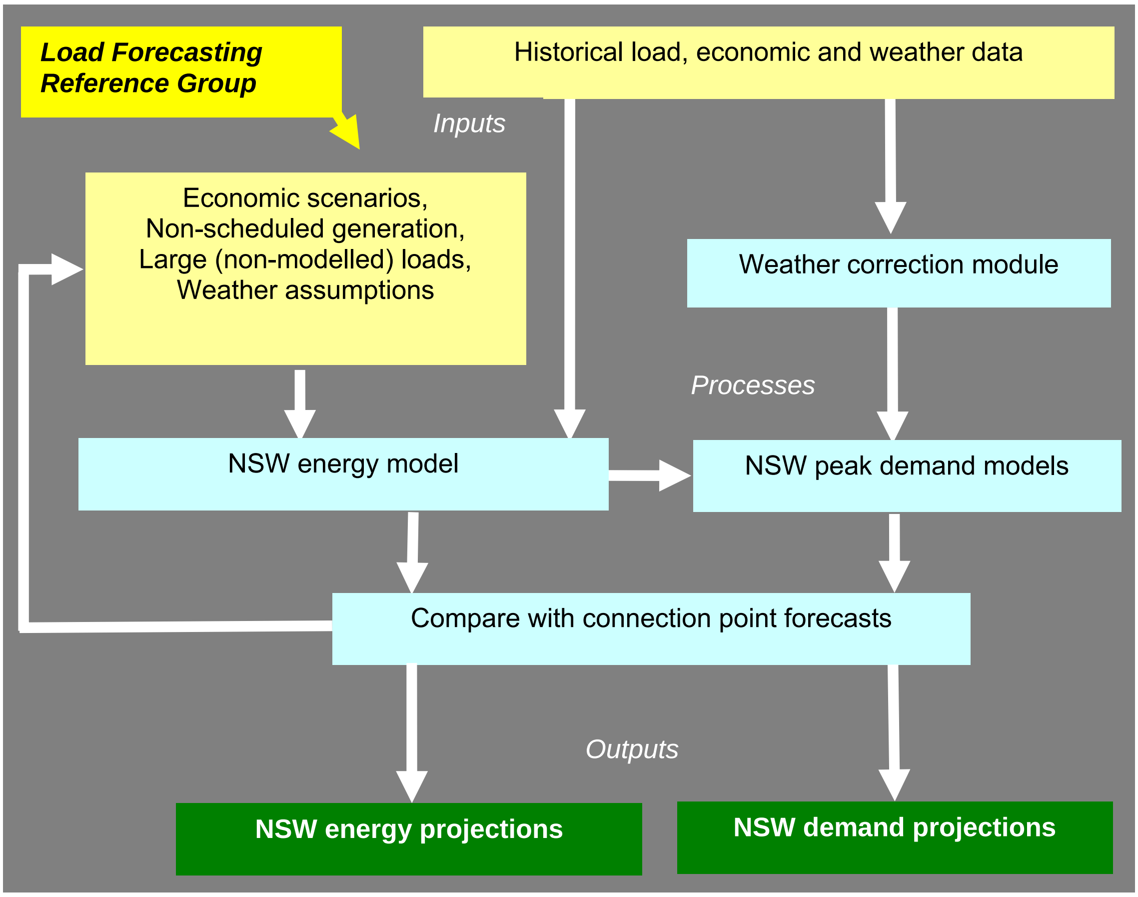
NOTE: 1. Information contained in this Appendix relating to TransGrid's forecasting methodology is based on TransGrid's current Annual Planning Report. This document can be found on TransGrid's web site http://www.transgrid.com.au/trim/trim242922.pdf

2. The information contained in this Appendix relating to demand forecasts in the Newcastle - Sydney - Wollongong area is based on Appendix 2 of TransGrid's "Final Report, Proposed New Large Transmission Network Asset, Development of Supply to the Newcastle - Sydney - Wollongong Area, October 2006". This document can be found in Appendix 10 or on TransGrid's web site http://www.transgrid.com.au/trim/trim224993.pdf

A1.1 TransGrid's Forecasting Methodology

The production of the energy and demand projections for the NSW region of the NEM is illustrated in Diagram A1.1 and the overall process is described below.

Diagram A1.1 TransGrid's Load Forecasting Processes



The NEM Load Forecasting Reference Group (LFRG) ensures that the regional energy and maximum demand projections throughout the NEM are developed by Jurisdictional Planning Bodies (JPBs) for inclusion in NEMMCO's Statement of Opportunities (SOO) on a consistent basis, by developing consistent definitions and assumptions. It is noted that TransGrid is the NSW Jurisdictional Planning Body.

Inputs to the overall process include the historical data that is used for estimating and testing the various models that are used and future scenarios for the independent variables in these models. Assumptions about the future, including the economic scenarios, are applied to the models to produce the NSW energy and demand projections.

Several statistical models have been developed by TransGrid, particularly:

- The energy model relates electrical energy to demographic, economic and weather variables.
- The weather correction module conducts analysis on historical demands and weather conditions to determine a probability distribution of demand for each season of each year, subject to a range of possible weather patterns. The 10th, 50th and 90th percentile of each distribution are selected as the historical series of demands that are projected into the future using the peak demand models.
- The peak demand models relate demand at the selected percentiles of the distribution to lagged demand and energy. Therefore, the projected demands from each model are implicitly at their respective percentile, or Probability of Exceedence (POE) level.

Forecasts of summer and winter demand at individual connection points are provided by EnergyAustralia, Integral Energy, Country Energy and ActewAGL for their respective distribution network areas across New South Wales. These projections, which are assumed to represent approximate 50% POE demands, are aggregated by TransGrid incorporating appropriate allowances for network losses and time diversity of peak demands throughout the New South Wales region. These aggregates are then directly comparable with the modelled demands for New South Wales produced by TransGrid. An iterative process of re-examining the basis of both the TransGrid modelled projections and the connection point forecasts is undertaken to ensure compatibility.

A1.2 The Demand for Electricity in Newcastle - Sydney - Wollongong

The “core” transmission network is facing limitations in supplying customer demand in the greater Newcastle area as well as in the Central Coast to Wollongong area. The nature of the demand for electricity in these two areas is described in the following Sections.

A1.3 Greater Newcastle Area

The load supplied in the greater Newcastle area include the electricity demand of the city and suburbs of Newcastle, the electricity demand supplied on the lower mid north coast from Newcastle (between Newcastle and Taree) and the aluminium smelter loads in the area. In recent years the growth in summer maximum demand for electricity has exceeded that of winter maximum demand. The maximum demand in summer and winter are now comparable.

Diagram A1.2 shows the maximum demand (averaged over a half hour period) for each day from 1 July 1996 to 19 September 2007. The average growth in summer maximum demand for electricity in the greater Newcastle area over this period has been approximately 1.5% p.a. despite major events in the area (such as changes to BHP’s operations).

Diagram A1.2 Daily Maximum Demand for Electricity in the Greater Newcastle Area

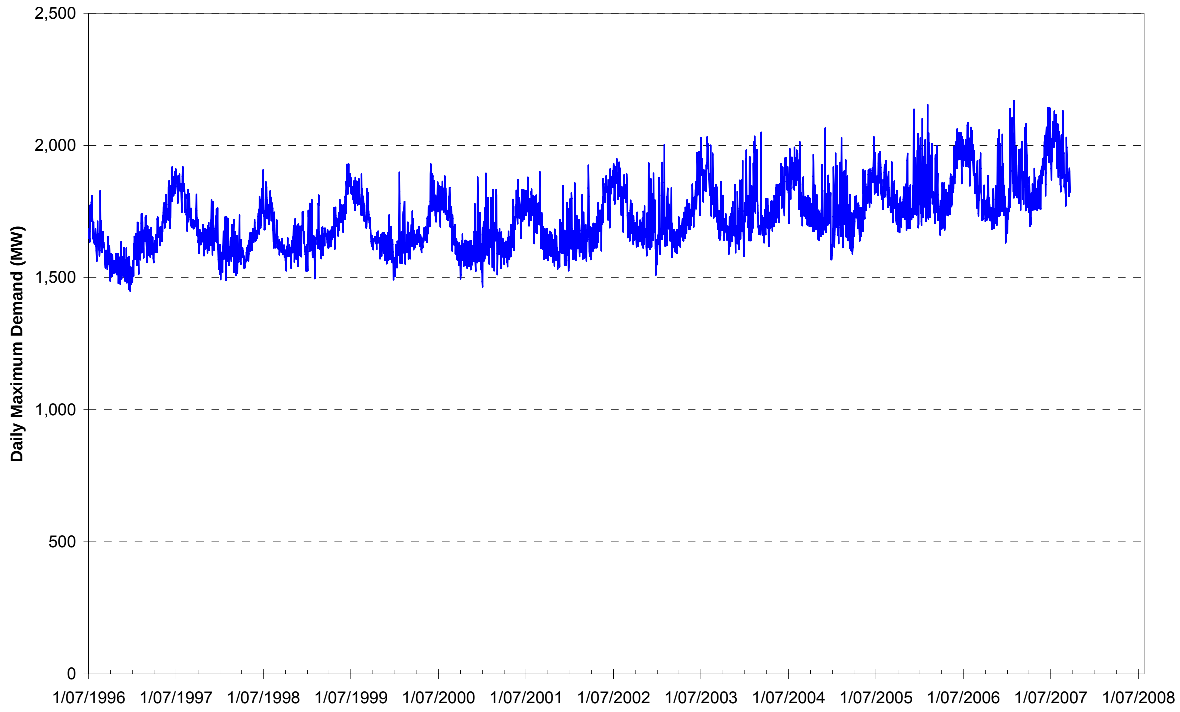


Diagram A1.3 shows typical profiles for the days of summer and winter maximum demand.

Diagram A1.3 Greater Newcastle Load Profiles on Day of Maximum Demand

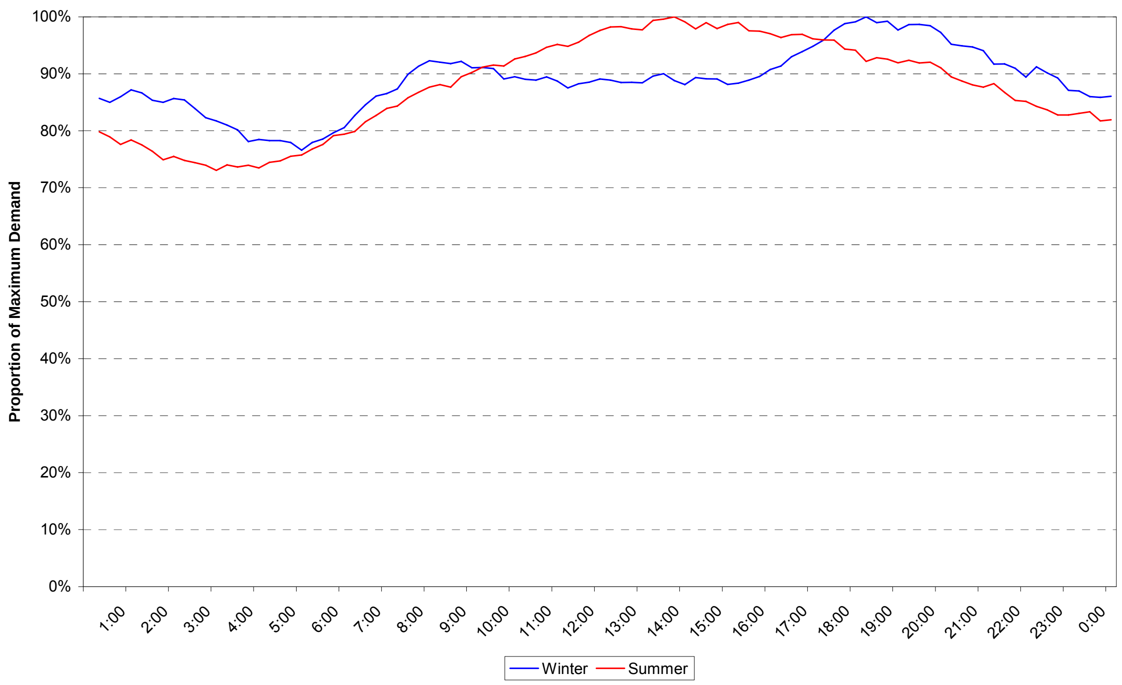
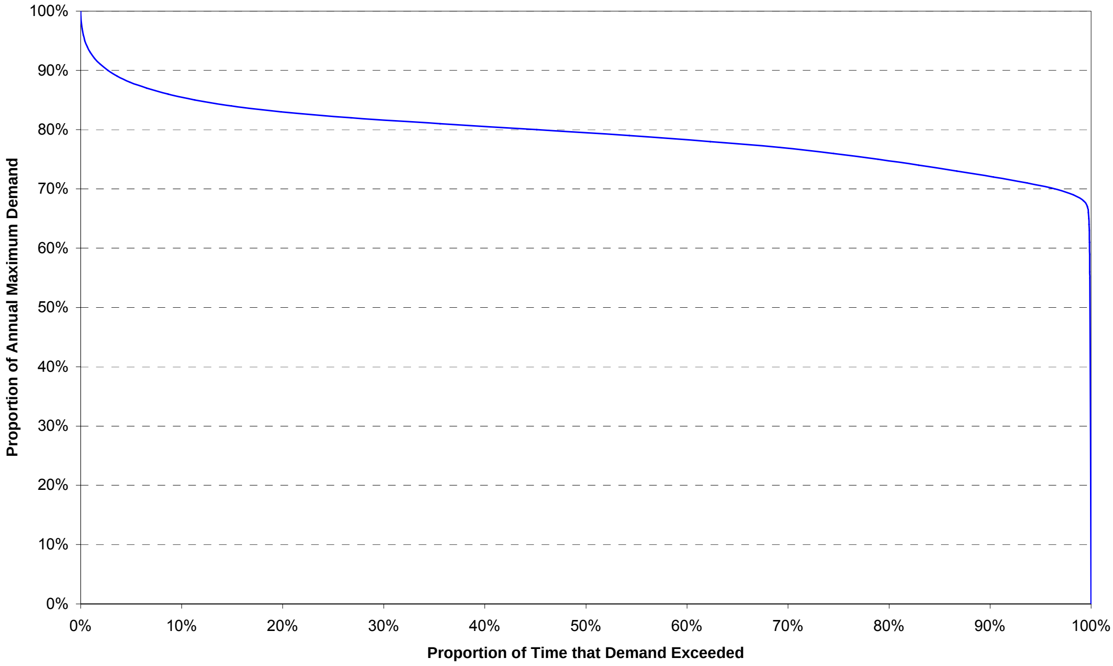


Diagram A1.4 shows the load duration curves (the proportion of time that particular demands, expressed as a proportion of the maximum demand for that year, are exceeded).

Diagram A1.4 Load Duration Curves for the Greater Newcastle Area



The load duration curve is relatively “flat” because the load in the area is dominated by the large aluminium smelter loads (of the order of 1,200MW), which operate almost continuously. Consequently, periods of high customer demand for electricity are relatively frequent as shown in Table A1.1. It shows that actions to curtail demand to, for example, 90% of the expected maximum demand would typically have to be undertaken on 170 occasions each year and to operate for periods of typically up to 11 hours on each occasion.

Table A1.1 Typical Number and Duration of High Demand Events for the Greater Newcastle Area

Demand Threshold (Proportion of Maximum Demand)	Typical Total Duration of All Events Where the Threshold is Exceeded (hours p.a.)	Typical Maximum Duration of an Individual Event Where the Threshold is Exceeded (hours)	Typical Number of Events per Year Where the Threshold is Exceeded
95%	35	5	40
90%	250	11	170
85%	1,000	16	550

A1.4 Central Coast to Wollongong Area

This area includes the Central Coast area (south of Lake Macquarie), the greater Sydney area and the Wollongong area. Included in the load supplied at Wollongong is the south coast load (from Wollongong to the Moruya area).

In recent years the growth in summer maximum demand for electricity has exceeded that of winter maximum demands. The maximum demands in summer and winter are comparable.

Diagram A1.5 shows the maximum demands (averaged over a half hour period) for each day from 1 July 1996 to 19 September 2007. The average growth in summer maximum demand for electricity in the Central Coast to Wollongong area over this period has been approximately 4% p.a.

Diagram A1.5 Daily Maximum Demand for Electricity in the Central Coast to Wollongong Area

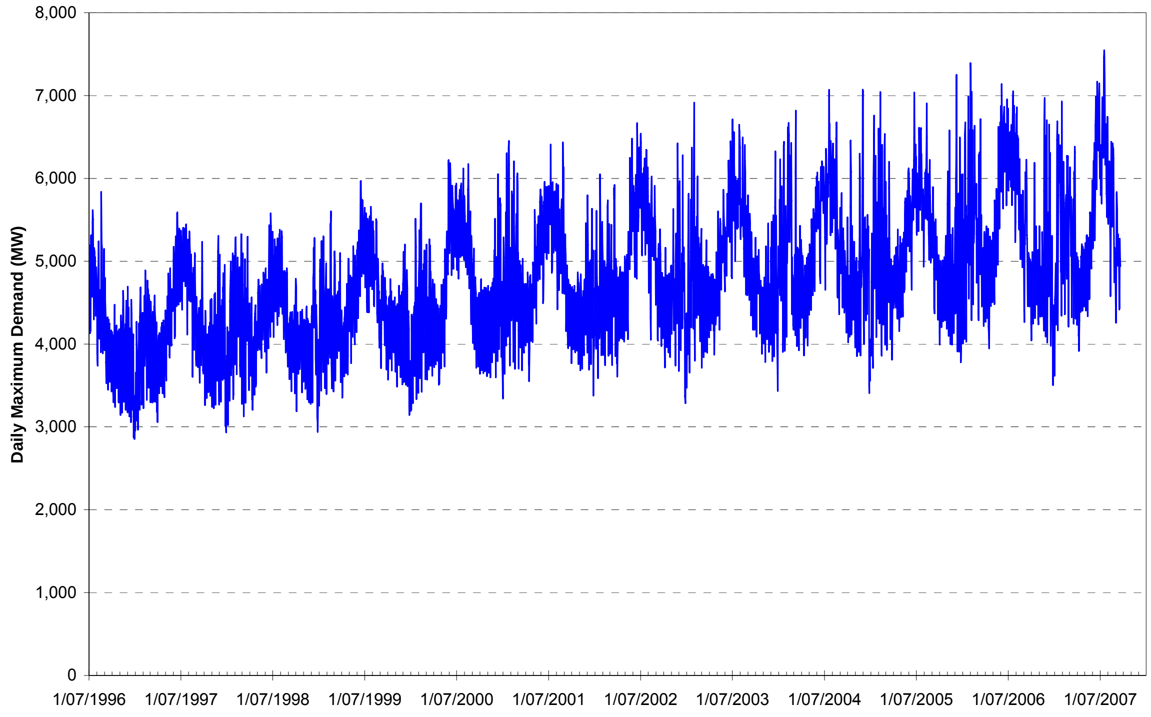


Diagram A1.6 shows typical profiles for the days of summer and winter maximum demands.

