TransGrid's Submission to the
Australian Competition & Consumer Commission

Revised Transmission Capital Investment Program 2004-2009

Attachment 6C

Backgrounds Affecting Main System and Interconnection Developments

November 2004

ATTACHMENT 6C

TransGrid

BACKGROUNDS AFFECTING MAIN SYSTEM AND INTERCONNECTION DEVELOPMENTS

DISCUSSION PAPER

Version 1.0

Transmission Development
File 2003/3466

Date: 12th November 2004

Issue	1.0 – First issue
Pages	37
Author	C. Parker

BACKGROUNDS AFFECTING MAIN SYSTEM AND INTERCONNECTION DEVELOPMENTS

1. INTRODUCTION

The future supply / demand balance in NSW and adjoining states is one driver that will determine the future development of generation in the NEM. Load growth and the range of possible generation developments across the NEM will require network augmentations which will include reinforcement of the NSW main system. Reinforcement of the existing interconnectors and the development of new interconnectors may also be required.

The future for generation development in NSW is unknown and hence it is necessary to assess the need for network developments against a set of scenarios or "Backgrounds" that represent the more probable likely future developments.

The TransGrid discussion paper of 5th August 2004[1] sets out the process for developing backgrounds.

A preliminary discussion paper was provided by TransGrid to the ACCC on 30th August[2] setting out some preliminary backgrounds to illustrate the process of conversion of the projected NSW supply shortfalls to a set of assumed generation and interconnection developments. This paper was based on the abbreviated process set out in the paper of 5th August 2004.

This present document builds upon the preliminary paper with further information on the selection of Backgrounds and following discussion with the ACCC. Part of the input to this paper was also derived from the ROAM work on the assessment of generation developments for the future[3].

2. NSW SUPPLY / DEMAND SITUATION

The future NSW supply requirements have been calculated using the supply / demand calculator provided by NEMMCO in the SOO 2004. The supply requirements are the minimum new supply injections to meet NEMMCO's reserve plant level standard as set out in the SOO 2004. The assumptions underlying this assessment are:

- The load forecast for NSW is as set out in the APR 2004 and for the other States as set out in the SOO 2004;
- The generation capacities in each state are as set out in the SOO 2004;
- The interconnection capabilities are as described in the Annual Interconnector Review (SOO 2004);
- All generation in NSW is regarded as available for service for the future;

[1] "Development and Application of a Set of Backgrounds Forming the Basis for the Future High Voltage Network Augmentation Program", discussion paper dated 5th August 2004, File 2003/3466.
[2] "Preliminary Backgrounds Affecting Main System and Interconnection Developments", discussion paper dated 30th August 2004, file 2003/3466.
[3] ROAM Consulting, "Probabilistic Assessment of Generation Developments for NSW"

- All generating plant in other states is regarded as available for service, apart from known isolated retirements;
- It is assumed that the Kogan Ck generator is fully commissioned by summer 2007/8 – effectively supporting both Queensland and NSW; and
- The regional reserve requirements are at the present levels determined by NEMMCO. These reserve levels

Table 1 shows the approximate annual NSW supply side augmentations required to meet the NSW load growth, whilst satisfying NEMMCO's reserve plant margin standard:

Table 1 - Supply Reserve Shortfall in NSW

Year	Low Growth	Medium Growth	High Growth
2004/5	0	0	0
2005/6	0	0	0
2006/7	0	0	221
2007/8	0	0	433
2008/9	0	157	474
2009/10	148	641	1558
2010/11	569	1193	2085
2011/12	1002	1721	2614
2012/13	1430	2269	3140
2013/14	1810	2783	3684

The growth of the supply deficit in NSW exceeds the growth of NSW load. The load growth across the NEM results in an overall depletion of the present margin between supply and demand and this is reflected in a reduced capability to support adjoining states at time of supply shortfall. Hence the need for additional support to NSW tends to accelerate over the years. The Kogan Ck generator will increase the capability for export of Queensland energy to NSW.

Under the medium load growth forecast there is a need for additional power sources from 2008/9. The need is advanced by two years under high growth conditions and delayed by one year under low growth conditions.

Other states also face shortfalls in supply. Victoria and SA fall short from summer 2004/5 but the supply shortfall would be relieved with the expected commissioning of Basslink in late 2005. Kogan Ck is a committed development and hence Queensland has adequate generation reserves until 2009/10 and may share its surplus with the southern states. Should Kogan Ck not be commissioned Queensland faces reserve shortfalls from about 2007/8.

The NSW supply needs could in theory be met with the various types of generation sources in NSW or by interstate power station development. The new power sources are "reliability" entry plant.

The work of the AIR in the SOO 2004 identified sufficient levels of pool price to justify "market" entry plant. The above approach that satisfies only the reserve plant level requirements does not allow for the development of "market" entry plant and is thus a theoretically conservative estimate of the possible extent of new entry plant.

The NSW supply shortfall could be rectified with combinations of:

- Upgrading of the two Mt Piper and four Eraring 660 MW units to 700 MW. The Bayswater units have been assumed completed.
- New gas-fired generation in NSW.
- New coal-fired generation in NSW.
- Small-scale interconnection developments to improve the NSW import capability. These projects would not require new line developments therefore reducing the necessary lead-time. It is assumed that generation development occurs in adjoining states such that there is surplus generation to supply the NSW load requirements.
- Large-scale interconnection development allowing bulk power transfer from new interstate power stations.
- Relatively small scale renewable and embedded generation development.

The lead-time for new lines will need to be taken into account in defining the possible timing of development of some major new power stations in NSW. Transmission line works have lead-times governed by the need for community consultation, environmental assessment, letting of contracts for works and construction phases. Hence not all of the potential generation developments will be able to be supported with matching transmission reinforcements. It is possible that the timing of the development of a major power station could be governed by the lead-time for the transmission works.

Due to transmission line development lead-times it is not expected to be possible to connect any large-scale generation development in NSW, that is remote from the existing main system, in 2008/9 and possibly 2009/10.

It is also possible that any deep network augmentations that may be required may not be able to be completed by 2008/9 and possibly by 2009/10.

In general it is also not expected to be possible to achieve large-scale interconnection development requiring major new lines within the 2004/5 to 2008/9 period.

Within the 2004/5 to 2008/9 period it is possible to commence the preparatory work that would be required to commission major line developments in the following years.

Some observations about the generation development requirements for each level of forecast and the implications for interconnector development follow.

2.1 Low Growth Forecast

The low growth forecast suggests adequate supply capability from the existing generators and interconnectors until 2009/10. Hence it is not expected that new generation would be required in NSW in the 5 year Reset period. There are some underlying assumptions that need to be considered:

- The interconnection capability for NSW import is assumed to be maintained at approximately present levels. In reality the capability for NSW import from Queensland declines with northern coastal load growth. Similarly the impact of load growth on the interconnection capability for the other interconnectors must be recognised

- Existing generators are assumed to have indefinite lives (Munmorah is about 40 years old) and will not be retired.

- The NSW main system is unconstrained.

The implication of the 2009/10 timing for the supply augmentation is that any transmission development associated with the generation development is likely to be required in service in about 2009/10 and hence only early stages of the work will fall within the 5 year Reset period. This simplifies the range of backgrounds for low load growth.

2.2 Medium Growth Forecast

The medium growth forecast suggests adequate supply reserves from the existing generators and interconnectors until 2008/9. There is then a progressive shortfall increasing by about 500 MW, or about the size of a major generating unit, each year. The assumptions in Section 2.1 continue to apply.

The impact of supply augmentation or generator development in 2008/9 will be felt on the transmission system in this year and possibly earlier years depending on the extent of necessary works. Later generation developments may also require the staging of transmission works that may fall within the 5 year period. The range of possible backgrounds is nevertheless limited.

The Annual Interconnector Review (AIR) set out in the SOO 2004 identified a set of possible NSW generation developments. The AIR was based on medium load forecasts but assumed load levels from the SOO 2003 and hence the developments can only be regarded as indicative of what would occur using the present load forecast. The AIR work showed that generation may be developed in response to market prices (market entry plant) or as required for supply reserves (reliability plant).

Table 2 shows the possible developments. This table has not been used in developing Backgrounds for the Revenue Reset process, it is included here only to demonstrate the potential for significant market entry plant.

Table 2 - SOO 2004 table 11.2 - page 11-6

Year	Coal-fired – Market entry plant	Gas-fired – Market entry plant	Reliability plant required
2004/5	-	-	-
2005/6	-	-	-
2006/7	-	-	-
2007/8	-	-	115
2008/9	-	-	512
2009/10	-	100	541
2010/11	500	100	325
2011/12	-	100	1028
2012/13	-	100	1369
2013/14	500	100	1105

These plantings will change with changes to the load forecast. It should be noted that coal generation was considered likely to arise as market entry plant by 2010/11.

An alternative to NSW generation development is the planting of the generator in another state and reinforcement of the interconnectors to share the capacity of the new power stations. Hence in 2010/11 the 500 MW generator could be located in Queensland or Victoria and shared with NSW.

2.3 High Growth Forecast

The supply shortfalls arise from 2006/7 and grow to very significant levels over the decade.

Significant generation development would be required in the NEM and interconnector reinforcements would be required to share the generation among the states.

2.4 ROAM Consulting Work

ROAM selected five scenarios as the most probable cases representing the range of potential development scenarios within the NEM over the next decade:

- Low black coal fuel pricing
- Medium black coal fuel pricing
- High black coal fuel pricing
- Application of carbon taxes
- Application of carbon taxes and high gas pricing

ROAM also assigned probabilities to these scenarios.

The scenario probabilities and expected plant developments in the NEM are shown in Table 3:

Table 3 - Probability of Development of Generator Types

Scenario	**Probability**	**Generation Entry by 2009/10**
Low black coal fuel price	20%	1400 MW Black
Medium black coal fuel price	25%	1200 MW OCGT
High black coal fuel price	10%	1200 MW OCGT
Application of carbon tax	25%	1200 MW OCGT
Application of carbon tax and high gas price	20%	1200 MW OCGT

Additional generator entry occurs for the years following 2009/10.

ROAM indicate that the black coal developments could be in Queensland and transported to NSW.

Under the third scenario, with a low probability, there is brown coal development in Victoria from 2010/11.

3. ABBREVIATED PROCESS OF BACKGROUND DEVELOPMENT

The above supply / demand balance needs to be translated to various Backgrounds of generation and interconnection development. The abbreviated process set out in the 5th August paper requires some judgement as to whether generation development would occur in NSW or would occur in another state with associated interconnection development. The judgement can be based on the possible interconnector options and the lead-time for these developments. Major interconnector development would also require intra-regional reinforcements which also have minimum lead-times.

The following sections set out the range of possible interconnector developments, potential generator upgrades in NSW and identify generic generation developments. The medium, low and high load growth forecasts are then assessed and a range of Backgrounds developed. It has been aimed to minimise the number and complexity of the Backgrounds.

3.1 Overall Process

The overall process is:

1. Determine the NSW supply shortfall (Table 1)

2. Assume the interconnection with Victoria / Snowy is maintained at its present capability with respect to NSW import, with minor works.

3. Assume that QNI is maintained at its present capability with respect to NSW import and export, with minor works that do not involve new line developments.

4. Rectify the supply shortfall by:

a. Interconnection upgrades – taking into account lead-times

b. Upgrading of 660 MW units to 700 MW (the 660 MW upgrades are assumed prior to any new generation).

c. New coal generation in 660 MW increments – taking into account lead-times. (larger unit sizes of 700 MW or more may become the norm but in terms of network impact the outcomes will be similar)

d. New gas generation in 150 MW increments to a maximum of 600 MW.