Diagram A1.6 Central Coast to Wollongong Load Profiles on Day of Maximum Demand

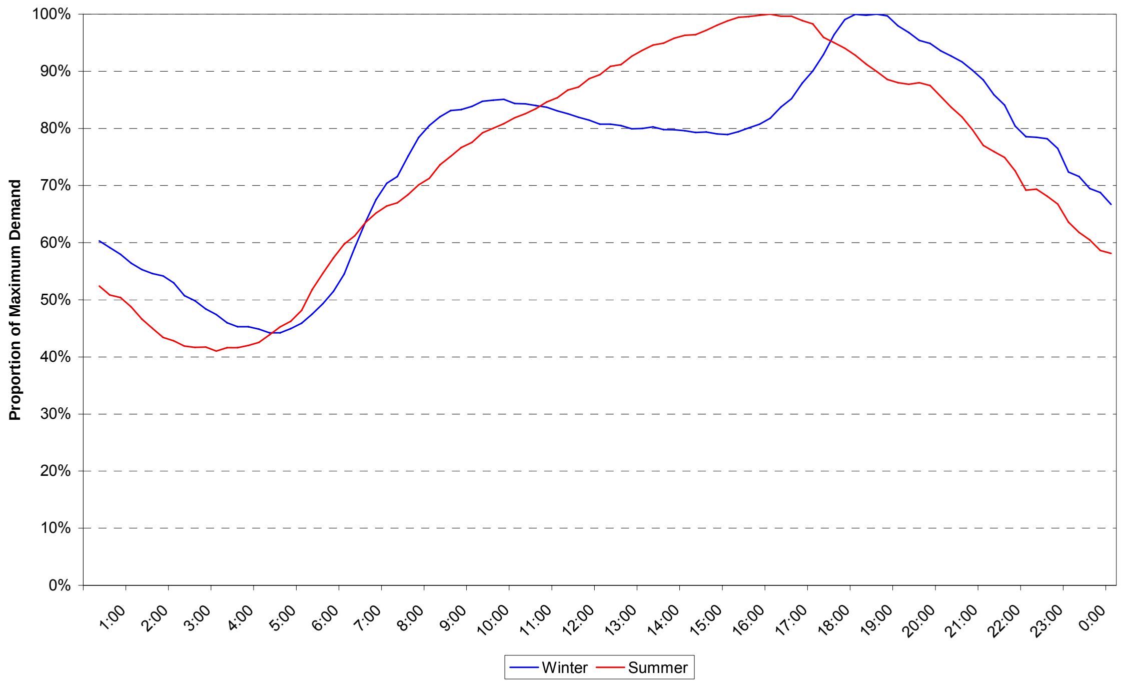
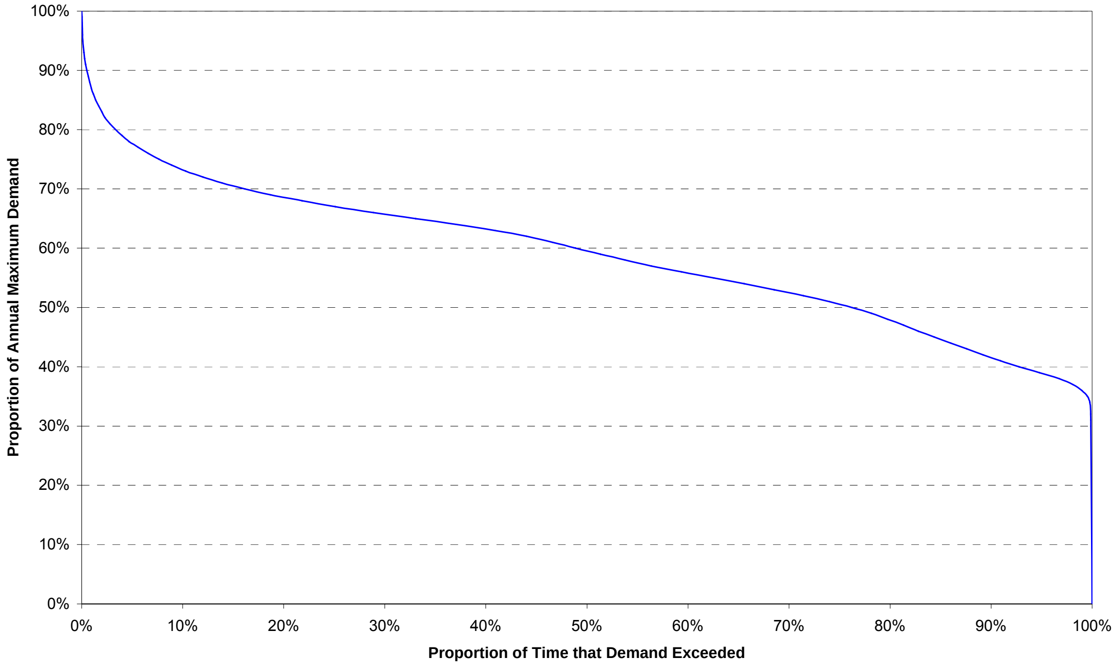


Diagram A1.7 shows the load duration (the proportion of time that particular demands, expressed as a proportion of the maximum demand for that year, are exceeded).

Diagram A1.7 Load Duration Curves for the Central Coast to Wollongong Area



Periods of high load are less frequent than for the greater Newcastle area, as shown in Table A1.2. It shows that actions to curtail demand to, for example, 95% of the expected maximum would typically have to be undertaken on 5 occasions each year and to operate for periods of typically up to 5 hours on each occasion.

Table A1.2 Typical Number and Maximum Duration of High Demand Events for the Central Coast to Wollongong Area

Demand Threshold (Proportion of Maximum Demand)	Typical Total Duration of All Events Where the Threshold is Exceeded (Hours p.a.)	Typical Maximum Duration of an Individual Event Where the Threshold is Exceeded (Hours)	Typical Number of Events per Year Where the Threshold is Exceeded
95%	10	5	5
90%	45	8	30
85%	120	10	60

A1.5 What Causes High Demand?

From a transmission network capability perspective, summer is the most critical time due to lower thermal ratings of equipment (under the prevailing higher ambient temperatures) and poorer power factors of customer demand (usually due to air conditioning) than at other times of the year. Increasing use of air conditioners in recent years has contributed to the growth in summer maximum demands throughout the State. It has also contributed to greater sensitivity of demand to temperature. Diagram A1.1 and Diagram A1.4 show, inter alia, the recent increase in the “volatility” of demand over summer for the greater Newcastle and Central Coast to Wollongong areas, respectively.

An inspection of the maximum demand data for the days of highest demand in recent summers shows that:

- The days of high demand occur more frequently in January and February.
- High demand typically occurs on working weekdays.

A1.6 The Demand Forecasts

The forecast summer 10% PoE maximum demands for the greater Newcastle area and the Central Coast to Wollongong area are shown in Table A1.3 and Table A1.4. Diagram A1.8 and Diagram A1.9 show recent actual maximum demands and the (diversified) forecast 10% PoE maximum demands.

The planning approach applied by TransGrid, including the rationale for using 10% PoE forecast demands is discussed in Appendix 2.

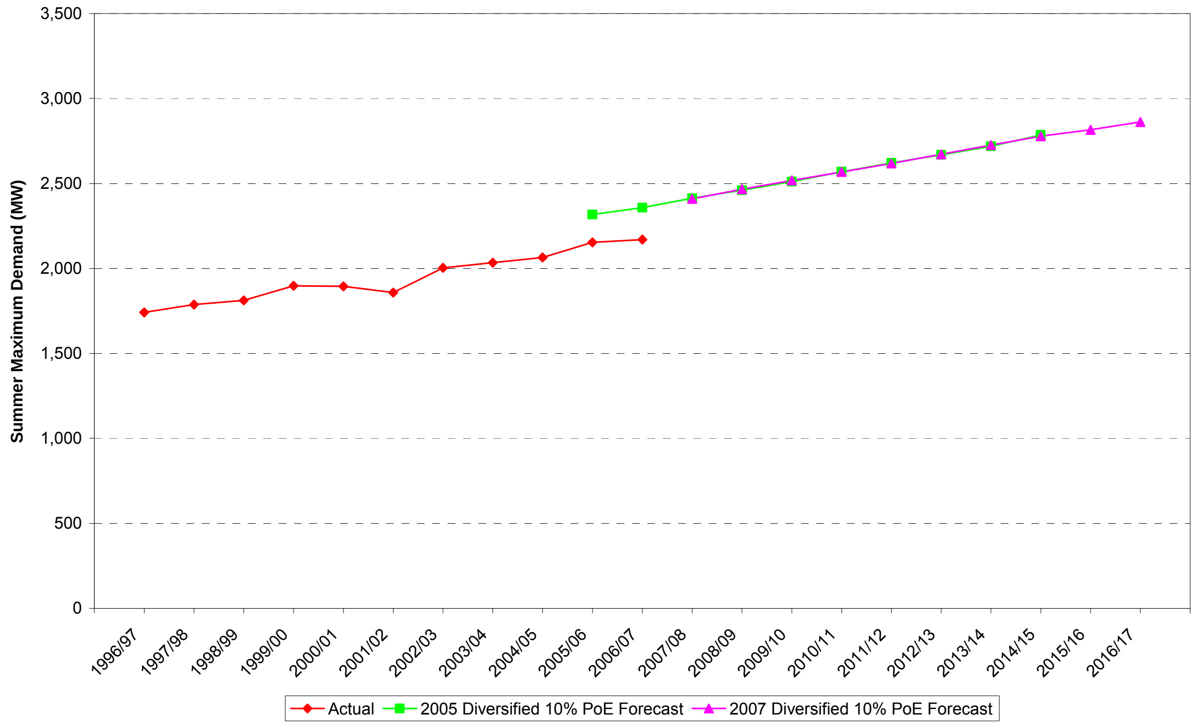
Table A1.3 Greater Newcastle Summer 10% PoE Maximum Demand Forecasts (MW)

Supply Point	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Greater Newcastle	2,409	2,467	2,518	2,568	2,617	2,672	2,726	2,779	2,816	2,862

Table A1.4 Central Coast to Wollongong 10% PoE Summer Maximum Demand Forecasts (MW)

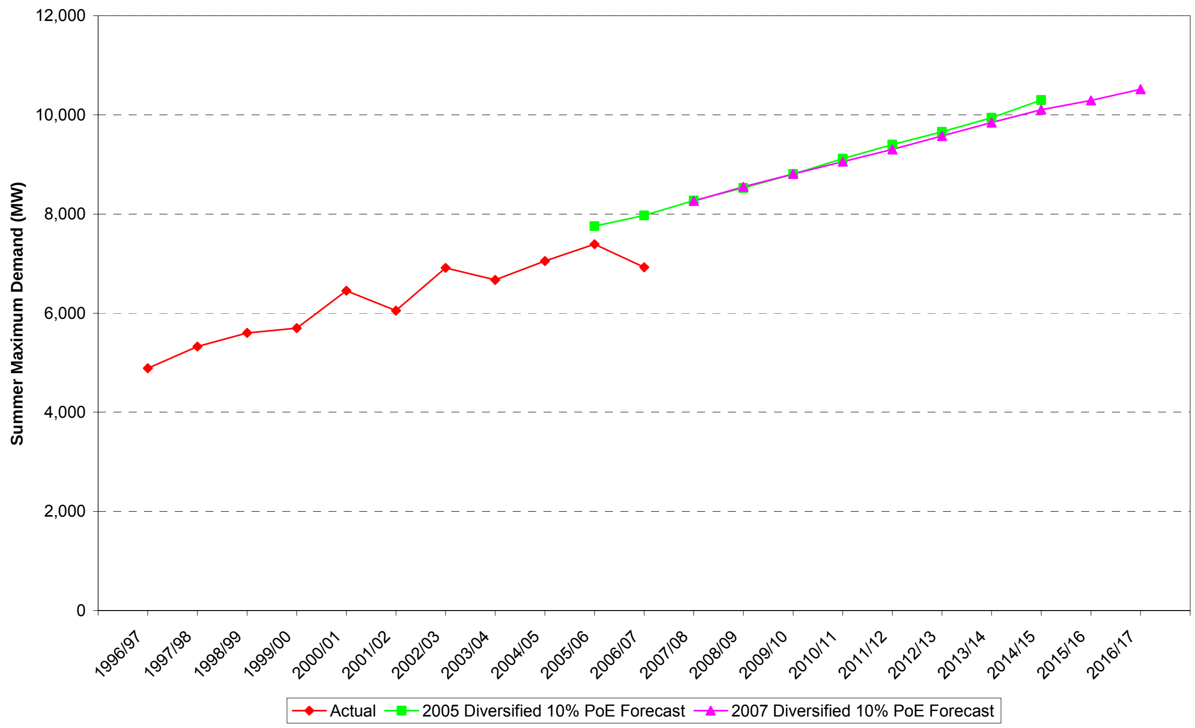
Supply Point	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Central Coast	469	488	506	523	540	560	580	599	613	631
Greater Sydney	7,084	7,331	7,552	7,768	7,979	8,214	8,444	8,669	8,827	9,021
Wollongong	711	731	749	766	783	802	820	838	850	865
Total	8,264	8,550	8,807	9,057	9,302	9,576	9,844	10,106	10,291	10,517

Diagram A1.8 Greater Newcastle Actual and 10% PoE Forecast Maximum Demands



The forecast maximum 10% PoE demands for the greater Newcastle area are above the levels which would be derived by projecting historical maximum demands as they include recent increases in major industrial loads.

Diagram A1.9 Central Coast to Wollongong Actual and 10% PoE Forecast Maximum Demands



A1.7 Comparison of Demand Forecasts of different years

The studies undertaken at the time of the Application Notice used the main system forecast of loads at the 132 kV buses of the 330 kV substations. The main system forecast was derived by taking the state load forecast and assigning the individual 132 kV loads based on their historical proportions at the time of system peak load. These proportions came from peak load snapshots from the NEMMCO and TransGrid Energy Management Systems (i.e. SCADA measurements).

In particular the area 10% probability of exceedence (PoE) forecasts are developed from the State 10 % PoE forecast and measured loads at major substations on a day of (or near) 10% PoE demand. Essentially, the measured loads are scaled (where appropriate, as some loads such as major industries are relatively constant) to align with the forecast total State load for each year.

Thus the 10% PoE forecasts represent diversified demands at the time of the overall state maximum demand. Given that the State load is dominated by the Newcastle - Sydney - Wollongong load, this is also the time of Newcastle - Sydney - Wollongong maximum demand.

Diagram A1.10 shows the forecast NSW 10% PoE summer maximum demands published in the 2005, 2006 and 2007 Annual Planning Reviews (APRs). The 2007 forecast has been adjusted to exclude the Tweed Shire load (which was included in the NSW forecast for the first time in 2007 to reflect a regional boundary change). The Tweed Shire load is less than 1% of the State load. The adjustment to the 2007 forecast was done to ensure an “apples with apples” comparison of forecasts.

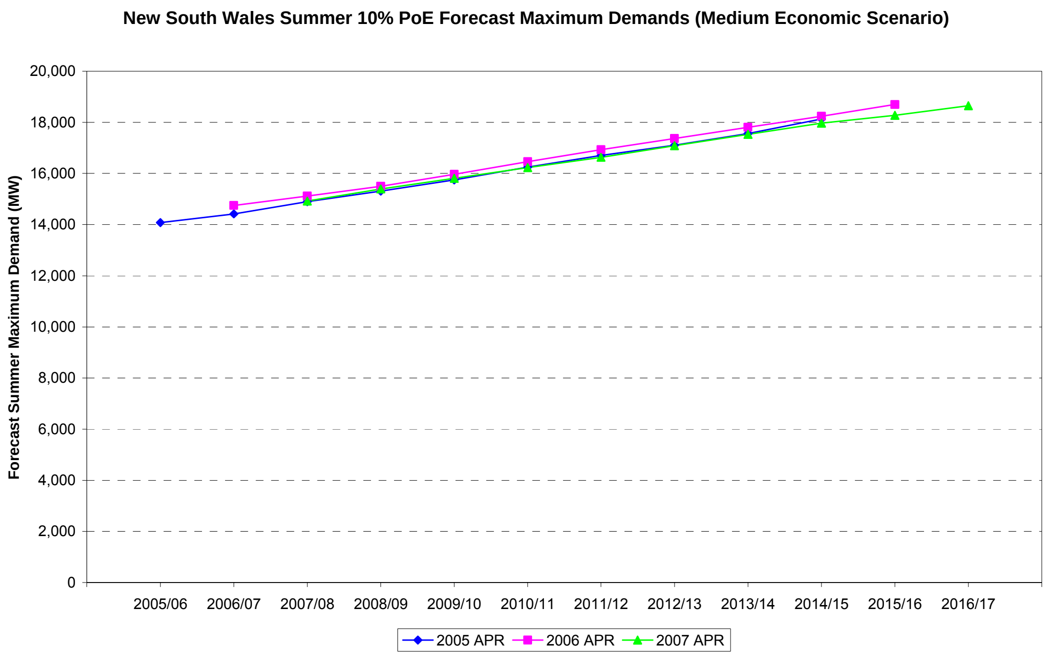
The 2007 Tweed Shire load forecast is shown in Table A1.5 below.

Table A1.5 Tweed Shire Load Forecast

Summer	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Load (MW)	97	103	109	115	120	128	133	138	143	148	152

The forecast used in the analysis reported in the Newcastle - Sydney - Wollongong Area Application Notice and Final Report was based on the NSW forecast published in the 2005 APR. Looking at the period of interest from 2009/10 the forecast in the 2006 APR is slightly above that in the 2005 APR, although the increase is only around half of one year’s load growth, and therefore immaterial. The forecast in the 2007 APR (corrected for the Tweed Shire load) is very close to that in the 2005 APR.

Diagram A1.10 Comparison of 10% PoE Maximum Demands as forecast in 2005, 2006 and 2007



The latest demand forecasts for the Newcastle and Central Coast to Wollongong areas are very similar to those prepared in 2005 for the years of interest. Consequently, system studies carried out to determine the need for system augmentations carried out on the basis of the 2005 forecast are still valid and no new studies have been undertaken.

It should be noted that the need for the supply reinforcement is not very sensitive to the details of the power flow modelling given that the load is growing by the order of 300MW per annum.

A2 Appendix 2 - The Criteria Used to Determine Transmission Network Capability

NOTE: The information contained in this Appendix is based on Section 2.4 of TransGrid's "Final Report, Proposed New Large Transmission Network Asset, Development of Supply to the Newcastle - Sydney - Wollongong Area, October 2006". This document can be found in Appendix 10 or on TransGrid's web site http://www.transgrid.com.au/trim/trim224993.pdf

Under NSW legislation TransGrid has responsibilities that include planning for future NSW transmission needs, including interconnection with other networks.

In addition, as a Transmission Network Service Provider (TNSP) TransGrid is obliged to meet the requirements of Schedule 5.1 of the Rules. In particular, TransGrid is obliged to meet the requirements of clause S5.1.2.1 in Schedule 5.1:

> "*Network Service Providers* must plan, design, maintain and operate their *transmission networks* to allow the transfer of power from *generating units* to *Customers* with all *facilities* or equipment associated with the *power system* in service and may be required by a *Registered Participant* under a *connection agreement* to continue to allow the transfer of power with certain facilities or *plant* associated with the *power system* out of service, whether or not accompanied by the occurrence of certain faults (called "*credible contingency events*").

TransGrid's planning obligations are also interlinked with the licence obligations imposed on all Distribution Network Service Providers (DNSP) in NSW. TransGrid plans its transmission network to enable these licence requirements to be met.

Jurisdictional Planning Requirements

There is no specific jurisdictional instrument, such as a transmission licence, that specifies planning criteria. In addition to meeting requirements imposed by the NER, Connection Agreements, environmental legislation and other statutory instruments, TransGrid is required by the NSW jurisdiction to describe in the five year Network Management Plan, the transmission planning requirements, so as to meet the statutory obligations contained in the Electricity Supply Regulation (Safety and Management) 2002. This document is submitted to the Department of Water and Energy (the NSW Technical Regulator) and therefore has jurisdictional approval. In this document TransGrid describes its planning and development of its transmission network on an "N-1" basis, except in the case of the Sydney CBD where a "modified N-2" reliability standard is required. That is, unless specifically agreed otherwise by TransGrid and the licensed distribution network owner or major directly connected end-use customer, there will be no inadvertent loss of load (other than load which is interruptible or dispatchable) following an outage of a single circuit (a line or a cable) or transformer, during periods of forecast high load. N-1 planning criteria is well accepted and widely used in Australia and internationally.

In fulfilling this obligation, TransGrid must recognise specific customer requirements as well as NEMMCO's role as system operator for the NEM. To accommodate this, the standard "N-1" approach can be modified in the following circumstances:

- Where agreed between TransGrid and a distribution network owner or major directly connected end-use customer, agreed levels of supply interruption can be accepted for particular single outages, before augmentation of the network is undertaken (for example the situation with radial supplies).

- Where requested by a distribution network owner or major directly connected end-use customer and agreed with TransGrid there will be no inadvertent loss of load (other than load which is interruptible or dispatchable) following an outage of a section of busbar or coincident outages of agreed combinations of two circuits, two transformers or a circuit and a transformer (for example supply to the inner metropolitan/CBD area).

- The main transmission network, which is operated by NEMMCO, should have sufficient capacity to accommodate NEMMCO's operating practices without inadvertent loss of load (other than load which is interruptible or dispatchable) or uneconomic constraints on the energy market. At present NEMMCO's operational practices include the re-dispatch of generation and ancillary services following a first contingency, such that within 30 minutes the system will again be "secure" in anticipation of the next critical credible contingency.

Hence, in assessing the capability of the NSW core network to supply the forecast customer demands, TransGrid applies an "N-1" criterion such that[6]:

1. The power system is able to be operated so that it is in a secure state in anticipation of a credible contingency; and

2. The power system is able to be restored to a secure state within 30 minutes of a credible contingency occurring, in anticipation of a second credible contingency.

Accordingly TransGrid plans the transmission network to avoid the need for pre-emptive customer load shedding for credible circumstances. Pre-emptive load shedding would entail interrupting supply to customers prior to a critical outage occurring, to ensure that power system security could be maintained if that outage were to occur. That is, load interruptions would be required, with the transmission network in its normal state, to cater for critical outages that may not occur.

In relation to the use of 10% PoE forecasts in situations where system security is a consideration, the occurrence of the 10% PoE demand (rather than outage of a line, cable or transformer) can be thought of as being the contingency. TransGrid plans to develop the network to avoid pre-contingent load shedding (which NEMMCO may otherwise require to meet its power system security obligations) should the 10% PoE demands occur.

Requirements 1 and 2 are typically met by the scheduling (or rescheduling) of generation. Under normal system conditions the dispatch of generation is primarily governed by the market behaviour of generators and it is possible to have a wide range of different generation patterns within NSW and in other states, influencing the power flow over the interconnectors with NSW.

Accordingly, TransGrid's analysis of the capability of the NSW core network to adequately deliver power to the Newcastle – Sydney – Wollongong load area considers:

- NEMMCO's power system security obligations;
- Single credible contingencies;
- Days of high summer demand for electricity, including using 10% probability of exceedence (PoE) forecast demands; and
- A range of generation patterns that could reasonably be expected to occur.

Over the last ten years, the reliability of the core NSW network has met the planning criteria described above.

[6] Further details of TransGrid's planning criteria may be found in TransGrid's 2007 Annual Planning Report

A3 Appendix 3 - Transmission Network Limitations

NOTE: The information contained in this Appendix is based on Section 2.5 of TransGrid's "Final Report, Proposed New Large Transmission Network Asset, Development of Supply to the Newcastle - Sydney - Wollongong Area, October 2006". This document can be found in Appendix 10 or on TransGrid's web site http://www.transgrid.com.au/trim/trim224993.pdf

A3.1 Limitations

The transmission network supplying the Newcastle – Sydney – Wollongong area faces two main emerging limitations:

1. Overloading of one of the two 330kV transmission lines between the Hunter Valley power stations (Liddell and Bayswater) and the Newcastle area. This could occur following an outage of the other line; and

2. Inadequate control of voltage levels in the Sydney area 330kV network. This could occur following an outage of one of a number of 330kV circuits, in particular either of the circuits between Bayswater and Western Sydney (either of the Bayswater – Regentville/Sydney West circuits).

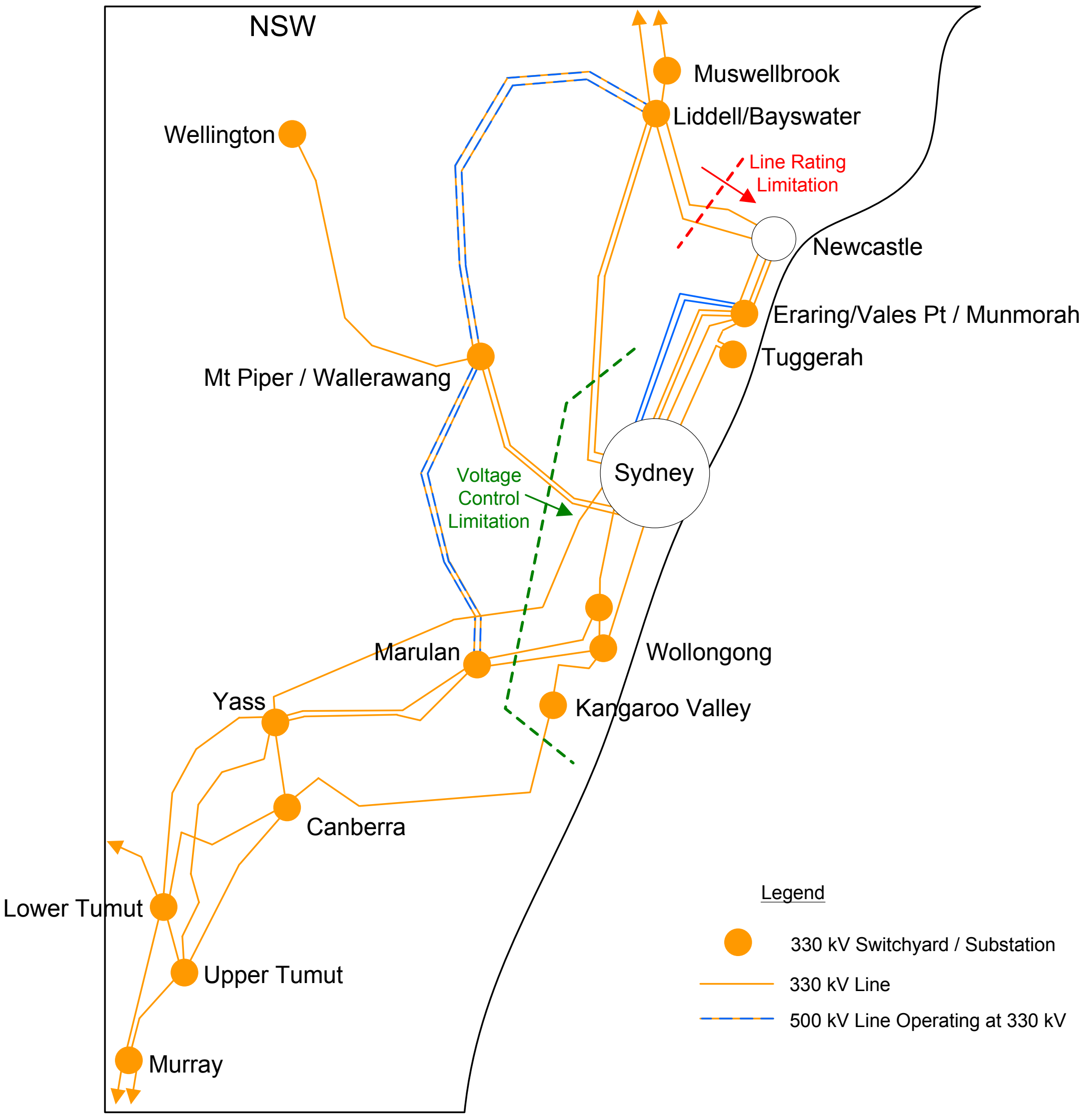
These limitations are exacerbated by high power transfers from the north of the State and the south of the State to the major load centres. They are described in more detail in the following sections.

With the growing State demand for electricity and increasing dependence on existing generation sources[7] it is expected that these limitations will become a critical reliability issue for supply to this area from the summer of 2008/09 onwards under the medium economic growth load forecast[8]. The limitation is expected to arise in summer 2007/08 under the high economic growth forecast and in 2009/10 under a low economic growth forecast.

These transmission network limitations are shown in Diagram A3.1 and described in detail in Sections A3.2.1 and A3.2.2.

[7] As the margin between the total generation capacity and the load level diminishes, the scope to re-dispatch generation to manage network limitations also reduces.
[8] Reference should be made to TransGrid's Revenue Reset application to the ACCC 2004

Diagram A3.1 Transmission Network Limitations – Summary



Options to relieve these limitations must be consistent with sound longer term development strategies and:

- Increase transmission capacity across the constrained parts of the network; and/or
- Alter power flows to reduce flows across the constrained parts of the network and increase flows elsewhere; and/or
- Reduce the effective load on the network in the Newcastle – Sydney – Wollongong area.

The proposed development forms part of the "500 kV ring" which is expected to be necessary to meet the longer term requirements of electricity within the State. It alters power flows to reduce the loading on the 330kV lines between the Hunter Valley power stations and the Newcastle area. It supports voltages in the Newcastle – Sydney – Wollongong area by reducing reactive losses, providing additional "line charging" and increasing access to the reactive power capability of power stations in the Hunter Valley and in the Lithgow area.

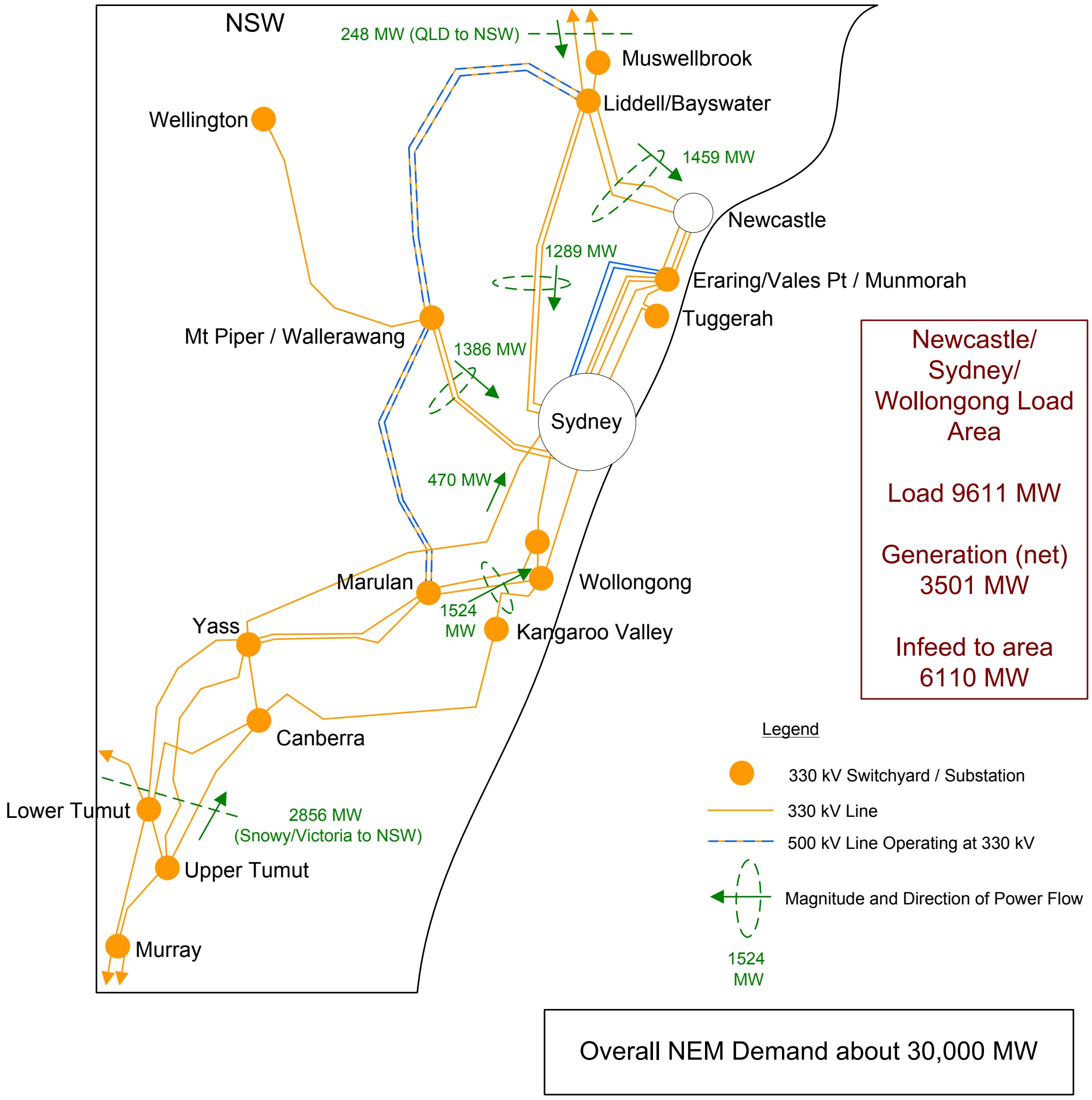
A3.2.1 Hunter Valley to Newcastle Line Rating Limitation

The supply capability to the load area, governed by the Hunter Valley – Newcastle line rating limitation, is a function of the generation levels at the NSW power stations and the level of supply from the south and from Queensland. TransGrid believes that, without corrective action, it will not be possible to manage this limitation from summer 2008/09.

The patterns of power flow in the NSW core network are determined by the load levels in the major load areas and the distribution of generation throughout the State, in conjunction with power flow over the interconnectors.

In order to illustrate how power is distributed along the various transmission paths, Diagram A3.2 shows the pattern of power flows on the major transmission paths supplying the Newcastle – Sydney - Wollongong load area at a time of a high NSW demand on a hot day in early February 2006 (the values shown are indicative for illustration purposes and have been taken from a snapshot of the power system conditions at one particular instant of time).

Diagram A3.2 Illustrative Power Flows at a time of High Summer Demand



At the time that this pattern was observed the load in the Newcastle – Sydney – Wollongong load area was about 9,600MW. The Central Coast power stations within the Newcastle – Sydney – Wollongong area contributed about 3,500MW resulting in a net in-feed to the load area of about 6,100MW. The net in-feed to the area was supplied by the other power stations throughout the interconnected southeast Australian system, outside the Newcastle – Sydney – Wollongong load area.

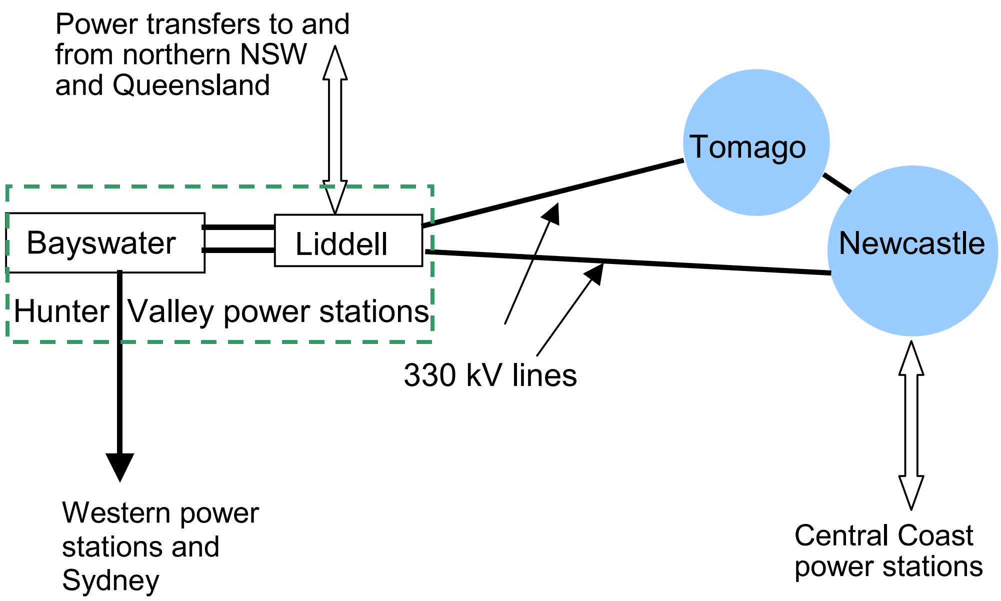
The supply situation at this time was characterised by relatively low import to NSW from Queensland and high import to NSW from Snowy and Victoria.