3.2 Scenarios of Interconnection and Generation Development

The order of interconnection and generation development can be rotated by defining a set of more probable backgrounds. The following 10 scenarios are believed to reasonably cover the likely outcomes, with the selection based on judgement.

Scenario 1

Small scale interconnection development with Queensland and Victoria / Snowy to maintain or marginally improve NSW import capability is favoured first. Subject to lead-times larger scale interconnection is then developed. The NSW import capability from the south is increased by 200 MW and the capability from Queensland is increased by 800 MW. Shortfalls are otherwise rectified by coal-fired power station development in NSW.

Scenario 2

As in Scenario 1 except that supply shortfalls are rectified by gas-fired power station development in NSW. Coal-fired generation follows after 600 MW of gas-fired generation.

Scenario 3

Small scale interconnection development with Queensland and Victoria / Snowy to maintain or marginally improve NSW import capability is favoured first . Shortfalls are otherwise rectified by coal-fired power station development in NSW. Larger scale interconnection is not developed.

Scenario 4

As in Scenario 3 except that supply shortfalls are otherwise rectified by gas-fired power station development in NSW. Coal-fired generation follows after 600 MW of gas-fired generation.

Scenario 5

Small scale interconnection development with Queensland and Victoria / Snowy to maintain or marginally improve NSW import capability is favoured first. Subject to lead-times larger scale interconnection is then developed. The NSW import capability from the south is increased by 200 MW and the capability from Queensland is increased by 2000 MW, assuming large-scale generation development in Queensland. Shortfalls are otherwise rectified by coal-fired power station development in NSW.

Scenario 6

As in Scenario 5 except that supply shortfalls are otherwise rectified by gas-fired power station development in NSW. Coal-fired generation follows after 600 MW of gas-fired generation.

Scenario 7

This scenario follows the theme of Scenario 5 except that the Victorian import capability is enhanced in 20011/12 when there could be surplus NSW and Queensland supply capability.

Scenario 8

This follows Scenario 6 except that the Victorian import capability is enhanced in 20011/12 when there could be surplus NSW and Queensland supply capability.

.

Scenario 9

As per Scenario 1 except that the upgrade of the 660 MW units occurs first, assumed for 2006/7.

Scenario 10

As in Scenario 2 except that the upgrade of the 660 MW units occurs first, assumed for 2006/7.

With respect to Scenarios 7 and 8 it is possible that enhanced Victorian import capability may become attractive if there was a supply surplus in the northern states.

There is uncertainty in the timing of the upgrade of the Eraring and Mt Piper 660 MW units and it has been attempted to cover the range of possibilities in the variations of Scenarios 9 and 10 compared to 1 and 2 respectively. Scenarios 9 and 10 assume an early upgrade of the units which may be driven by profit considerations rather than the need to address supply shortfalls.

The limited 5 year period of the Reset suggests that generation and interconnection developments in 2010/11 and onwards can be largely ignored for the purpose of determining the capital expenditure budgets. It is necessary however to take them into account in planning the development of the transmission system in an orderly manner over the planning horizon.

4. INTERCONNECTION OPTIONS

4.1 Range of Possible Interconnection Developments

The following are the interconnection developments that have been the subject of recent conceptual design. Some are referred to in the ANTS (SOO 2004).

NSW – Queensland	
Q1	QNI - to maintain the existing capability for NSW import over the interconnector. This involves relatively low cost works on the NSW northern 132 kV system. Power flow control would be installed on the Armidale – Kempsey line to control potential overloads at times of high import from Queensland and high north coast load. There would be initial works and then possibly progressive minor works to maintain the capability. The SOO supply/demand balance seems to effectively assume that some of this work is committed. The initial work could be completed by summer 2006/7 or 2007/8. There may be a supply deficit in NSW in 2006/7 due to constraints on QNI if the work is not completed. In the longer-term the 132 kV system limitations would be removed with local works to support the growing NSW north coast loads. Lead-time – about 3 years
Q2	QNI – upgrade NSW import capability by about 150 - 200 MW – this would involve works within substations, without the need for new line works The work involves mainly line series compensation. Lead-time – about 4 years.
Q3	QNI – major upgrade of the interconnection to allow an increase in NSW import capability by the order of 800 MW to 1000 MW. Some HVDC transmission work may be requred. It would be expected to also improve NSW export capability by similar amounts. It involves major line development between NSW and Queensland Lead-time – about 6 – 7 years

Q4	High capacity interconnection development with Queensland – 2000 MW. This project involves major HVDC interconnection development between NSW and Queensland. Lead-time – about 6 – 7 years
Victoria / Snowy to NSW	
S1	Vic/Snowy to NSW – to maintain the existing capability – the works would involve the installation of capacitor banks at intervals and minor line uprating. There would be initial works and then progressive minor upgrading to maintain capability The SOO supply/demand balance effectively assumes this work is committed. Work will commence in 2005/6.
S2	Vic/Snowy to NSW – to upgrade the NSW import capability by the order of 160 - 200 MW. This would be achieved by development of the Yass – Wagga 330 kV line and relatively minor works between Yass and Marulan and Marulan and the south coast. These developments would also improve the Victorian import capability. Lead-time – about 6 years
Victorian Import	
V1	NSW to Vic - upgrade by the order of 200 MW. This would be achieved by development of the Yass – Wagga 330 kV line possibly with some additional power flow control plant Lead-time – about 6 years
V2	NSW to Vic upgrade – a major upgrade involving the development of new lines between south west NSW and Victoria. It requires the prior completion of the Yass – Wagga 330 kV line and upgrading of the system south of Marulan. This is assumed to benefit Victoria by about 1000 MW. Lead –time – about 6 – 7 years

4.2 QNI – Upgrading

TransGrid and Powerlink recently completed a review of the likely benefits of upgrading QNI, based on some of the above options. It was concluded that a low cost upgrade in a southerly direction may be cost effective. Since that study the Kogan Ck power station has become a firm project and the joint review with Powerlink is now being repeated.

The reserve margin requirement in NSW has also been reduced by NEMMCO. These changes suggest that a low cost upgrade in a southerly direction is very likely to be cost effective and this development (scheme Q1 above) has been assumed in all the Backgrounds.

The development of Kogan Creek has a number of implications for the supply situation in NSW and Queensland and need for interconnection reinforcement. As the power station is connected into QNI it will tend to force power flow on QNI towards its maximum southern power transfer capability for longer times, much as has occurred with Millmerran Power Station. It is expected to result in the QNI southern power transfer limit binding for much of the time. It is expected that there will be market benefits in upgrading QNI as the NSW supply/demand balance deteriorates.

Kogan Creek also provides supply to the Queensland region. The SOO 2004 seems to assume that it could contribute its full capacity of 750 MW. The present largest generator in Queensland is 450 MW and the NSW export capability to Queensland is partly a function of the size of the largest unit.

The NSW export capability to Queensland is governed by line thermal ratings, voltage control considerations and transient stability considerations. The voltage control limitations and transient stability limitations can be governed by the impact of line faults and or the impact of a trip of the largest generator in Queensland.

With respect to the limits for NSW export that are determined by the trip of a large generator in Queensland, the relatively large Kogan Ck generator is expected to result in almost a 1:1 reduction in NSW export capability to Queensland.

Hence even with the development of Kogan Creek it is possible that there would be benefits in upgrading QNI in a northerly direction to ensure that the present capability of QNI remains available for supply to Queensland. A major upgrading of QNI for NSW export is not included in the transmission works that fall in the 2004/5 – 2008/9 Reset period.

It is possible that large-scale coal-fired generation will proceed in Queensland after Kogan Ck implying an opportunity for NSW to share the surplus capability with enhanced interconnection.

4.3 NSW – Snowy / Victoria – Upgrade

The NSW import capability from the south is generally governed by line thermal rating issues. To maintain the present import capability it is necessary to manage underlying voltage control constraints as well as the line rating issues over time (scheme S1 above). This work is relatively low in cost and has been assumed in all the backgrounds.

TransGrid and VENCorp recently undertook a review of the benefits of upgrading the Victorian interconnection – with respect to Victorian import capability.

A cost-effective upgrade of the existing interconnection is not considered likely to be feasible before reinforcement of supply to the Wagga area can be completed. The reinforcement may result from development of a Yass – Wagga 330 kV line (scheme V1) or generation in the Wagga area.

There are some proposals for generation in the Wagga area with the most advanced being a gas turbine development of 300 MW to 600 MW near to the Wagga 330/132 kV Substation. This is presently the subject of a Commission of Inquiry relating to environmental impact.

A Wagga area power station would provide some support to the Wagga area but it does not significantly increase support to the NSW region as a whole due to the transmission limitations north of Snowy, which presently limit NSW import capability from the south. One means of relieving this limitation is via development of a Yass – Wagga line and upgrading of the system between Yass and Marulan and Marulan and the south coast (scheme S2 above).

The same would apply to the development of generation in Victoria. At times where the Victorian export capability is not otherwise limiting, the development of a Yass – Wagga 330 kV line and uprating of the Yass – Marulan – south coast system would provide the capability for NSW to access surplus generation in Victoria.

A large scale power station development in NSW or Queensland may provide a surplus of generation that is expected to lead to the need for increased interconnection capacity with Victoria, particularly to take advantage of the diversity of the peak loads between NSW and Victoria / SA.

Large-scale coal-fired generation development in Victoria is not expected in the timeframe of this study.

5. GENERATOR UNIT UPGRADE

The remaining potential NSW generator upgrades are as follows. They would be expected to be undertaken before the development of new generators.

MP	Mt Piper – upgrade the two units by a total of 80 MW
ER	Eraring – upgrade the two units by a total of 160 MW

The upgrade is considered to be feasible from 2005 and may be in response to market opportunities or reserve requirements.

Further upgrades of the 660 MW units to 720 MW or 750 MW may also be feasible but have not been considered here due to their lower probabilities.

6. NEW GENERATION IN NSW

TransGrid's knowledge of the potential siting of coal-fired and gas turbine developments is based on the following information:

- Corporate knowledge from the days of Pacific Power including the strategic plans of the organisation formulated in the past;
- Knowledge gleaned from connection inquiries and connection applications;
- Information presented in the SOO 2004 and past SOO's; and
- The Statement of System Opportunities[4].

New coal or gas-fired generation in NSW is denoted as follows:

Ci	Coal station development – 660 MW generated – corresponding to about 630 MW sent out. Generation development covers 5 siting alternatives.
Gi	Gas station development– 150 MW. The preliminary paper set out 10 siting alternatives. This has been expanded with additional combinations – see below. Maximum of 600 MW capacity.

where i ranges from 1 for the first to n for the nth unit

The work of ROAM indicates a 20% probability of coal-fired power station development and 80% probability of gas-fired development. These probabilities have been applied to the Backgrounds.

[4] Ministry of Energy and Utilities "New South Wales Statement of System Opportunities", June 2001.

6.1 Feasible Coal-Fired Power Stations

The coal stations could be 2 or 4 unit developments.

If power station development is required by 2008/9 or 2009/10 only some of the potential power station sites become feasible due to transmission development lead-times. The table below indicates the feasible developments that will be covered for the Revenue Reset period 2004/5 to 2008/89 and the following year or two that impact on the transmission capital expenditure.

Table 4 - Coal-fired power stations considered

Power Station	**Transmission Requirements**	**Feasibility for this study**
Hunter Valley	May be able to be largely accommodated by the upgrade of the western system to 500 kV operation and other uprating works. Some constraints on the combined output of this station, other stations and import over QNI may be required due to limitations between the Hunter Valley and cental coast.	One unit feasible
Ulan / Rylstone area	“	One unit feasible
Mt Piper	“	One unit feasible
Gunnedah	Long-distance transmission development required in addition to the upgrading of the western system. The constraints above would apply	Not feasible
Oaklands	“	Not feasible

Hence for this study only the potential power station developments in the Hunter Valley, Ulan / Rylstone area and Mt Piper should be considered.