The pattern of power flows was governed by the generation distribution. Under a different generation distribution there could have been higher import from Queensland and higher output from the Hunter

Valley power stations which would result in higher power flows from the Hunter Valley to the Newcastle – Sydney – Wollongong load area. Under another different generation distribution there could have been higher power import from the south which would tend to increase the loading in the transmission links between the southern system and Sydney.

As shown in Diagram A3.3 there are two 330kV transmission lines between Liddell Power Station and the Tomago / Newcastle area. A number of transmission lines then connect Newcastle to the Central Coast power stations.

Diagram A3.3 The Hunter Valley to Newcastle Network



The present output capability of the power stations and import capability from Queensland is shown in Table A3.1[9]:

Table A3.1 Present Hunter Valley Power Station Capability & Import Capability from Queensland (Summer Conditions)

Input to System	Capability (MW)
Bayswater	2,720
Liddell	2,080[10]
Redbank (near Muswellbrook)	148
Total Hunter Valley generation	4,948
Import from Queensland via QNI	Up to 1,078MW (the capability is variable depending on system conditions)[11]
Import from Queensland via Directlink	Approximately 196MW[12]
Total of generation and import	Approximately 6,200

[9] The power station MW capability is as documented in NEMMCO's Statement of Opportunities (SOO) 2006. Power station output may vary above these levels in practice.
[10] The 2006 SOO quotes the Liddell generation capability as 2070 in summer 2006/7, rising to 2080MW by summer 2008/09.
[11] The capability for import to NSW via QNI is dependent on a number of system limitations. Damping presently sets a limit to the interconnector capability of a maximum of 1,078MW. System conditions can arise where the transient stability limits or line thermal rating limits become dominant and the import capability may be lower than 1,078MW.
[12] Directlink is connected to the Gold Coast system in Queensland. The capability for power transfer over Directlink to NSW is determined by the level of load on the Gold Coast. Under high load conditions in the Gold Coast area the capability may fall below 196MW.

Hence the generation in the Hunter Valley area together with import from Queensland can potentially supply a large part of the NSW load.

There is a relatively high power flow from Liddell to the Tomago / Newcastle area at times of high generation in the Hunter Valley and high import of power from Queensland.

This power flow is also affected by the load level in the Tomago / Newcastle area and the level of generation at the Central Coast power stations. As the load level in the Newcastle area is increased the power flow between the Hunter Valley and the Newcastle area tends to increase. Similarly as the generation in the Central Coast is reduced there tends to be an increase in power flow between the Hunter Valley and the coast.

An outage of either of the two 330kV transmission lines between Liddell and the Tomago / Newcastle area can lead to a high loading on the other line. The two 330kV lines have been designed for high temperature operation and uprating them is not considered to be practicable. The impact of these transmission line ratings is an overall limitation on the combined level of generation in the Hunter Valley and import of power from Queensland.

To date, this limitation has been managed by constraining generation at the Hunter Valley power stations and/or reducing imports from Queensland over QNI, according to NEMMCO's market operation practices.

This line rating limitation imposes a constraint on market operation at infrequent times at present. The constraint has arisen at times when there has been high import of power from Queensland, relatively high Hunter Valley generation (the majority of the eight Bayswater and Liddell generators operating) and reduced Central Coast generation. The limitation will be exacerbated in the future by higher Hunter Valley generation (should all eight Bayswater/Liddell units operate frequently to meet the State load requirements), increased incidence of high levels of import from Queensland and increasing Tomago / Newcastle area loads.

The line rating limitation is partly governed by the level of Central Coast generation. The Central Coast generation is shown in Table A3.2[13]:

Table A3.2 Central Coast Generation Capability

Power Station	Generating Capability (MW)
Eraring	2,640
Vales Pt	1,320
Munmorah	600
Total of generation	Approximately 4,560

It should be noted that this capability may not be always available in summer. The Vales Point power station output may be limited to below 1,320MW due to cooling water considerations in summer[14]. Munmorah is the oldest of the power stations in the area and has the lowest capacity factor of the stations.

Table A3.3 provides an indication of the impact on the supply capability to the Newcastle – Sydney – Wollongong area due to the limited thermal rating of the Hunter Valley – Newcastle network. This table has been derived under the following assumptions:

- The NSW load has been set at the 10% PoE forecast level (medium economic growth scenario);
- All NSW thermal generation is assumed to operate its maximum level, except as shown in Table A3.3: and
- Shoalhaven generation is assumed to not be in service.

[13] NEMMCO SOO 2006
[14] Reference should be made to NEMMCO's SOO 2006

The Shoalhaven scheme is primarily for water supply to Sydney. On the days of maximum demand for the past five summers, maximum output was available for the period of highest demand on only one occasion. Therefore it is not considered prudent to rely on this scheme to generate at times of high NSW demand.

The total supply to NSW is made up of NSW generation, Snowy generation and import from Queensland and Victoria. In order to illustrate the supply capability to the Newcastle – Sydney – Wollongong load area in Table A3.3, the NSW thermal generation has been assumed to be at its maximum. Various levels of Snowy and import from Victoria have then been assumed, constituting a certain level of import from the south. This import was varied between 2,800MW and 3,200MW for the purpose of illustration. As the import from the south was varied the import from Queensland was then adjusted to match the overall demand in the State.

Because the thermal rating limitations between the Hunter Valley and Newcastle are very dependent on the level of generation in the Central Coast (which is within the load area), various levels of Central Coast generation were then analysed. Generation was withdrawn in the Central Coast in two steps of 300MW[15]. Hence Table A3.3 shows the margin of supply capability above the area load as the level of generation in the area is varied, with the sharing of supply to NSW then balanced between import from the south and import from Queensland.

When the transmission capability exceeds the load in the area in Table A3.3 the margin of supply is positive. When the transmission capability falls below the area load the margin is negative.

Table A3.3 Margin of supply capability over the load level in the Newcastle – Sydney – Wollongong area

	Difference between the supply capability and load (MW)					
	2007/08			2008/09		
Import from south	Central Coast Generation 600MW below maximum	Central Coast Generation 300MW below maximum	Maximum Central Coast Generation (Note 1)	Central Coast Generation 600MW below maximum	Central Coast Generation 300MW below maximum	Maximum Central Coast Generation (Note 1)
2800	-265	74	413	-492	-153	186
2900	-183	156	495	-410	-71	268
3000	-113	216	555	-340	-11	328
3100	-52	287	626	-279	60	399
3200	9	348	687	-218	121	460

Note 1: The maximum Central Coast generation is approximately 4,560MW as shown in Table A3.2.

The excess capability for supply to the area is shown graphically in Diagram A3.4 and Diagram A3.5, for summer 2007/08 and summer 2008/09, respectively.

[15] As indicated in the 2006 SOO, the output of Central Coast power stations can be limited by lake (cooling water) temperatures at times of high ambient temperatures.

Diagram A3.4 Excess Capability for Summer 2007/08

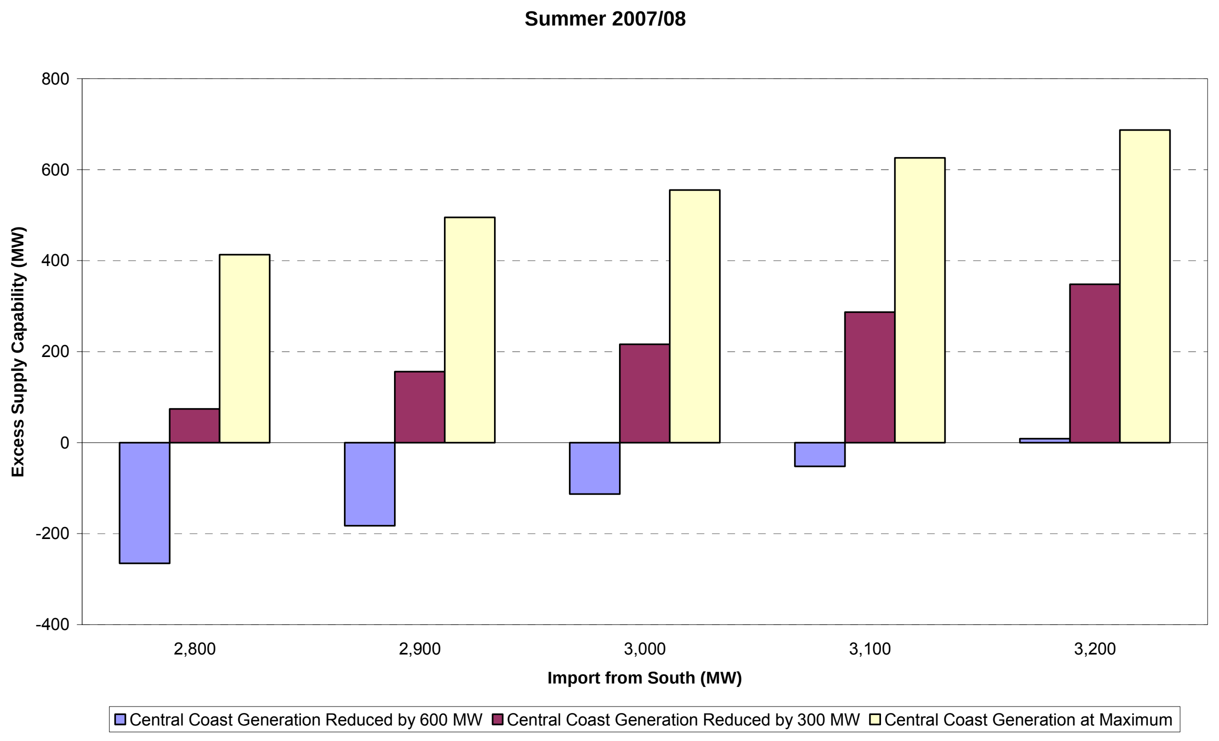
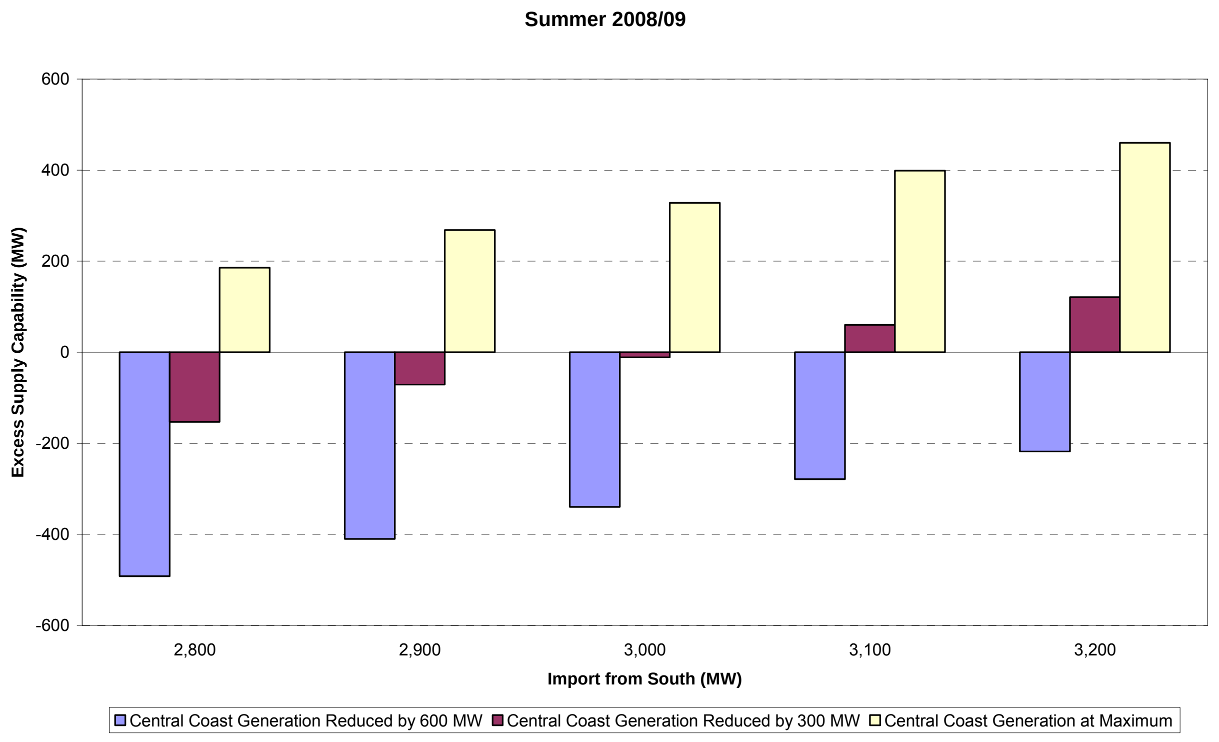


Diagram A3.5 Excess Capability for Summer 2008/09



For example in summer 2008/09 if the import from the south was set at 3,000MW the supply capability to the Newcastle – Sydney – Wollongong area would exceed the actual load by 328MW if the Central Coast generators operated at their maximum output. If the Central Coast generation was reduced by 300MW there would be a shortfall in supply to the area of 11MW and if the Central Coast generation was reduced by a further 300MW (i.e. a reduction of 600MW in total) there would be a shortfall in supply capability of 340MW.

The limitation that would need to be placed on the supply to the Newcastle – Sydney – Wollongong area, to manage the loading on the Hunter Valley to Newcastle transmission lines, is directly related to the capability to generate power in the Hunter Valley and to import power from Queensland. Limiting these sources would also affect the ability to supply the overall NSW load.

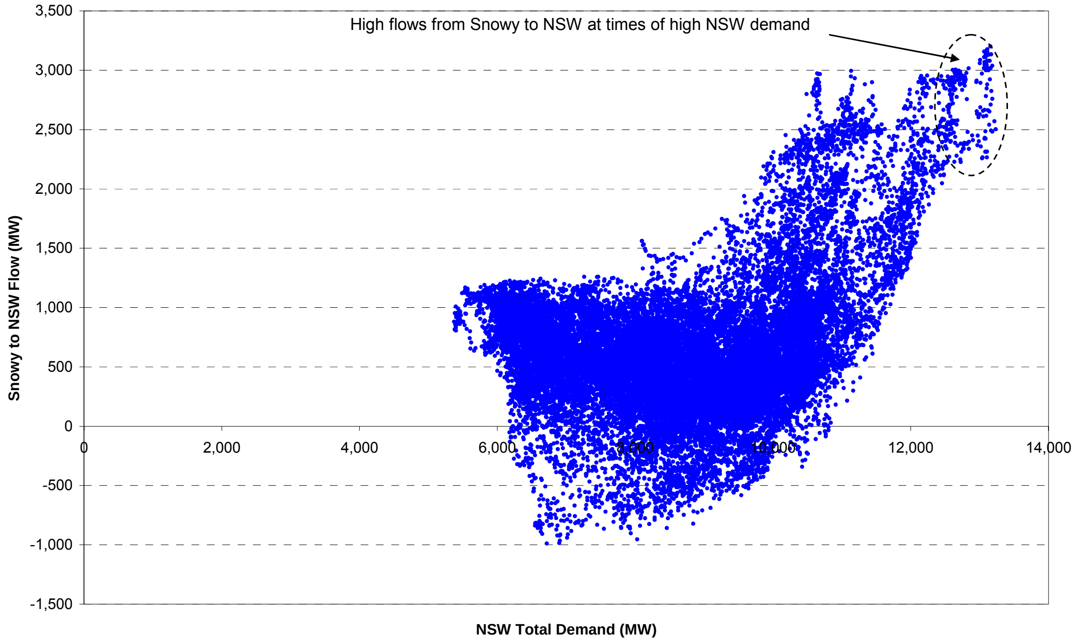
A shortfall in supply capability implies that the load could not be supplied and the load in the Newcastle – Sydney – Wollongong area would need to be reduced to enable the power system to operate securely.

The supply capability to the area is clearly a function of the generation levels at the NSW power stations and the availability of supply from the south and from Queensland.

The present import capability from the south is variable depending on system conditions but can typically be about 3,200MW on a summer day. This actual import from the south varies up to this limit depending on generation dispatch within the market.

Diagram A3.6 shows the southern import level versus the NSW demand during the past summer. Import from the south varied up to about 3,200MW but import at such high levels was relatively rare. At times of high NSW demand the import from the south has varied from about 2,300MW to about 3,200MW.

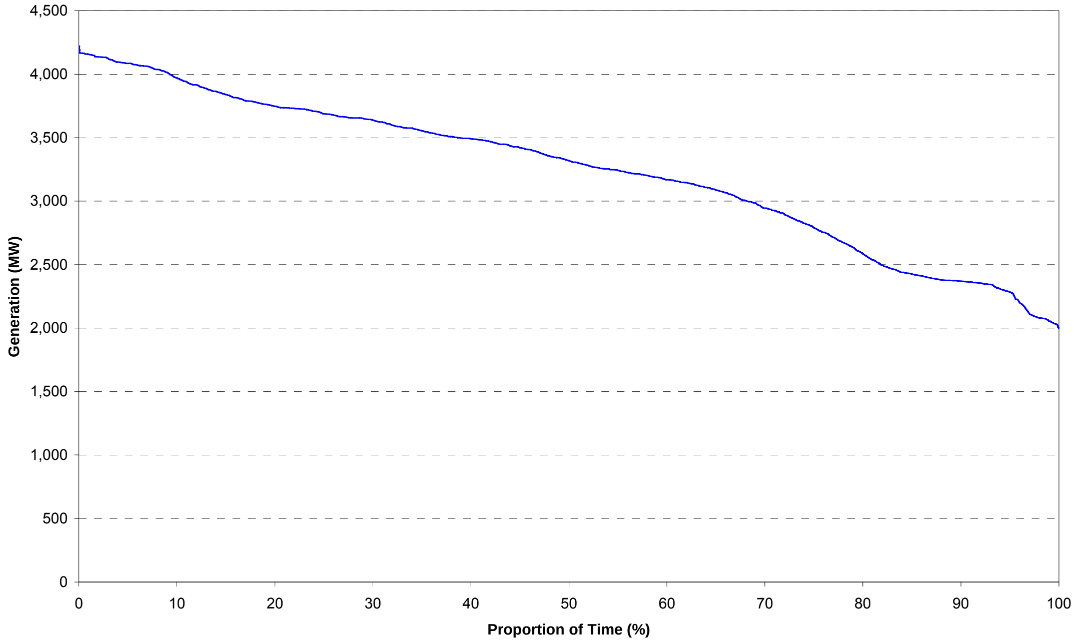
Diagram A3.6 Southern Import and NSW Demand



As an indication of recent generation patterns, the output of in the Hunter Valley, Central Coast and Western power stations over the past summer is shown in the following three diagrams. These diagrams are in the form of duration curves (i.e. cumulative frequency graphs - the output exceeds the level shown for the duration shown). Information of this type has been used in developing the generation patterns used in the planning analysis.