The probability of the development of an individual power station or upgrade of an existing unit is not able to quantified.

It has been assumed that the development of any of the three coal-fired power station sites have equal probability.

6. 2 Feasible Gas-Fired Power Stations

The most probable developments are considered to be as follows:

- Tomago – being close to the aluminium smelter.
- Eraring and Munmorah – the gas turbine generators may be able to be largely accommodated on the power station sites and connected to the existing switchyards. The proposals have been around for some time and examined by TransGrid in the past.
- Port Kembla – this proposal has been around for some time as part of the steelworks supply issues and has been examined by TransGrid in the past.
- Tallawarra – the perception is that the retired power station site would be used and it is understood that the site has been acquired for that purpose.
- Tomerong / Nowra area – this proposal has been considered in recent years
- Wagga – the proposed development of a gas turbine power station is public knowledge.
- Marulan area - this proposal has been considered in recent years and is representative of various sites in the area.
- Victoria – due to proximity to gas sources with some proposals being public knowledge.

The gas turbine units are assumed to be rated at 150 MW. In general it is assumed that a site could be developed to 300 MW capacity, involving two units. Some sites may have a larger capability but may be limited by environmental issues, particularly with respect to lake-cooled stations.

Due to the large number of potential gas turbine sites there would be a very large number of combinations that are possible in meeting a total 600 MW capacity. There may be a higher probability that two stations in the same area will be developed before moving to another area. It is assumed that gas infrastructure development would be required and it would be necessary to have economies of scale. The same may apply to the transmission system.

Each of the individual developments are close to existing transmission facilities and hence transmission development lead-times may not affect their feasibility. It is expected that they would have similar local transmission connection costs. Hence it is considered reasonable to reduce them to generic north and south developments.

The gas (fuel) price is higher in the north than south and hence it is considered that southern gas developments are more likely overall than northern developments. On the other hand considerations such as the black-start capability to supply the smelters and the availability of existing power station sites may favour northern developments.

The probability of the development of an individual power station is not able to quantified. Instead the power station developments have been ranked and indicative probabilities applied.

The following probabilities have been assumed for the gas turbine developments to meet 600 MW supply increments:

Gas Turbine Development	Probability %
Tomago and Eraring	4
Tomago and Munmorah	4
Eraring and Munmorah	4
Pt Kembla and Tallararra	4
Tomerong area and Marulan	4
Marulan and Wagga / Victoria	15
Tomago and Pt Kembla	20
Tomago and Wagga / Victoria	20
Pt Kembla and Wagga / Victoria	25
total	100

It should be noted that the quantification of the probabilities is based on judgement and the above table may diverge significantly from reality.

6.3 Wind Parks

There is potential for wind generation development at a number of sites in NSW. A number of Connection Applications are under consideration.

As these are speculative developments and are not committed at the moment the transmission developments are not included in the list of projects that may occur within the period 2004/5 to 2008/9.

7. LOAD RELATED SCENARIOS

The three economic growth scenarios, that lead to the future load forecast, need to be addressed. Hence the load related scenarios cover low, medium and high growth forecasts. In addition there is a possibility of an expansion of an aluminium smelter in the Hunter Valley or development of a steel manufacturing load in the Newcastle area. Hence a fourth scenario needs to be covered and it has been assumed that the additional load amounts to 400 MW, on top of the medium growth forecast.

It is TransGrid's view that the load growth scenarios have the following probabilities:

Load growth scenario	Indicative Probability
Medium economic load growth	70 – 90%
Low economic load growth	10% or less
High economic load growth	10% or less
Medium economic load growth and the addition of a 400 MW industrial load development	Up to 30%

From these ranges the following probabilities have been assumed:

Load growth scenario	Probabilities Applied
Medium economic load growth	70%
Low economic load growth	10%
High economic load growth	10%
Medium economic load growth and the addition of a 400 MW industrial load development	10%

The overall scenarios for each of the medium, low and high load growth forecasts and medium + 400 MW projection, according to the future scenarios of section 3.2, are set out in Appendix 1.

With the focus on the next 5 years Sections 7.1 to 7.5 summarise the basic scenarios that will be considered. Four scenarios are relevant to the medium growth load. Only the first two scenarios become relevant for the low and high load growth and the medium + 400 MW projection.

The interconnector developments S1 and Q1 and the generator upgrades MP and ER occur in all scenarios.

In meeting the supply shortfall with relatively lumpy generation or interconnector developments it is inevitable that some excess capacities will occur in some years. Some relatively small deficits have been accepted in some years to minimise the extent of excess capacity. This process is a very simplified approximation of true generation planning processes and hence the outcomes are considered indicative.

7.1 Medium Load Growth

The medium load growth forecast results in 10 main scenarios . However due to the focus on the 5 year capital budget there are only four relevant outcomes SM1, SM2, SM9 and SM10:

SM1

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	0					0
2007/08	0	Q1				0
2008/09	157	Q2 (150)			150	-7
2009/10	641		MP (80) ER (160) C1 (630)		1020	-380

SM2

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	0					0
2007/08	0	Q1				0
2008/09	157	Q2 (150)			150	-7
2009/10	641		MP (80) ER (160)	G1 (600)	990	-350

SM9

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	0		MP (80) ER (160)		240	-240
2007/08	0	Q1				-240
2008/09	157	Q2 (150)			390	-230
2009/10	641		C1 (630)		1020	-380

SM10

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	0		MP (80) ER (160)		240	-240
2007/08	0	Q1				-240
2008/09	157	Q2 (150)			390	-230
2009/10	641			G1 (600)	990	-350

7.3 Low Load Growth

Only one outcome is relevant

SL1

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	0					0
2007/08	0	Q1				0
2008/09	0					0
2009/10	148	Q2 (150)			150	-2

7.4 High Load Growth

Two outcomes are relevant:

SH1

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	221		MP (80) ER (160)		240	-20
2007/08	433	Q1 Q2 (150)			390	+40
2008/09	474		C1 (630)		1020	-550
2009/10	1558	S2 (200) Q3 (800)			2020	-460

SH2

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	221		MP (80) ER (160)		240	-20
2007/08	433	Q1 Q2 (150)			390	+40
2008/09	474			G1 (600)	990	-520
2009/10	1558	S2 (200) Q3 (800)			1990	-430

7.5 Medium Load Growth Forecast + 400 MW

Two outcomes are relevant:

SF1

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	0					0
2007/08	200	Q1	MP (80) ER (160)		240	-40
2008/09	557	Q2 (150)	C1 (630)		1020	-470
2009/10	1041					+20

SF2

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	0					0
2007/08	200	Q1	MP (80) ER (160)			40
2008/09	557	Q2 (150)		G1 (600)	990	-430
2009/10	1041					+50

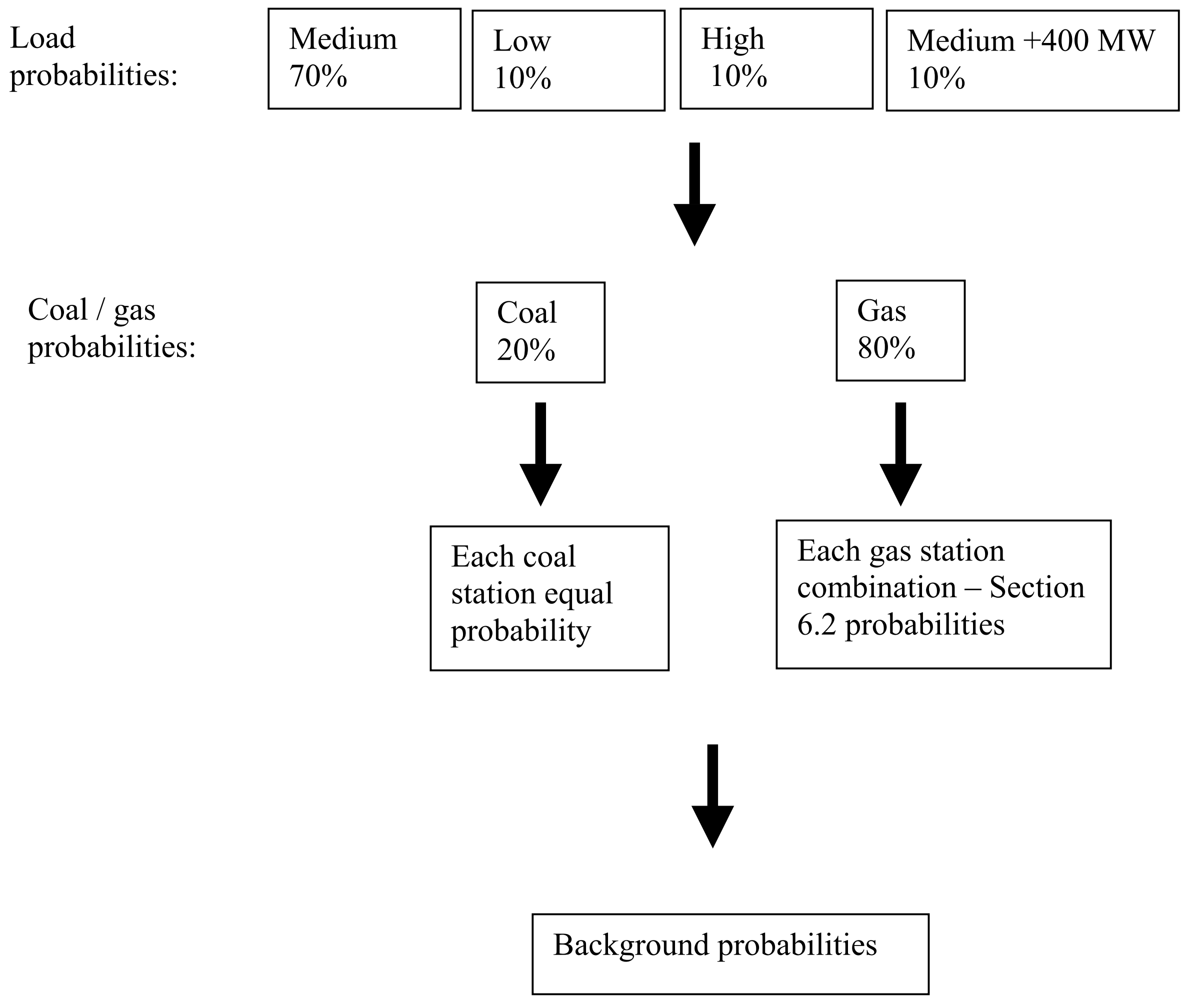
8. RESULTING BACKGROUNDS

From the above outcomes or scenarios the resulting Backgrounds are set out in Appendix 2. For each of the above scenarios the coal or gas generation requirements are made up from the combinations of power stations discussed above.

There are forty three Backgrounds.

In practice the capital budget would be dominated by the transmission works required for the medium growth forecast due to the higher probability of this load forecast.