The total output of the Hunter Valley power stations is shown in Diagram A3.7. The maximum output recorded was below the maximum of 4,948MW (refer to Table A3.1). It is expected that the maximum output will be approached more often in the future if Macquarie Generation operates all of the Bayswater and Liddell units in response to the tightening supply / demand balance in NSW.

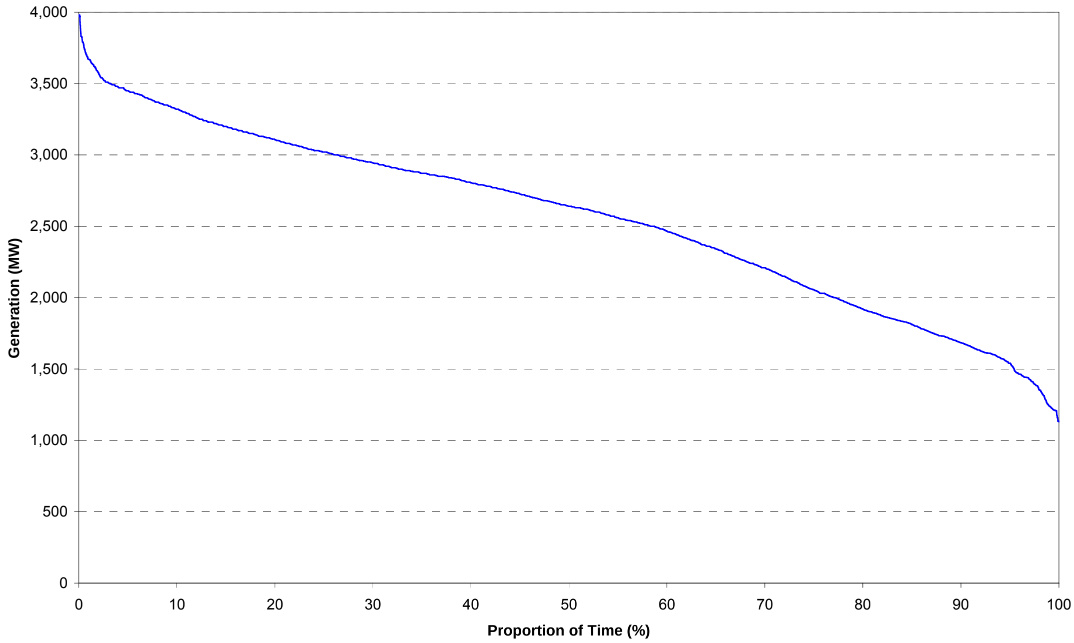
Diagram A3.7 Hunter Valley Power Station Output



The total output of the Central Coast power stations is shown in Diagram A3.8. The maximum output approached about 4,000MW, well below the maximum of 4,560MW shown in Table 3.2. The high levels of generation were also of a relatively short total duration.

It should also be noted that the Vales Point power station output may be limited below its maximum due to cooling water considerations in summer.

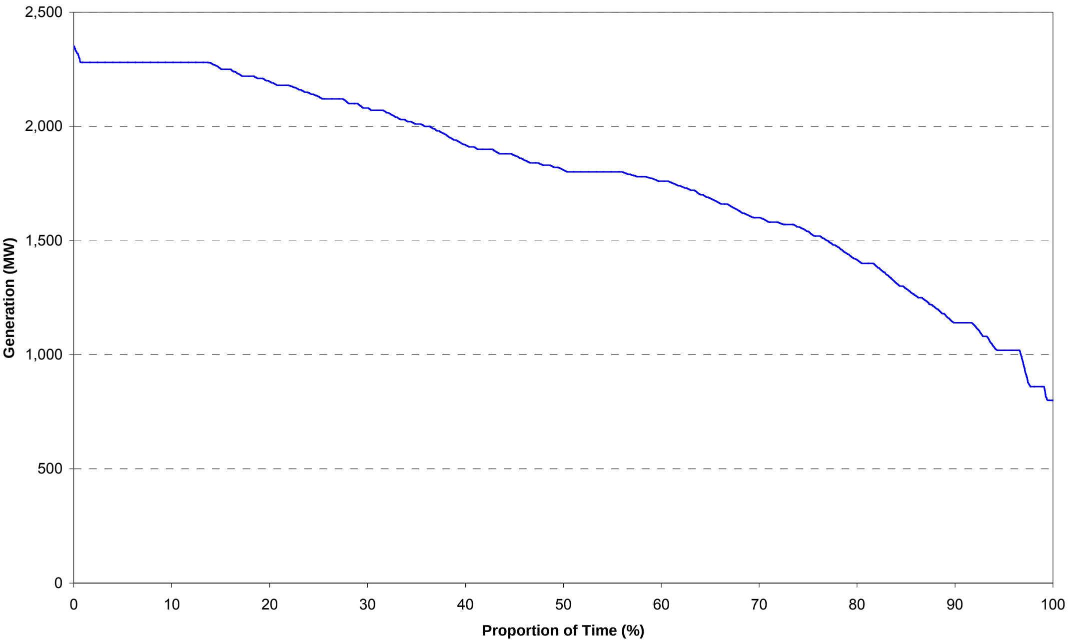
Diagram A3.8 Central Coast Power Station Output



The total output of the western power stations (Mt Piper and Wallerawang) is shown in Diagram A3.9. The maximum output approached the total capability of 2,400MW[16]. High levels of output occurred over a relatively long total duration.

[16] 2006 SOO

Diagram A3.9 Western Power Station Output



In assessing the capability of the NSW core network to supply the Newcastle – Sydney – Wollongong area TransGrid must take into account the potential generation patterns throughout the State. Table A3.3 shows potential capability shortfalls in summer 2007/08 when the Central Coast generation is about 600MW below its maximum. Otherwise in summer 2007/08 there is expected to be a margin in capability above the load at reasonably high levels of import from the south.

In summer 2007/08 it is however possible that Central Coast generation will need to be constrained to operate at high levels to manage the line rating limitation.

By summer 2008/09, in order to manage the supply limitation and to maintain the Hunter Valley – Newcastle lines within their capability, the Central Coast generation would need to be operated close to maximum output, even with high levels of import from the south. In this summer if the Central Coast generation was about 300MW below its maximum output it would be necessary to import above 3,000MW from the south to meet the full load in the Newcastle – Sydney – Wollongong area. The potential shortfall increases if either the output of the Central Coast generation is reduced or the import from the south is reduced.

TransGrid considers the planning criteria for supply to the Newcastle – Sydney – Wollongong load area would not be able to be met from summer 2008/09. TransGrid considers that it would not be prudent to rely on extreme generation patterns and the availability of every Central Coast generator to avoid a supply capability shortfall and that there would be an unacceptable risk to the supply to the Newcastle – Sydney – Wollongong area.

In the absence of additional transmission capability between the generation outside of the Newcastle – Sydney – Wollongong area or suitably located generation developments and/or demand reductions within the area, TransGrid believes that it will not be possible to adequately manage this limitation to the Newcastle – Sydney – Wollongong area and the overall NSW supply from summer 2008/09, over a reasonable range of generation dispatch conditions.

It should be noted that the potential shortfall in supply capability to the Newcastle – Sydney – Wollongong area would increase in future summers in accordance with the load growth in the area. The limitation is expected to arise in summer 2007/08 under the high economic growth forecast and in 2009/10 under a low economic growth forecast.

Demand Side Remedial Options

One option to manage this limitation is to reduce customer demand in the Newcastle – Sydney – Wollongong area (or alternatively to supply some of the load from new generation in the area) in anticipation of an outage of one of the two critical transmission lines from the Hunter Valley.

Another option would be to rapidly reduce the local customer demand following an outage of one of the critical transmission lines. This may take the form of rapid and effectively unannounced load shedding.

It is anticipated that the load shedding controls would be automatic and would be armed at times when the 330kV transmission lines would be potentially overloaded should an outage of one of them occur. As these 330kV transmission lines are very reliable, it is expected that the load shedding would have a low probability of being required. Once shed, the load would need to remain off until the line is returned to service or transmission network loading levels are otherwise relieved.

The load shedding controls are denoted System Protection Schemes and such schemes are already applied in various forms in other parts of the NSW network and are common in international practice. The shedding of load would need to be managed by a comparable reduction in generation in the interconnected southeast Australian system. Care would need to be taken to ensure that the generation reduction occurred in a location that led to an offloading of the critical transmission line. For example if the load shedding was undertaken in Sydney and generation in the south of the State or in Victoria or South Australia was reduced, the net power transfer into the north of NSW would appear to remain relatively constant and the loading in the critical lines may not be relieved. In contrast, for example, if the generation in Queensland was to be reduced in line with the Sydney area load reduction, the net transfer into the Newcastle – Sydney - Wollongong area from the north would be reduced as required.

Demand side options are addressed in Section A4.3.4 of Appendix 4.

A3.2.2 Voltage Control Capability

The voltage control issues on the NSW main transmission network reflect the high power transfers to the Newcastle - Sydney – Wollongong area over the relatively long distances from the major power sources in the north, west and south of NSW.

Reactive power support to the main transmission network has been provided for many years through the installation of switched shunt capacitor banks and Static VAr Compensators (SVC). An important component of the reactive power support is also the MVAr capability of generators. A fundamental assumption in the planning of the NSW main transmission network has always been that the full MVAr capability of generators would be available to support the main transmission network.

TransGrid has derived the values for the full MVAr capability based on its knowledge of the generator capabilities.

It should be noted that the full MVAr capability of the generators (according to TransGrid's understanding) significantly exceeds the performance standard for the generators (NER). Table A3.4 compares TransGrid's view of the generator MVAr export capability with the performance standard levels. NEMMCO is required to manage the difference between the performance standard levels and the maximum generating capability by entering into contracts for network control ancillary services.

Table A3.4 Generator MVAr Export Capability

Power Station	Performance Standard Reactive Generating Capability (of each unit) (MVAr)	TransGrid assumed Reactive Generating Capability (of each unit)
Bayswater	320	410 MVAr at 660MW
Liddell	93	335 MVAr at 700MW
Eraring	320	310 MVAr at 500MW
Vales Pt	320	410 MVAr at 660MW
Munmorah	145	410 MVAr at 660MW
Wallerawang	112 – 161	200 MVAr at 300MW
Mt Piper	320	200 MVAr at 500MW

The reactive power support requirements of the main transmission network are also dictated by load power factors and MVAr losses (reactive losses) in the network (which result from flows on transmission and distribution lines). The overall customer MW load in the Newcastle – Sydney – Wollongong area is growing and, with it, the network MVAr losses.

Should one of a number of critical transmission lines supplying the Newcastle - Sydney – Wollongong area be forced out of service at times of high demand, the MW loadings and consequently the MVAr losses on the remaining lines increase, giving rise to a need to provide reactive capability that enables adequate voltage levels to be maintained in the area under these conditions.

This limitation has been managed in the past by the installation of reactive plant however there is limited scope to continue this strategy. There are now about 3,300 MVAr of shunt capacitors installed at 330kV and 132 kV in the Newcastle – Sydney – Wollongong area. In recent years TransGrid has been installing capacitor banks rated at 330kV and 200 MVAr in order to manage the reactive supply situation. In addition the SVCs at Sydney West and Kemps Creek provide dynamic reactive support.

The voltage control capability of the system is a function of the generating units on line and their power output. The reactive support afforded by the generators in the Newcastle – Sydney – Wollongong area is more critical than those at more distant locations. The Central Coast power stations are reasonably effective in supporting the load area voltages, particularly in the Sydney area. The reactive power capability of the Hunter Valley and western power stations are also important in supporting the sending end of the transmission network but provide less reactive support to the area than the Central Coast generators. Snowy reactive power capability is important in supporting the voltages in the immediate Snowy area but as Snowy is distant from the Newcastle – Sydney – Wollongong area it does not directly contribute to voltage control in that area.

The voltage control capability of the supply to the Newcastle – Sydney - Wollongong area is relatively independent of the level of import from the south of the State or north of the State for any given output from the thermal power stations in the State. For example under peak load conditions, with all presently installed reactive support plant in service and with most of the NSW generators in service, the capability for supplying the Newcastle – Sydney – Wollongong area varies with the import from the southern system as shown in Table A3.5.

In establishing the values in this table the same approach was taken as described for Table A3.3. The NSW thermal generation has been assumed to be at its maximum. Three levels of import from the south are illustrated. As the import from the south was varied the import from Queensland was then adjusted to match the overall demand in the State.

Table A3.5 Variation of Supply Capability with Import from the South

Import from the South	Capability to Supply the Newcastle – Sydney – Wollongong Area Based on Voltage Control Limitations
2,800MW	10,560MW
3,000MW	10,578MW
3,200MW	10,577MW

As the import from the north or south increases a point is reached where the supply capability will decline as a result of increasing reactive power losses (which varies in a square law relationship).

The capability to supply the Newcastle – Sydney – Wollongong area is very dependent on the number of generators connected in the Central Coast. Table A3.6 shows the load supply capability with all Central Coast generators in service, with one Munmorah unit off-line and with two Munmorah units off-line. In the table the import from the south has been fixed at 3000MW. The capability is compared to the 10% PoE (medium economic growth) load levels for summer 2007/08 and 2008/09 (medium economic growth load forecast).

Table A3.6 Variation of Supply Capability with Central Coast Generation

	Approximate Load Supply Capability	Excess Supply Capability Compared to Load Summer 2007/08	Excess Supply Capability Compared to Load Summer 2008/09
All Central Coast generators in service, import from south 3,000MW	10,770	87	-217
One Munmorah unit out of service, import from south 3,000MW	10,580	-103	-407
Both Munmorah units out of service, import from south 3,000MW	10,380	-303	-607

TransGrid plans to install further major capacitor banks in the Sydney area to meet the loads of summer 2006/7 and 2007/08. It is expected that the supply deficits shown above in summer 2007/08 will be able to be managed through the installation of a further 800 MVAr to 900 MVAr of capacitor banks.

At present there is also scope to alleviate the voltage control limitations if necessary by appropriate dispatch of generation in NSW. The ability to schedule generation to manage this voltage control limitation will decrease as the State aggregate customer demand approaches the level where, to meet it, all existing generation within the State and high levels of power import from Snowy/Victoria and Queensland are required.

There are two limitations to the further installation of reactive support, particularly in the Sydney area:

- The space available for the installation of major shunt capacitors in the Sydney area is now very limited; and

- There are technical limits to the degree to which shunt capacitor compensation can be used to maintain the power transfer capability of an electric power system. As the loading on the transmission network grows there is a need to manage voltage levels using static capacitors, SVCs and control systems. At relatively high levels of customer demand for electricity, a point is reached where these means are no longer adequate and the transmission capability needs to be improved by other means which may include the construction of new transmission lines.

It is expected that virtually all the accessible space for installation of capacitor banks in the Sydney area TransGrid substations will be used by summer 2007/08. In addition, by this time, the technical limits to shunt compensation will limit further major capacitor bank installations[17].

It is expected that due to the practical limits of capacitor installation in the Sydney area other means will need to be applied to ensure reliability of supply to the Newcastle – Sydney – Wollongong area in summer 2008/09 (medium economic growth forecast scenario). The limitation is expected to arise in summer 2007/08 under the high economic growth forecast and in 2009/10 under a low economic growth forecast[18].

Demand Side Remedial Options

As discussed in Section A3.2.1, one option to manage this limitation is to reduce customer demand in the Newcastle – Sydney – Wollongong area (or alternatively to supply some of the load from new generation in the area) in anticipation of an outage of the critical transmission lines.

The option to rapidly reduce the local customer demand following an outage of one of the critical transmission lines remains, however the load shedding would need to be significantly quicker than

[17] In technical terms the level of shunt compensation results in increasing voltage at the point of voltage collapse to the point where the collapse point approaches the normal operating voltage levels of the system.
[18] TransGrid Revenue Reset application to ACCC 2004.

would be the case to manage line rating limitations. The load shedding to manage the voltage control limitation would need to be effected within a second or at most a few seconds following an outage of one of the critical lines.

The load shedding controls would be automatic and would be armed at times when the 330kV transmission system capability is approached. Again, as the 330kV transmission lines are very reliable, it is expected that the load shedding would have a low probability of being required. Once shed, the load would need to remain off until the line is returned to service or transmission network loading levels are otherwise relieved.

Such load shedding controls are also categorised as System Protection Schemes and such schemes have been applied in international practice. Again the shedding of load would need to be managed by a comparable reduction in generation in the interconnected eastern Australian system. Care would need to be taken to ensure that the generation reduction occurred in a location that led to a reduced loading on the transmission system.

The demand side options are addressed in Section A4.3.4 of Appendix 4.

A3.2.3 Dependency of Network Limitations on Demand Levels and Location of New Generation

By about the summer of 2008/09 it will be necessary to increase the power transfer capability of the core transmission network between the Hunter Valley and southern areas.

Alternatively:

- The loading on the transmission network will need to be maintained at acceptable levels through management of load; or
- New generation would need to be installed at appropriate locations.

Management of load would involve load reductions in the greater Sydney area either:

- At times of high demand in anticipation of the outage of a critical transmission line; or
- Following an outage of a critical transmission line.

  In this case, customer load shedding would need to be effected immediately following the outage to avoid potential voltage collapse on the network. It would also be necessary to rapidly adjust generation patterns in a strategic manner to ensure that critical parts of the transmission network are successfully off-loaded. Similarly load would need to be reduced to overcome line rating limitations.