The probability of each Background has been derived from the following:



APPENDIX 1

Medium Load Growth Forecast Scenarios

SM1 (follows Scenario 1)

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	0					0
2007/08	0	Q1				0
2008/09	157	Q2 (150)			150	-7
2009/10	641		MP (80) ER (160) C1 (630)		1020	-380
2010/11	1143	S2 (200)			1220	-80
2011/12	1721	Q3 (800)			2020	-300
2012/13	2269		C2 (630)		2650	-280
2013/14	2783		C3 (630)		3280	-500

SM2 (follows Scenario 2)

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	0					0
2007/08	0	Q1				0
2008/09	157	Q2 (150)			150	-7
2009/10	641		MP (80) ER (160)	G1 (600)	990	-350
2010/11	1143	S2 (200)			1190	-50
2011/12	1721	Q3 (800)			1990	-270
2012/13	2269		C1 (630)		2620	-350
2013/14	2783		C2 (630)		3250	-470

SM3 (follows Scenario 3)

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	0					0
2007/08	0	Q1				0
2008/09	157	Q2 (150)			150	-7
2009/10	641		MP (80) ER (160) C1 (630)		1020	-380
2010/11	1143		C2 (630)		1650	-410
2011/12	1721		C3 (630)		2280	-560
2012/13	2269					-10
2013/14	2783		C4 (630)		2910	-130

SM4 (follows Scenario 4)

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	0					0
2007/08	0	Q1				0
2008/09	157	Q2 (150)			150	-7
2009/10	641		MP (80) ER (160)	G1 (600)	990	-350
2010/11	1143		C1 (630)		1620	-480
2011/12	1721		C2 (630)		2240	-520
2012/13	2269					+30
2013/14	2783		C3 (630)		2870	-90

SM5 (follows Scenario 5)

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	0					0
2007/08	0	Q1				0
2008/09	157	Q2 (150)			150	-7
2009/10	641		MP (80) ER (160) C1 (630)		1020	-380
2010/11	1143	S2 (200)			1220	-80
2011/12	1721	Q4 (2000)			3220	-1500
2012/13	2269					-950
2013/14	2783					-440

SM6 (follows Scenario 6)

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	0					0
2007/08	0	Q1				0
2008/09	157	Q2 (150)			150	-7
2009/10	641		MP(80) ER (160)	G1 (600)	990	-350
2010/11	1143	S2 (200)			1190	-50
2011/12	1721	Q4 (2000)			3190	-1470
2012/13	2269					-920
2013/14	2783					-410

SM7 (follows Scenario 7)

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	0					0
2007/08	0	Q1				0
2008/09	157	Q2 (150)			150	-7
2009/10	641		MP (80) ER (160) C1 (630)		1020	-380
2010/11	1143	S2 (200)			1220	-80
2011/12	1721	Q4 (2000) V2 (1000)			2220	-500
2012/13	2269					+50
2013/14	2783		C2 (630)		2850	-70

SM8 (follows Scenario 8)

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	0					0
2007/08	0	Q1				0
2008/09	157	Q2 (150)			150	-7
2009/10	641		MP (80) ER (160)	G1 (600)	990	-350
2010/11	1143	S2 (200)			1190	-50
2011/12	1721	Q4 (2000) V2 (1000)			2190	-470
2012/13	2269		C2 (630)		2820	-550
2013/14	2783					-50

SM9 (follows Scenario 9)

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	0		MP (80) ER (160)		240	-240
2007/08	0	Q1				-240
2008/09	157	Q2 (150)			390	-230
2009/10	641		C1 (630)		1020	-380
2010/11	1143	S2 (200)			1220	-80
2011/12	1721	Q3 (800)			2020	-300
2012/13	2269		C2 (630)		2650	-280
2013/14	2783		C3 (630)		3280	-500

SM10 (follows Scenario 10)

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	0		MP (80) ER (160)		240	-240
2007/08	0	Q1				-240
2008/09	157	Q2 (150)			390	-230
2009/10	641			G1 (600)	990	-350
2010/11	1143	S2 (200)			1190	-50
2011/12	1721	Q3 (800)			1990	-270
2012/13	2269		C1 (630)		2620	-350
2013/14	2783		C2 (630)		3250	-470

Low Load Growth Forecast Backgrounds

SL1 (follows Scenario 1)

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	0					0
2007/08	0	Q1				0
2008/09	0					0
2009/10	148	Q2 (150)			150	-2
2010/11	569		MP (80) ER (160) C1 (630)		1020	-450
2011/12	1002					-20
2012/13	1430	S2 (200) Q3 (800)			2020	-590
2013/14	1810					-200

SL2 (follows Scenario 2)

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	0					0
2007/08	0	Q1				0
2008/09	0					0
2009/10	148	Q2 (150)			150	-2
2010/11	569		MP (80) ER (160)	G1 (600)	990	-420
2011/12	1002					+10
2012/13	1430	S2 (200) Q3 (800)			1990	-560
2013/14	1810					-180

High Load Growth Forecast Backgrounds

SH1 (follows Scenario 1)

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	221		MP (80) ER (160)		240	-20
2007/08	433	Q1 Q2 (150)			390	+40
2008/09	474		C1 (630)		1020	-550
2009/10	1558	S2 (200) Q3 (800)			2020	-460
2010/11	2085		C2 (630)		2650	-570
2011/12	2614					-40
2012/13	3140		C3 (630)		3280	-140
2013/14	3684		C4 (630)		3910	-230

SH2 (follows Scenario 2)

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	221		MP (80) ER (160)		240	-20
2007/08	433	Q1 Q2 (150)			390	+40
2008/09	474			G1 (600)	990	-520
2009/10	1558	S2 (200) Q3 (800)			1990	-430
2010/11	2085		C1 (630)		2620	-530
2011/12	2614					0
2012/13	3140		C2 (630)		3250	-110
2013/14	3684		C3 (630)		3780	-90

Medium Load Growth Forecast + 400 MW Backgrounds

SF1 (follows Scenario 1)

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	0					0
2007/08	200	Q1	MP (80) ER (160)		240	-40
2008/09	557	Q2 (150)	C1 (630)		1020	-470
2009/10	1041					+20
2010/11	1543	S2 (200) Q3 (800)			2020	-480
2011/12	2121		C2 (630)		2650	-530
2012/13	2669					+20
2013/14	3183		C3 (630)		3280	-100

SF2 (follows Scenario 2)

Year	MW Supply Deficit	Inter-connection added	Coal Generation Added	Gas Generation Added	Total Capacity Added	Approx Remaining Deficit
2004/05	0					0
2005/06	0	S1				0
2006/07	0					0
2007/08	200	Q1	MP (80) ER (160)			40
2008/09	557	Q2 (150)		G1 (600)	990	-430
2009/10	1041					+50
2010/11	1543	S2 (200) Q3 (800)			1990	-450
2011/12	2121		C2 (630)		2620	-500
2012/13	2669					+50
2013/14	3183		C3 (630)		3250	-70

APPENDIX 2 – COMPONENTS OF THE BACKGROUNDS

The supply side developments making up each Background are set out in the table below.