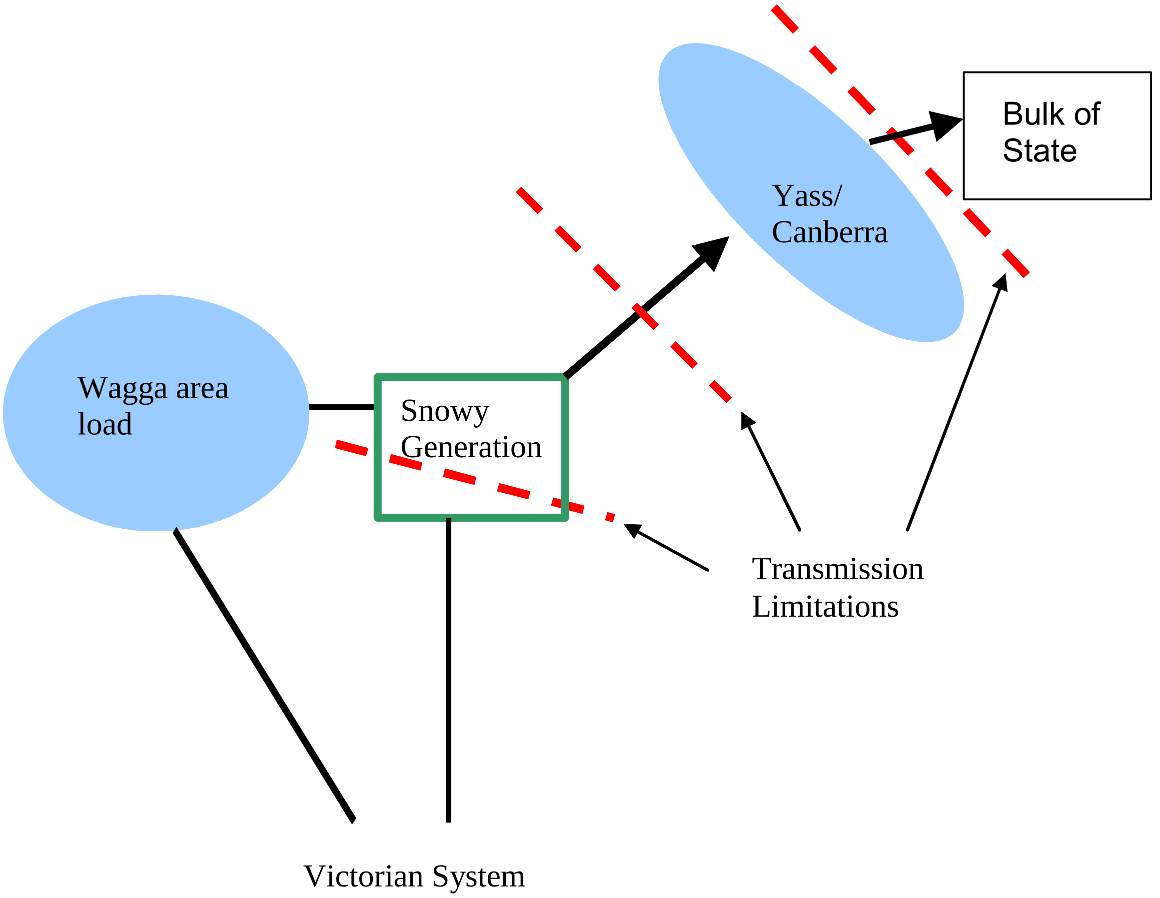
The customer demand could be restored once the faulted line has been restored to service or the power system loading conditions have eased.

Any additional generation installations would ideally need to be located within the NSW main network between the Newcastle and Wollongong areas. However, the effectiveness of new generation in relieving the network limitations will be affected by an additional network limitation described in Section A3.2.4.

There are power transfer limitations in the Snowy system, immediately north of Snowy between Snowy and Yass / Canberra and between Yass / Canberra and the Sydney and south coast areas. The limitations are shown indicatively in Diagram A3.10. The limitations are primarily governed by line thermal ratings but voltage control limitations arise in the Canberra area. The discussion of Sections A3.2.1 and A3.2.2 has illustrated the voltage control limitations that also arise in transmitting power from the south to the Newcastle – Sydney – Wollongong area.

Hence any new generation south of the Yass / Canberra area is not likely to be effective in meeting the NSW aggregate peak customer demand requirements, without an upgrading of the southern transmission network and without addressing the overall voltage control limitation on transmitting power to the Newcastle – Sydney – Wollongong area.

Diagram A3.10 Snowy to New South Wales Network Limitation



A3.2.4 Short Circuit Level Limitations

In addition to the limitations described in Sections A3.2.1 and A3.2.2 and those outlined in Section A3.2.3, it is also necessary to ensure that switchyard plant is operated within its short circuit rating.

A number of 330kV switchyards at the major power stations in the Hunter Valley and Central Coast have short circuit levels which are at or near the limit of the capability of the plant. There is limited capability to accommodate the connection of new generating plant to the NSW 330kV network without remedial action. There is considered to be no scope for upgrading the short circuit rating of the Bayswater and Liddell 330kV switchyards.

The capability of the network to accommodate new generating plant is dependent on the location of the new generation and its technical parameters. Generally new generating plant in the Central Coast to Hunter Valley area would be expected to significantly exacerbate the short circuit level restrictions in the area and hence only limited new plant would be able to be connected to the network. New generating plant south of Sydney is electrically more remote from the critical switchyards and there is generally more scope for such installations.

TransGrid is actively assessing the extent of short circuit level remedial works required to accommodate new generation following a number of Connection Applications for new generation in the Central Coast to Hunter Valley area and also at various sites in the southern area of the network.

The remedial action being considered includes the uprating of switchyard plant (where feasible), the rearrangement of connections to switchyards and the insertion of series reactors.

One network option is the upgrading of the western system to 500kV operation (refer to Section A4.2.1 of Appendix 4). This option effectively reduces the short circuit levels at the Hunter Valley 330kV switchyards. It is considered that this network option would enable the connection of limited additional generation to the 330kV network in the Hunter Valley to Central Coast area. This option therefore provides one means for assisting in the management of the short circuit level restrictions. It is possible that the other remedial actions being considered (plant uprating, line rearrangements and series reactors) will not be technically feasible or economic and a stage may be reached where the western system will need to be converted to 500kV operation just to enable the development of additional generation in NSW. The timing for the conversion would be specifically dependent on the new generation developments.

In assessing the options for generation development (as a non-network option) the following assumptions have been made concerning the capability of the network to accept new generation:

Table A3.7 Short Term Impact of Additional Generation on the Hunter Valley Short Circuit Level Limitation

Generation Site	Installed Capacity Limited by Short Circuit Limitations in the Hunter Valley
Central Coast to Hunter Valley	Up to 300MW of plant is able to be connected
Sydney to the south around Marulan	No limitation due to short circuit levels
South of Yass / Canberra	No limitation due to short circuit levels
Capacity expansion of existing 660MW units	No limitation due to short circuit levels (providing the plant main electrical parameters are unchanged)

It should be noted that the above applies in assessing generic generation options. However in practice any new generating plant installed anywhere on the network causes an increase in short circuit levels at all locations. Hence the cumulative effect of multiple new generators in the south of the State would also lead to short circuit level issues in the Hunter Valley. The situation would be assessed as each case arises in the Connection Application process.

A4 Appendix 4 - Options Considered

NOTE: The information contained in this Appendix is based on Section 4 of TransGrid's "Final Report, Proposed New Large Transmission Network Asset, Development of Supply to the Newcastle - Sydney - Wollongong Area, October 2006". This document can be found in Appendix 10 or on TransGrid's web site http://www.transgrid.com.au/trim/trim224993.pdf

The proposed works are required to meet minimum network performance requirements set out in the NER and by the New South Wales jurisdiction. Failure to implement measures to overcome the system constraints in the required timeframe would result in the minimum network performance standards not being met. Consequently, "do nothing" is not an option and would result in unacceptable levels of supply reliability in the core NSW network.

A number of network and non-network options having potential to relieve the line loading and voltage control limitations have been considered. These are discussed in the following sections.

A4.1 Timing of Options

The timing of implementation of options will be determined by system analysis taking into account the reliability criteria, load forecast and likely generation scenarios. Where network support is a feasible alternative, the timing of this has been taken into account in the application of the regulatory test (see Appendix 5). System analysis (see Appendix 3) has shown that reliability criteria will not be met from summer 2008/09 onwards. Consequently, some action needs to be taken by that time and can not be deferred to a future Regulatory Period.

A4.2 Network Options

Seven network options were considered.

Four of the network options considered below involve the establishment of sections of a future 500kV "ring" connecting the major load centres (Newcastle, Sydney and Wollongong) to the existing major thermal power stations. It is anticipated that in the longer term it will be necessary to complete the 500kV ring to serve the growing demand for electricity in NSW and new power stations developed to meet that demand. The optimal staging of these works depends on the location of future major generation within the State, which is at present unclear.

Two options involve an upgrade of transmission capacity from the Snowy area to Sydney by upgrading a number of existing 330kV lines plus establishment of a 330kV switching station at Bannaby.

The seventh option involves series compensation of existing lines.

A4.2.1 Option 1: Convert the Bayswater – Mount Piper – Marulan Line to 500kV Operation, Transfer Bayswater Units 3 & 4 to the 500kV Switchyard and Selected Line Upratings

The main works include:

- At Bayswater:
  - Establishment of a 500kV switchyard at Bayswater adjacent to the existing 330kV switchyard;
  - Connection of the two switchyards by two 500/330kV transformers;
  - Connection of two 150 MVAr shunt reactors to the transformer tertiaries;
  - Reconnection of the existing Mt Piper/Wallerawang line at Bayswater to the 500kV switchyard (the remote ends are to be reconnected to Mt Piper and Wollar); and
  - Reconnection of generator units 3 and 4 at Bayswater from the 330kV switchyard to the 500kV switchyard.

- At Mount Piper:
  - Establishment of a 500kV switchyard at Mt Piper adjacent to the existing 330kV switchyard;
  - Connection of the two switchyards by two 500/330kV transformers;
  - Connection of two 150 MVAr shunt reactors to the transformer tertiaries;

- Reconnection of the existing Bayswater circuit from the 330kV switchyard to the 500kV switchyard;
  - Connection of a Wollar circuit to the 500kV switchyard;
  - Reconnection of the existing Marulan line from the 330kV switchyard to the 500kV switchyard;
  - Connection of the existing 330kV circuit, which presently connects one of the 500kV circuits to Bayswater, to Mount Piper to form a second Mount Piper – Wallerawang 330kV circuit; and
  - Relocation of the existing Wellington line within the 330kV Switchyard.

- At Bannaby:
  - Establish a new 500/330kV substation including 500kV and 330kV switchyards, two 500/330kV transformers and two 150 MVAr shunt reactors connected to the transformer tertiaries;
  - Connect two 500kV circuits to Mount Piper; and
  - Connect 330kV circuits to Yass, Sydney West and two to Marulan.

- At Wollar:
  - Convert 500kV switchgear operating at 330kV to 500kV operation;
  - Install a 500/330kV transformer and 330kV switchbay; and
  - Reconnect the Wellington 330kV circuit to the new 330kV switchbay.

Additional works that form part of this option are as follows:

- At Wallerawang 330kV Switchyard:
  - Uprate equipment to ensure adequate fault level ratings.

- Carry out uprating works on the following 330kV circuits:
  - Marulan – Avon;
  - Marulan – Dapto; and
  - Kangaroo Valley – Dapto.

- Modify 330kV line protections in the Bayswater – Liddell area.

This option involves establishment of 500/330kV substations at Bayswater, Wollar, Mount Piper and Bannaby (near the intersection of the Sydney West – Yass 330kV line and the Mount Piper – Marulan 500kV line).

The existing 330kV switchyards at Bayswater and Mount Piper were established with provision for the future installation of 500kV switchyards and 500/330kV transformers.

A switchyard is proposed to be constructed at Wollar, to connect the proposed Wollar – Wellington 330kV line to the existing Bayswater – Mt Piper/Wallerawang line. This switchyard is to be equipped with 500kV switchgear to facilitate its conversion to a 500/330kV substation.

Uprating of the 330kV Marulan – Dapto, Marulan - Avon and Kangaroo Valley – Dapto lines is required to provide for increased power flows on these lines following conversion of the Bayswater – Mt Piper – Bannaby line to 500kV operation.

Some equipment at Wallerawang would be required to be uprated to provide for increased short circuit level duty.

This option provides increased capability to supply the load of the Newcastle – Sydney – Wollongong area. Specifically:

- It permits increased power flow from the north to the south via the Bayswater - Mt Piper - Bannaby 500kV lines, reducing the loading on the Liddell to Tomago / Newcastle lines. It provides additional supply capability to the Newcastle - Sydney - Wollongong area.
- It relieves the voltage control limitation on supply to the Newcastle - Sydney - Wollongong area:
- By off loading 330kV lines it improves the overall system voltage control capability, allowing higher power transfer from the Hunter Valley, western and southern generation to the area.

- By reducing the overall network impedance between Bayswater and Bannaby it permits a high level of access to the MVAr generating capability of the Hunter Valley and western generators from the area; and
- It increases reactive support due to increased line charging.
- The line uprating in the southern network alleviates past limitations on power transfer between Marulan and the coastal area that has constrained southern and western generation levels.

Reconnection of the No. 3 and No.4 units at Bayswater to the 500kV switchyard would reduce short circuit levels at the Bayswater and Liddell 330kV switchyards. This would allow a limited range of future generation developments to occur without major upgrades being required at these sites for short circuit level reasons.

This option would take approximately 3½ years to construct with an estimated completion date being early 2010. Transfer of the Bayswater units to the 500kV switchyard would be co-ordinated with scheduled major outages of those units. The works other than transfer of the No.3 unit at Bayswater to the 500kV switchyard would be completed prior to summer 2009/10. The staged development of the option to coordinate with major generator outages results in a staged improvement of supply capability with some additional capability available in summer 2009/10.

A number of timing and staging variations of this option are being considered. The construction sequence for the project needs to be coordinated with the program of generator outages for major maintenance at Bayswater. Options are also being considered that would remove this constraint on the construction sequence. These variations relate to the project implementation phase where TransGrid will, to the extent possible, coordinate its activities with those of Macquarie Generation to minimise the impact of the works (and associated equipment outages) on Macquarie Generation and the National Electricity Market.

This option does not have a material inter-network impact (Clause 5.6.2A b (v) of the NER).

A4.2.2 Option 2: Convert the Bayswater – Mount Piper – Marulan Line to 500kV Operation without Transfer of Bayswater Units 3 and 4 to the 500kV Switchyard

This option is essentially the same as the previous option, except that No. 3 and No.4 units at Bayswater remain connected to the 330kV Switchyard.

This option would take approximately three years to construct with an estimated earliest completion date being late 2009. As per the previous option a number of timing and staging variations of this option are being considered.

This option provides relief of the line loading issue with the Liddell – Tomago / Newcastle lines. In conjunction with the work being carried out for Option 1, in assessing the potential to remove the linkage between the construction sequence of the project and the scheduling of maintenance on the Bayswater 3 and 4 units, it may be possible to improve the power flow capability benefits. This relates to the project implementation phase where TransGrid will, to the extent possible, coordinate its activities with those of Macquarie Generation to minimise the impact of the works (and associated equipment outages) on Macquarie Generation and the National Electricity Market.

The conversion of the Bayswater- Mt Piper line to 500kV operation marginally increases the short circuit level at the 330kV switchyards in the Hunter Valley and hence further remedial action is required with this option to allow the Bayswater 3 and 4 units to remain connected to the 330kV switchyard.

A4.2.3 Option 3: Bayswater – Newcastle/Eraring Line

This option would involve construction of a double circuit 500kV line between Bayswater and Eraring, together with the establishment of a 500/330kV substation at Richmond Vale or Kurri (in the Newcastle area) to supply the Newcastle area.

Environmental approval for this line would be very difficult to obtain at this point in time because:

- Until the location of future generation is known it cannot be demonstrated that this line would be the most appropriate short to medium term development. For example, if future generation was in the south of the State, constructing a line between Bannaby and Sydney could be more appropriate.
- Options which do not involve construction of a new line are viable.

There is also considerable risk of construction being delayed due to the extensive environmental consultation required for the line.

Consequently, obtaining environmental approval for and construction of this option is not considered to be practicable in the time available. This option has therefore not been considered for input to the regulatory test.

However, it has been included as a future transmission development in the regulatory test scenarios as a means of overcoming future constraints in the NSW core network over the longer-term horizon.

A4.2.4 Option 4: Bannaby – Sydney Line

This option would involve construction of a double circuit 500kV line between Bannaby and Sydney, most probably utilising part of the route of the existing Yass – Sydney West 330kV line and construction of a 330kV switching station at Bannaby. Depending on future generation developments, the new line could operate at 330kV for a number of years.

As with the previous option, environmental approval would be very difficult to obtain because:

- Until the location of future generation is known it cannot be demonstrated that this line would be the most appropriate short to medium term development. For example, if future generation was in the north of the State, constructing a line between Bayswater and Newcastle/Eraring could be more appropriate.
- Options which do not involve construction of a new line are viable.

There is also considerable risk of construction being delayed due to the extensive environmental consultation required for the line.

Consequently, obtaining environmental approval for and construction of this option is not considered to be practicable in the time available. This option has therefore not been considered for input to the regulatory test.

However, it has been included as a future transmission development in the regulatory test scenarios as a means of overcoming future constraints in the core network over the longer-term horizon.

A4.2.5 Option 5: Southern 330kV Upgrade by 300MW

This option was developed following the SnowyHydro Limited submission to TransGrid's paper of September 2005 describing the expected transmission network limitations. Whilst it does not overcome those limitations, it is an option to improve supply capacity to the Newcastle – Sydney - Wollongong area in the medium term.

The capability for Snowy export to NSW is dependent on the rating of the Murray Switching Station to Upper Tumut Switching Station and Lower Tumut Switching Station 330kV lines. The ratings of these lines are being investigated. At this stage TransGrid is pessimistic as to the potential to undertake any substantial uprating of these two lines.

North of Snowy the power transfer capability is limited by the following factors:

- The rating of the four Snowy to Yass / Canberra 330kV lines;
- The rating of the two Yass to Marulan 330kV lines;
- The rating of the Yass to Sydney West 330kV line;
- The rating of the Marulan to Avon / Dapto and Kangaroo Valley – Dapto lines;

- Voltage control at Canberra; and
- Voltage control in meeting the load of the Newcastle – Sydney – Wollongong area.

TransGrid has investigated the works that would be required to upgrade the power transfer capability from the south by 300MW.

The works of this option involve:

- Uprating of various sections the following 330kV lines:
    - Upper Tumut – Yass ;
    - Lower Tumut – Yass;
    - Upper Tumut – Canberra;
    - Lower Tumut – Canberra;
    - Marulan – Avon;
    - Marulan – Dapto; and
    - Kangaroo Valley – Dapto.
- Establishment of a 330kV switching station at Bannaby
- Reactive power support

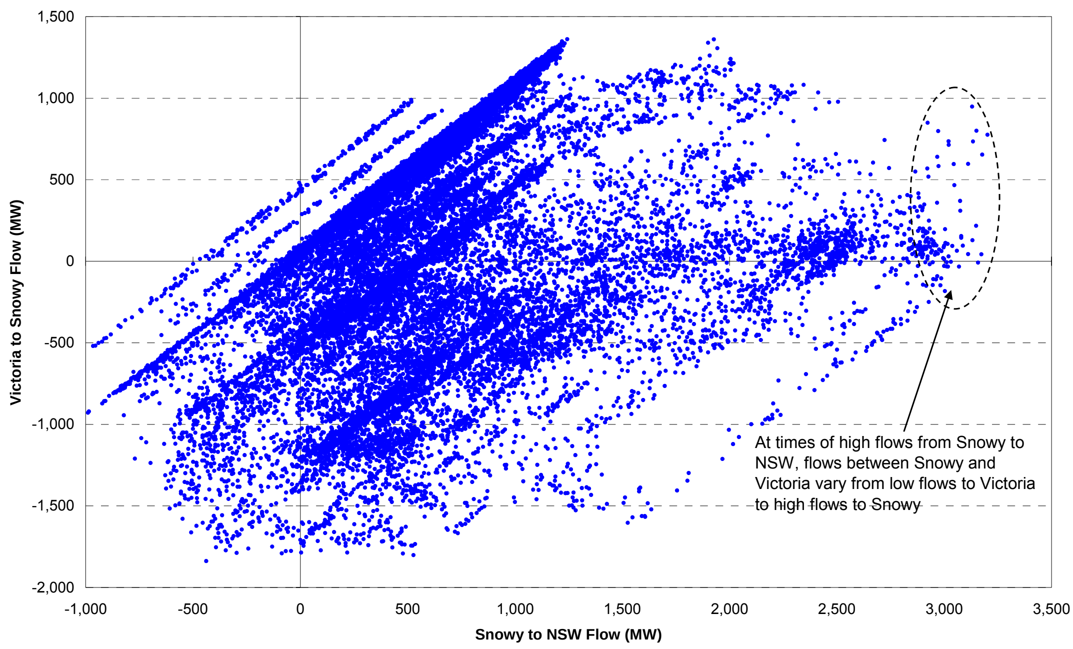
The development of a substation at Bannaby would reduce the level of line uprating required east of Marulan.

It should be noted that the line uprating work would require the lines to be taken out of service. The feasibility of these outages has not been examined.

TransGrid has assessed the line thermal rating limit north of Snowy at about 3200MW under normal system conditions. TransGrid would expect that there would be sufficient generating capability within Snowy (and possibly supported by Victoria) to reliably provide power to NSW up to this level on hot summer days, in a peaking pattern[19], from the south.

Diagram A4.1 shows the NSW import from the south against the Victorian import for summer of 2005/06. This data is typical of most summers.

Diagram A4.1 NSW Import from the South and Victorian Import



[19] The Snowy system is energy limited and hence will only be able to provide high levels of generation in peaking patterns.

On the rare occasions when there was high import by NSW, Victoria generally provided limited support. At very high levels of import the Victorian export contribution varied from about 1,000MW down to zero. At times Victoria was also importing coincidently with NSW.

The capability for power transfer to the north of Murray (i.e. the combined output of Murray plus Victorian export to Snowy) is limited by the rating of the two 330kV lines north of Murray (as discussed above). TransGrid does not have a high degree of confidence that an additional 300MW of generating capability would be available for support of the Newcastle – Sydney – Wollongong load.

This view is supported by the market simulation analysis carried out by NEMMCO for the 2005 ANTS. NEMMCO examined the total market benefits of the Snowy to NSW interconnector. The benefits from augmenting this interconnector appear to be relatively small, compared to the other interconnectors.

Increased power flows from Snowy/Victoria would increase reactive losses in the network between Snowy and Sydney. To manage the voltage control issues addressed in Section A3.2.2 of Appendix 3 it would be necessary to have completed the western 500kV conversion.

As this option on its own does not overcome the expected network limitations, it has not been considered in the regulatory test. However, in the medium term, once the presently expected transmission limitations have been relieved, it could provide additional capacity to supply the Newcastle - Sydney - Wollongong area and would be considered for inclusion in a separate application of the regulatory test at the appropriate time.

A4.2.6 Option 6: Southern 330kV Upgrade by 500MW

As with Option 5, this option was developed following the SnowyHydro Limited submission to TransGrid's paper of September 2005 describing the expected transmission network limitations. Whilst it does not overcome those limitations, it too is an option to improve supply capacity to the Newcastle – Sydney - Wollongong area in the medium term.

Similar to Option 5, TransGrid has assessed the works required to achieve an increased import capability of 500MW.

TransGrid expects this option would involve:

- Uprating of the following 330kV lines by re-conductoring the lines with high temperature alloy conductors:
    - Upper Tumut – Yass;
    - Lower Tumut – Yass;
    - Upper Tumut – Canberra;
    - Lower Tumut – Canberra;
- Uprating of various sections of the following 330kV lines:
    - Yass to Marulan (2 lines);
    - Marulan – Avon;
    - Marulan – Dapto; and
    - Kangaroo Valley – Dapto.
- Establishment of a 330kV switching station at Bannaby
- Reactive power support.

Similar reservations as with Option 5 apply.

The voltage control at Canberra may need to be of a dynamic form (SVC).

Increased power flows from Snowy/Victoria would increase reactive losses in the network between Snowy and Sydney. To manage the voltage control issues addressed in Section A3.2.2 of Appendix 3 it would be necessary to have completed the western 500kV conversion.

As this option on its own does not overcome the expected network limitations, it has not been considered in the regulatory test. However, in the medium term, once the presently expected transmission limitations have been relieved, this option could provide additional capacity to supply the Newcastle - Sydney - Wollongong area and would be considered for inclusion in a separate application of the regulatory test at the appropriate time.

A4.2.7 Option 7: Series Compensation of Existing 330kV Lines

This option involves the installation of series capacitors in the following 330kV circuits:

- Bayswater – Regentville
- Bayswater – Sydney West
- Wallerawang – Sydney South
- Wallerawang – Ingleburn

In addition reactive support is required in the Sydney area.

The level of line series compensation is limited by the rating of the 330kV lines[20] and short circuit levels (series capacitance reduces line impedance and hence they will tend to increase short circuit levels).

This construction of this option is not considered to be practicable given the number of switchyards that would need to be uprated or reconstructed and the limited improvement to line loading capability.

[20] By reducing the line impedance there is a consequent increase in power flow through the line. As many of the 330 kV lines are operated close to their thermal rating the level of series compensation must be limited.

A4.3 Non-network Options

In September 2005 TransGrid published a consultation document entitled "Emerging Major Transmission Network Limitations in Supplying the Newcastle – Sydney - Wollongong Load Area" which, inter alia, sought proposals for non-network options.

Three submissions were received in response to this needs statement. The options proposed were:

- Establishment of a 400MW combined cycle power station at Tallawarra;
- Establishment of a 400MW combined cycle power station at Bamarang (near Nowra);
- Establishment of up to 600MW open cycle gas turbine power station at Munmorah; and
- Use of the existing No. 1 and No. 2 units at Munmorah as synchronous condensers.

These options are addressed in the following sections.

A further option that arose out of the submissions involves uprating existing 330kV lines between Snowy and Sydney and establishing a 330kV switching station at Bannaby to increase transmission capacity between Snowy and Sydney. This is a network option and is discussed in Section A4.2.5 and A4.2.6 above.

A4.3.1 Combined Cycle Power Stations in the Wollongong/Nowra Area

The summer maximum demand for the State is forecast to grow by approximately 400MW each year. Thus, each of the proposed combined cycle power stations could potentially accommodate one year of demand growth.

A4.3.2 Munmorah Open Cycle Gas Turbine Power Station

The 600MW power station at Munmorah may be developed in two 300MW stages. The first stage could potentially accommodate one year of load growth in the Newcastle - Sydney - Wollongong area. Commissioning of the second stage would however increase fault levels in the Hunter Valley and Central Coast to beyond the capability of the existing switchyards.

A4.3.3 Synchronous Condensers

Use of the presently disconnected No.1 and No.2 units at Munmorah as synchronous condensers offers the potential to defer installation of switched shunt capacitors in the Central Coast and Sydney area. However, they would increase short circuit levels in the Hunter Valley and Central Coast, which would require remedial action.

The installation of synchronous condensers does not address the Hunter Valley to Newcastle line rating limitation in supply to the load area.

A4.3.4 Ongoing Development of Non-Network Options

TransGrid has engaged (Commercial-in-Confidence) to assist it in the development of non-network options. This has entailed, inter alia, the issue, in August 2006, of a request for proposals (RFP) for non-network projects.

A number of submissions in response to the RFP have been received evaluated. The review of these submissions indicates that:

- The magnitude of non-network projects offered could be sufficient to manage the network limitations over summer 2008/09 and summer 2009/10; and
- The cost of implementing a portfolio of non-network projects could be up to $15 - $20 million for summer 2008/09 and at least $70 million for summer 2009/10.

No single proposal could provide sufficient network support to allow deferment of network augmentation. However, combinations of the proposals were considered potentially suitable to defer network augmentation and were considered as an input to the regulatory test.

This information has been used by NERA when applying the regulatory test.

This network support is the subject of this Pass-Through Notice.

A5 Appendix 5 - Application of the Regulatory Test

NOTE:
1. The information contained in this Appendix is based on Section 5 of TransGrid's "Final Report, Proposed New Large Transmission Network Asset, Development of Supply to the Newcastle - Sydney - Wollongong Area, October 2006". This document can be found in Appendix 10 or on TransGrid's web site http://www.transgrid.com.au/trim/trim224993.pdf

2. A copy of NERA's Report can be found in Appendix 11 or on TransGrid's web site http://www.transgrid.com.au/trim/trim224991.pdf

3. The options considered by TransGrid in Appendix 4 (TransGrid Options) differ from the Options considered by NERA (NERA Options) in this Appendix 5. NERA Options are made up of combinations of TransGrid Options. To distinguish between the two in this document, TransGrid Options have been labelled numerically while NERA Options have been labelled alphabetically.

A5.1 Introduction

The AER's regulatory test states:

"An option satisfies the *regulatory test* if:

(a) in the event the option is necessitated solely by the inability to meet the minimum network performance requirements set out in schedule 5.1 of the Code or in relevant legislation, regulations or any statutory instrument of a participating jurisdiction - the option minimises the present value of *costs*, compared with a number of *alternative options* in a majority of *reasonable scenarios*;

(b) in all other cases - the option maximises the expected net present value of the *market benefit* (or in other words the present value of the *market benefit* less the present value of *costs*) compared with a number of *alternative options* and timings, in a majority of *reasonable scenarios*."

The proposed works are required to meet minimum network performance requirements to comply with the requirements of the NER and the New South Wales jurisdiction (Appendix 2). Failure to implement measures to overcome the system constraints in the required timeframe would result in the minimum network performance standards (Appendix 2) not being met. Consequently, "do nothing" would result in TransGrid not meeting its planning criteria and therefore is not an option. Only part (a) of the regulatory test was applicable. The cost or frequency of not meeting the planning criteria is not relevant to the application of part (a) of the regulatory test.

TransGrid engaged the services of a specialist economics consultant, NERA Economic Consulting (NERA) to apply the regulatory test to reasonable network and non-network options over a range of market development scenarios.

A5.2 Scenarios

The regulatory test requires that an option that satisfies the regulatory test must do so in a majority of reasonable scenarios. The scenarios developed by TransGrid and considered by NERA encompass:

- A range of demand forecast outcomes; and
- A range of different views regarding the development of new generation and/or demand management projects in relevant areas of NSW.

A5.3 Options

The options considered by NERA must address the network limitations described in Appendix 3 over a planning horizon from 2006 to 2016. No single "option" described in Appendix 4 would be sufficient; however combinations of these options may be sufficient, if constructed at appropriate times within the planning horizon.

To distinguish them from the combination options considered in the application of the regulatory test the "options" detailed in Appendix 4 are described in the remainder of this Appendix 5 as "projects" (i.e. components of combination options that may be considered by the regulatory test).

To cover periods where network projects may not be constructed in timely manner, network support via non-network projects are included within NERA's combination options. These non-network projects are not specified in detail for commercial confidentiality reasons (refer to Section A4.3 of Appendix 4). Instead, they are characterised by the amount of additional network capacity (to reliably supply the Sydney-Newcastle-Wollongong area) that they may provide and the payments that may be made to project proponents to achieve that capacity.

The options considered by NERA thus consist of:

- One or more of the network projects described in Appendix 4 constructed at appropriate times; and
- Network support capacity provided at appropriate times;

To ensure that the resultant combined options meet the network limitations described in Appendix 3 in all of the "realistic" (other than "least likely") scenarios described above.

A complete discussion of the development of these options is contained in Section 5 of NERA's report and is summarised below.

NERA initially considered a "long list" of potential options, as per the following table. Other options, discussed in Appendix 4, which could not meet the reliability criteria across a range of reasonable scenarios, were not considered further. Not investigating these options further is consistent with good electricity industry practice.

Table A5.1 Potential Options

Option No	Year	Project
Option A	08/09:	no action
	09/10:	500kV conversion (i.e. the "option" described in Section A4.2.1 of Appendix 4)
	10/11:	no action
Option B	08/09:	Network support
	09/10:	500kV conversion
	10/11:	no action
Option C	08/09:	Network support
	09/10:	Additional network support
	10/11:	500kV conversion
Option D	08/09:	Network support
	09/10:	500kV Conversion excluding Bayswater Units 3 & 4 (i.e. the "option" described in Section A4.2.2 of Appendix 4)
	10/11:	no action

<u>Notes to Table A5.1</u>

1. The capacity of the network support projects is not specified in the above table but is determined from the requirement to address scenarios - see below.
2. The above options include other network projects that would be necessary to address emerging network limitations in the period to from 2010/11 to 2016. These consist of either the project described in Section A4.2.3 of Appendix 4 or the project described in Section A4.2.4 of Appendix 4. Whichever of these projects would be required depends on future scenarios of major generation developments in NSW. However, for a given generation development scenario the same project would be required for all options. As this project would be a common cost component of all options within that scenario, it would not affect the ranking of options. Thus for clarity these future generation development scenarios have not been defined and the later network projects have not been explicitly included in Options B and C.

NERA concluded that Options A, and D would not be included in the regulatory test calculations, as they did not meet the network limitations described in Appendix 3 for all the realistic (other than least likely) scenarios.

NERA then determined the capacity of the non-network projects in the remaining Options B and C to ensure that these options avoided the onset of network constraints in all “realistic” scenarios, determining the following two options to be assessed in accordance with the principles of the regulatory test.

Table A5.2 Options Assessed in the Regulatory Test Analysis

Option No	Year	Project
Option B	08/09:	350MW of network support
	09/10:	500kV conversion (i.e. the “option” described in Section A4.2.1 of Appendix 4)
Option C	08/09:	350MW of network support
	09/10:	Additional 350MW of network support
	10/11:	500kV conversion (as in Option B but delayed by 1 year)

A5.4 Costs Taken into Account by the Regulatory Test

As this is a reliability augmentation the “least cost” limb (part (a) of the regulatory test is applied.

This requires the following costs to be taken into account:

A5.4.1 Capital Costs

Capital costs for network projects were estimated by TransGrid. TransGrid uses a rigorous process for the estimation of project capital costs based on ongoing analysis of equipment costs, market factors and project risks.

The following table summarises the estimated capital cost estimates for the network projects included in Options B and C above.

Table A5.3 Network Projects Capital Cost Estimates

Project	Estimated Cost
500 kV conversion	$320 million
Bayswater generator transformers	$30 million

Capital costs for these network projects are estimated in $2006 to ±25% accuracy.

Bayswater Generator Transformers

Since the time that this estimate of capital cost was prepared more accurate figures for the costs of the replacing the Bayswater generator transformers have become available. The new figure is approximately $50 million. As this figure is common to both Options considered by NERA, it will not have a material impact on the outcome of the regulatory test.

The Bayswater costs used in the regulatory test were those for reconnection of both #3 and #4 units to 500 kV. The only option considered was replacement of the generator transformers. Other higher cost arrangements (such as retaining the existing generator transformers and installing 330/500 kV transformers in series) were not considered because, being much more expensive, they could not pass a regulatory test in which simple replacement was another option.

Non-network Option Costs Used in the Regulatory Test

Costs for non-network projects are based on responses to TransGrid’s August 2006 Request for Proposals (RFP) (refer to Section A4.3.4 of Appendix 4).

They are estimates of payments that may be made to non-network project proponents for the provision of relevant network support services.

The Newcastle - Sydney - Wollongong Area Application Notice was published in May 2006. At that time submissions in response to the RFP for non-network options had not been received. Consequently, NERA used an indicative cost and noted that the Final Report would use information based on responses to the RFP.

The RFP covered the summers of 2008/09, 2009/10 and 2010/11, with progressively larger amounts of Network Support being required in the later summers. It requested non-network options in the Newcastle - Sydney - Wollongong area, as well as the mid north coast and parts of the south coast. As non-network options in different parts of the network would vary in their effectiveness in managing the network limitations, the RFP contained geographical "effectiveness factors".

Responses to the RFP were received from seven parties, some of whom made multiple offers. Not all offers were complete: for example some gave only indicative prices.

The initial evaluation of offers involved adjusting the amounts of Network Support offered and the prices offered by the geographical effectiveness factors. Portfolios which would deliver the required amount of network support in 2008/09 and 2008/09 plus 2009/10 were then developed. Insufficient network support was offered to enable portfolios for the summers up to and including 2010/11 to be developed.

The portfolios were based on utilising the most cost effective offers first. Consequently the portfolios covering summer 2008/09 plus 2009/10, contained offers which were significantly less cost effective than those in the portfolios covering only summer 2008/09. Diagram A5.1 shows the range of costs offered (in $ per effective MW) for network support in 2008/09 and 2009/10. [It should be noted that some of these offers have since been withdrawn].

Diagram A5.1 Costs offered in response to RFP for Network Support

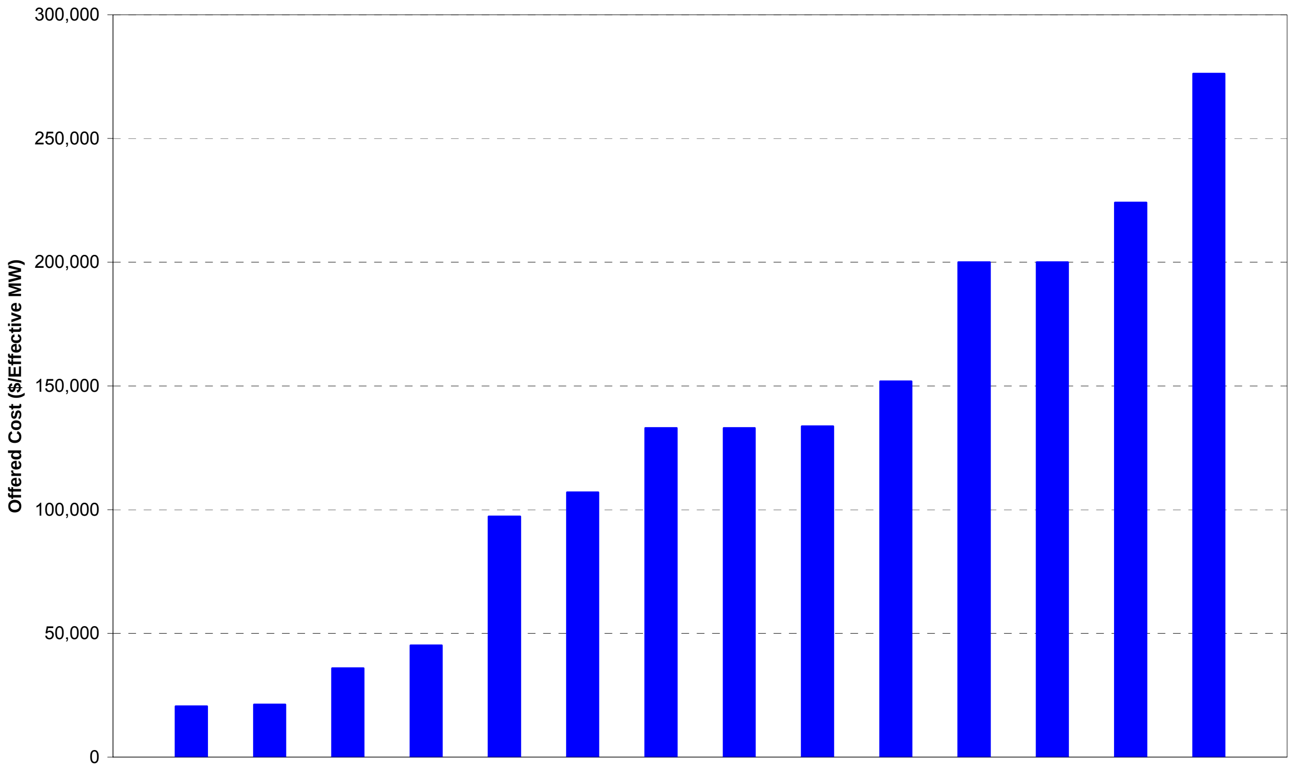


Table A5.4 and Table A5.5 show the total costs for the portfolios developed (for the initial evaluation). [It should be noted that each of these portfolios contains offers which have subsequently been withdrawn].

Table A5.4 Portfolios for Summer 2008/09

	Total Effective MW	Total Cost ($M)
Portfolio 1	440	23
Portfolio 2	375	14
Portfolio 3	375	17

Table A5.5 Portfolios for Summer 2008/09 and 2009/10

	Total Effective MW	Total Cost ($M)
Portfolio A	776	121
Portfolio B	708	78
Portfolio C	708	70

The conclusion of the initial evaluation was that:

- network support for summer 2008/09 would cost $15 million to $20 million;
- network support for summer 2008/09 and summer 2009/10 would cost at least $70 million; and
- network support covering summer 2008/09, summer 2009/10 and summer 2010/11 was not feasible.

This information was used by NERA in their application of the regulatory test for the Final Report. NERA assumed that these payments implicitly include allowances for environmental costs and subsidies.

Table A5.6 summarises the estimated cost estimates for non-network projects that NERA included in Options B and C.

Table A5.6 Non-Network Projects Capital Cost Estimates

	2008/09	2009/10
Option B	$18 million	-
Option C	$18 million	$70 million

These costs for non-network options are estimated in $2006 to ±50% accuracy.

After the Final Report was published, additional information was sought from proponents and meeting were held with most of them. During that process, a number of proponents withdrew their offers. Consequently, the conclusions reached in the preliminary assessment are conservative.

A5.4.2 Operating and maintenance costs

These are assumed to be 2% of capital costs ±25%. This is a generic figure for annual O&M costs of transmission networks. It is consistent with the Opex cost included in TransGrid's current revenue cap. It is also used widely within Australia and internationally.

A5.4.3 Other Costs Relevant to the Case Concerned

NERA has not identified any other costs that are relevant for this proposal.

A5.5 Results

5.5.1. Base Case

Table 5.7 summarises the results of NERA's financial modelling for Options B and C under the base case of financial assumptions.

Table A5.7 Summary of Results – Base Case

Option No	Year	Project	Costs PV $M	Rank
Option B	08/09: 09/10:	350MW network support 500kV conversion	$ 332	1
Option C	08/09: 09/10: 10/11:	350MW network support Additional 350MW network support 500kV conversion	$ 361	2

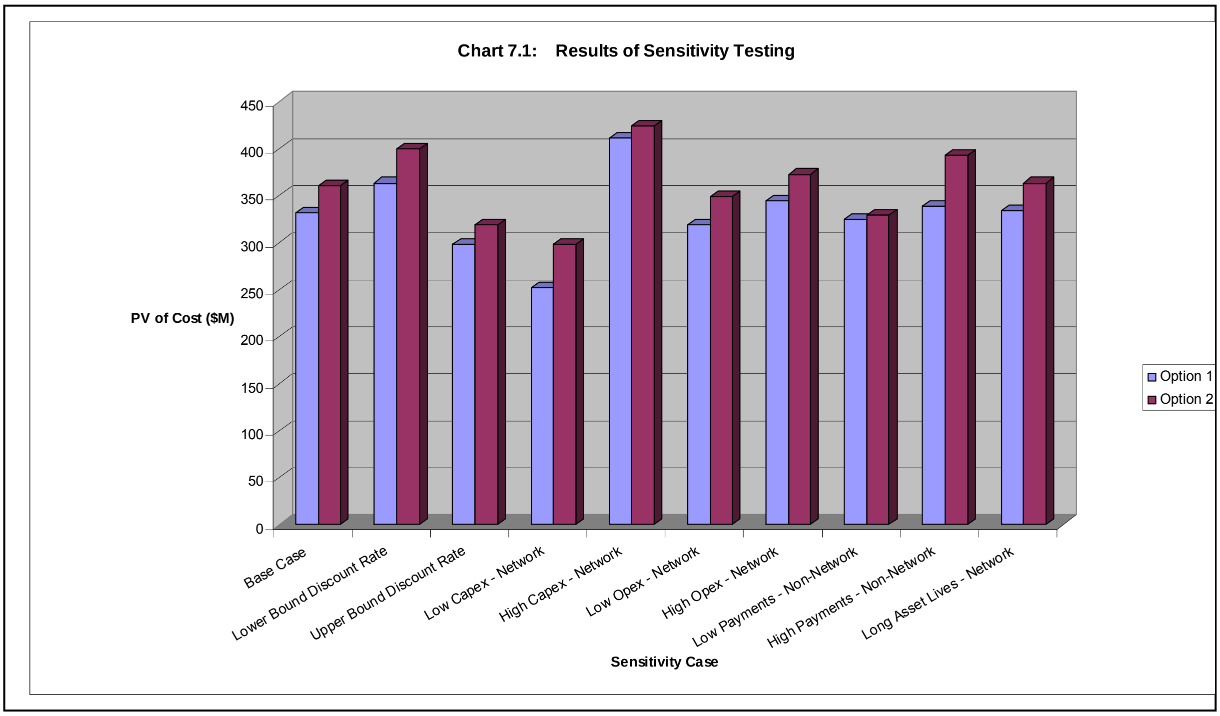
5.5.2. Sensitivity Tests

The regulatory test requires sensitivity tests to be conducted on key input assumptions. Table 5.8 details the range of key input variables used in these sensitivity tests.

Table A5.8 Range of Parameters for Sensitivity Tests

	Lower Bound	Base Case Value	Upper Bound
Discount Rate (%)	6.78	9	12
Network Project Capital Expenditure (Relative to Base Case)	-25%	-	+25%
Payments for Non-network Projects (Relative to Base Case)	-50%	-	+50%
Operating Expenditure (% of Capex)	1.5	2.0	2.5
Asset Lives Substations Lines		 30 45	 45 60

The following chart from NERA's report illustrates the present value of costs and ranking for Options B and C under the full range of "one at a time" sensitivity tests. This shows that in each case Option B is the highest ranked option i.e. the ranking of the options is robust to all reasonable "one at a time" variations in assumptions.



A5.6 Outcome of the Regulatory Test – NERA's Assessment

NERA's assessment of the outcome of the regulatory test is that Option B minimises the present value of costs compared with Option C, consequently Option B satisfies the regulatory test (refer to NERA's report page 1).

A6 Appendix 6 - Description of Least Cost Option

As shown in Appendix 5 the least cost option is a combination of network support and network augmentation. The components of this option are

A6.1 Western 500kV Conversion

- 350MW of network support in the Sydney-Newcastle-Wollongong area (summer 2008/09)

- At Bayswater (summer 2009/10 and summer 2010/11):
  - Establishment of a 500kV switchyard at Bayswater adjacent to the existing 330kV switchyard;
  - Connection of the two switchyards by two 500/330kV transformers;
  - Connection of two 150 MVAr shunt reactors to the transformer tertiaries;
  - Reconnection of the existing Mt Piper/Wallerawang line at Bayswater to the 500kV switchyard (the remote ends are to be reconnected to Mt Piper and Wollar); and
  - Reconnection of generator unit 4 at Bayswater from the 330kV switchyard to the 500kV switchyard. (April 2009 - to meet agreed generator outage date)
  - Reconnection of generator unit 3 at Bayswater from the 330kV switchyard to the 500kV switchyard. (April 2010 - to meet agreed generator outage date)
    NOTE: Reconnection of Bayswater Unit 3 and 4 generator transformers was the subject of a previous Pass-Through Notice.

- At Mount Piper (summer 2009/10):
  - Establishment of a 500kV switchyard at Mt Piper adjacent to the existing 330kV switchyard;
  - Connection of the two switchyards by two 500/330kV transformers;
  - Connection of two 150 MVAr shunt reactors to the transformer tertiaries;
  - Reconnection of the existing Bayswater circuit from the 330kV switchyard to the 500kV switchyard;
  - Connection of a Wollar circuit to the 500kV switchyard;
  - Reconnection of the existing Marulan line from the 330kV switchyard to the 500kV switchyard;
  - Connection of the existing 330kV circuit, which presently connects one of the 500kV circuits to Bayswater, to Mount Piper to form a second Mount Piper – Wallerawang 330kV circuit; and
  - Relocation of the existing Wellington line within the 330kV Switchyard.

- At Bannaby (summer 2009/10):
  - Establish a new 500/330kV substation including 500kV and 330kV switchyards, two 500/330kV transformers and two 150 MVAr shunt reactors connected to the transformer tertiaries;
  - Connect two 500kV circuits to Mount Piper; and
  - Connect 330kV circuits to Yass, Sydney West and two to Marulan.

- At Wollar (summer 2009/10):
  - Convert 500kV switchgear operating at 330kV to 500kV operation;
  - Install a 500/330kV transformer and 330kV switchbay; and
  - Reconnect the Wellington 330kV circuit to the new 330kV switchbay.

Additional works that form part of this option are as follows:

- At Wallerawang 330kV Switchyard (summer 2009/10):
  - Uprate equipment to ensure adequate fault level ratings.

- Carry out uprating works on the following 330kV circuits (summer 2009/10):
  - Marulan – Avon;
  - Marulan – Dapto; and
  - Kangaroo Valley – Dapto.

- Modify 330kV line protections in the Bayswater – Liddell area (summer 2009/10).

A6.2 Impact on System Capability

Conversion of the Bayswater - Mt Piper - Marulan line to 500kV operation will increase the power carrying capacity of this line. Increasing the voltage of this line also reduces the relative impedance of this line compared to the others in the system and thus more power will flow via this line than prior to the change in voltage. Connection of two Bayswater generating units to 500kV rather than 330kV at Bayswater will also force more power to flow over the 500kV line and less over the remaining 330kV lines.

On completion of the Western 500kV Conversion, more power will flower from the Hunter Valley area and north (Queensland interchange) to the major load areas in the Newcastle - Sydney - Wollongong area via the 500kV system and less over the remaining 330kV lines. This will alleviate the thermal constraints on lines between the Hunter Valley and Newcastle as well as the voltage constraints in the Sydney area.

A7 Appendix 7 – TransGrid's Costs

TransGrid's Operating Costs

Costs for Legal and Consultants incorporate actual invoiced costs and estimated costs up to 19th February 2008. An estimate of legal costs incurred in the preparing and reviewing Network Support Agreements is attached at the end of this Appendix 7. The lower end of this estimate, (Commercial-in-Confidence) has been used for these calculations. These costs are in addition to legal costs of (Commercial-in-Confidence) associated with the RFP process.

TransGrid's labour costs are actual recorded cost up to 27th January 2008. It should be noted that TransGrid will incur future Legal, Consultant and internal labour costs associated with this Network Support that has not been included

Legal and Consultant expenses			
(Commercial-in-Confidence)			$ (Commercial-in-Confidence)
(Commercial-in-Confidence)			$ (Commercial-in-Confidence)
TransGrid's labour costs	Hrs	Rate ($/hr)	Amount
Expert Engineer/Accountant etc	603.33	205	$ 123,683
Specialist Engineer/Accountant etc	105.33	170	$ 17,906
		Total	**$ 473,438**

(Commercial-in-Confidence)

TransGrid's Financing Charges

Monthly payments to Network Support providers are detailed in Appendix 9.

Recovery via TUOS

TransGrid will recover the Network Support payments via TUOS in equal monthly instalments for the 2008/09 financial year. TransGrid issues invoices for TUOS for a given month at the start of the following months. Payments are then not received until the start of the next month. i.e. the first payment for the 2008/09 financial year will be received at the start of September 2008 and the last payment will be received at the start of August 2009.

Calculation of TransGrid's Financing Costs - Methodology

(i) TransGrid will make total network support payments = $11,217,500 to the Network Support Providers during the period Mar 08-Aug 09. This amount does not include interest.

(ii) TransGrid will also receive TUOS payments over the period Mar08-Aug 09.

(iii) TransGrid then calculated its net balance for each month for the period Mar 08-Aug 09. This amount does not include interest.

(iv) TransGrid calculated the net balance for each month for the period Mar 08-Aug 09 that takes into account interest. TransGrid uses a monthly interest rate of 0.53% (=6.39%/12). TransGrid assumes interest is calculated using August 09 as a reference point, such that a payment of $100,000 in March 08 is compounded monthly at a rate of 0.53%. There are 17 periods between Mar 08-Aug 09 so if TransGrid incurs a $100,000 cost in March 2008, TransGrid would need to receive $109,448.60 in August 2009 to ensure that the time cost of money effect is neutral.

(v) TransGrid calculated the net balance (including interest) for the remaining months during Mar 08-Aug 09. TransGrid then calculated the sum of the monthly net balances (including interest) for Mar 08-Aug 09.

(vi) TransGrid assumes that each monthly TUOS recovery amount must be equal. Given this, TransGrid used the Goal Seek function in Excel and determined the monthly TUOS recovery amount required to ensure that the sum of the monthly net balances (including interest) for Mar 08- Aug 09 was zero.

(vii) TransGrid's financing costs are the difference between the total amounts received and the total amounts paid out. If amounts received exceed amounts paid, the interest TransGrid has paid exceeds the interest received and vice versa.

The cash flows and interested accrued or paid is shown in Table A7.1.

Assumptions: - Interest Rate = 6.39% (2007 annual average daily cash rate)

Table A7.1

Month	**Received**	**Paid**	**Nett**	**Nett amount +/- Interest**
Mar-08		$100,000.00	-$100,000.00	-$109,448.60
Apr-08		$20,000.00	-$20,000.00	-$21,773.77
May-08		$20,000.00	-$20,000.00	-$21,658.44
Jun-08		$20,000.00	-$20,000.00	-$21,543.72
Jul-08		$20,000.00	-$20,000.00	-$21,429.61
Aug-08		$20,000.00	-$20,000.00	-$21,316.10
Sep-08	$1,785,893.83	$20,000.00	$1,765,893.83	$1,872,129.54
Oct-08	$1,785,893.83	$520,000.00	$1,265,893.83	$1,334,941.11
Nov-08	$1,785,893.83	$20,000.00	$1,765,893.83	$1,852,349.50
Dec-08	$1,785,893.83		$1,785,893.83	$1,863,406.03
Jan-09	$1,785,893.83	$5,162,375.00	-$3,376,481.17	-$3,504,368.03
Feb-09	$1,785,893.83	$5,162,375.00	-$3,376,481.17	-$3,485,806.12
Mar-09	$ 1,785,893.83	$5,162,375.00	-$3,376,481.17	-$3,467,342.52
Apr-09	$ 1,785,893.83	$5,162,375.00	-$3,376,481.17	-$3,448,976.72
May-09	$ 1,785,893.83		$1,785,893.83	$1,814,575.67
Jun-09	$ 1,785,893.83		$1,785,893.83	$1,804,964.24
Jul-09	$ 1,785,893.83		$1,785,893.83	$1,795,403.71
Aug-09	$ 1,785,893.83		$1,785,893.83	$1,785,893.83
Totals	**$21,430,725.94**	**$21,409,500.00**		**$ -**

Thus the amount of interest TransGrid pays exceeds the amount received by $21,225.94. This is TransGrid’s financing costs.

Summary of Payments, Financing Charges and Operating Costs

Table A7.2

Date	Payments to Network Support Providers	Financing Charges	TransGrid Operating Expenses	Total
Up to Feb 2008			$473,437.57	**$473,437.57**
Mar-08	$100,000.00	$9,448.60		**$109,448.60**
Apr-08	$20,000.00	$1,773.77		**$21,773.77**
May-08	$20,000.00	$1,658.44		**$21,658.44**
Jun-08	$20,000.00	$1,543.72		**$21,543.72**
Jul-08	$20,000.00	$1,429.61		**$21,429.61**
Aug-08	$20,000.00	$1,316.10		**$21,316.10**
Sep-08	$20,000.00	-$106,235.71		**-$86,235.71**
Oct-08	$520,000.00	-$69,047.28		**$450,952.72**
Nov-08	$20,000.00	-$86,455.67		**-$66,455.67**
Dec-08		-$77,512.20		**-$77,512.20**
Jan-09	$5,162,375.00	$127,886.86		**$5,290,261.86**
Feb-09	$5,162,375.00	$109,324.94		**$5,271,699.94**
Mar-09	$5,162,375.00	$90,861.35		**$5,253,236.35**
Apr-09	$5,162,375.00	$72,495.54		**$5,234,870.54**
May-09		-$28,681.84		**-$28,681.84**
Jun-09		-$19,070.41		**-$19,070.41**
Jul-09		-$9,509.88		**-$9,509.88**
Aug-09		$ -		**$ -**
Totals	**$21,409,500.00**	**$21,225.94**	**$473,437.57**	**$21,904,163.51**

Therefore the Pass-Through amount is $21,904,164

Correspondence on Estimated Legal Costs

(Commercial-in-Confidence)

A8 Appendix 8 – ACCC Letter to TransGrid - 14 May 2003

(Commercial-in-Confidence)

A9 Appendix 9 – Payments to Network Support Providers

(Commercial-in-Confidence)