Alongside each Background are the key supply side augmentations assumed:

Load forecast

This covers medium (M) , low (L) and high (H) growth scenarios and a medium growth with 400 MW additional industrial load (F).

Interconnection Development

Only small-scale scale works to maintain existing capabilities or relatively small-scale works that do not require new line works are included in the 2004/5 – 2008/9 timeframe.

NSW unit upgrading

This sets the timing of the Eraring and Mt Piper upgrades.

Coal-fired Power Station Development

The three alternatives of a Hunter Valley power station, a Ulan / Rylstone development or a Mt Piper expansion are covered.

Gas-fired Power Station Development

The combinations of gas-fired power station developments, in lumps of 600 MW, discussed above are included.

The probabilities (approximate) are listed in the last column.

Background	Load forecast	Interconnection development	NSW unit upgrading	Coal-fired power station development	Gas-fired power station development	Probability % (approx)
M1	Medium	2005/6: NSW import capability from Vic maintained 2007/8: NSW import capability from Qld maintained 2008/9: NSW import capability from Qld increased by 150 MW	2009/10: Mt Piper units uprated Eraring units uprated	2009/10 Coal-fired unit – Hunter Valley		2.33
M2	Medium	As above	As above	2009/10 Coal-fired unit – Ulan/Rylstone		2.33
M3	Medium	As above	As above	2009/10 Coal-fired unit – Mt Piper		2.33
M4	Medium	As above	As above		2009/10 Tomago + Eraring	1.12
M5	Medium	As above	As above		2009/10 Tomago + Munmorah	1.12
M6	Medium	As above	As above		2009/10 Eraring + Munmorah	1.12
M7	Medium	As above	As above		2009/10 Pt Kembla + Tallawarra	1.12
M8	Medium	As above	As above		2009/10 Tomerong area + Marulan	1.12
M9	Medium	As above	As above		2009/10 Marulan + Wagga / Victoria	4.2
M10	Medium	As above	2006/7: Mt Piper units uprated Eraring units uprated	2009/10 Coal-fired unit – Hunter Valley		2.33
M11	Medium	As above	As above	2009/10 Coal-fired unit – Ulan/Rylstone		2.33
M12	Medium	As above	As above	2009/10 Coal-fired unit – Mt Piper		2.33
M13	Medium	As above	As above		2009/10 Tomago + Eraring	1.12
M14	Medium	As above	As above		2009/10 Tomago + Munmorah	1.12
M15	Medium	As above	As above		2009/10 Eraring + Munmorah	1.12

Background	Load forecast	Interconnection development	NSW unit upgrading	Coal-fired power station development	Gas-fired power station development	Probability % (approx)
M16	Medium	As above	As above		2009/10 Pt Kembla + Tallawarra	1.12
M17	Medium	As above	As above		2009/10 Tomerong area + Marulan	1.12
M18	Medium	As above	As above		2009/10 Marulan + Wagga / Victoria	4.2
M19	Medium	As above	2009/10: Mt Piper units uprated Eraring units uprated		2009/10 Tomago + Pt Kembla	5.6
M20	Medium	As above	As above		2009/10 Tomago + Wagga / Victoria	5.6
M21	Medium	As above	As above		2009/10 Pt Kembla + Wagga / Victoria	7
M22	Medium	As above	2006/7: Mt Piper units uprated Eraring units uprated		2009/10 Tomago + Pt Kembla	5.6
M23	Medium	As above	As above		2009/10 Tomago + Wagga / Victoria	5.6
M24	Medium	As above	As above		2009/10 Pt Kembla + Wagga / Victoria	7
L1	Low	2005/6: NSW import capability from Vic maintained 2007/8: NSW import capability from Qld maintained 2009/10: NSW import capability from Qld increased by 150 MW				10

Background	Load forecast	Interconnection development	NSW unit upgrading	Coal-fired power station development	Gas-fired power station development	Probability % (approx)
H1	High	2005/6: NSW import capability from Vic maintained 2007/8: NSW import capability from Qld maintained and increased by 150 MW 2009/10: NSW import capability from Vic increased 2009/10: Major interconnection development with Qld	2006/7: Mt Piper units uprated Eraring units uprated	2008/9 Coal-fired unit – Hunter Valley		0.67
H2	High	As above	As above	2008/9 Coal-fired unit – Ulan/Rylstone		0.67
H3	High	As above	As above	2008/9 Coal-fired unit – Mt Piper		0.67
H4	High	As above	As above		2008/9 Tomago + Eraring	0.91
H5	High	As above	As above		2008/9 Tomago + Munmorah	0.91
H6	High	As above	As above		2008/9 Eraring + Munmorah	0.91
H7	High	As above	As above		2008/9 Pt Kembla + Tallawarra	0.91
H8	High	As above	As above		2008/9 Tomerong area + Marulan	0.91
H9	High	As above	As above		2008/9 Marulan + Wagga / Victoria	3.43

Background	Load forecast	Interconnection development	NSW unit upgrading	Coal-fired power station development	Gas-fired power station development	Probability % (approx)
F1	High	2005/6: NSW import capability from Vic maintained 2007/8: NSW import capability from Qld maintained 2008/9: NSW import capability from Qld increased 150 MW	2007/8: Mt Piper units uprated Eraring units uprated	2008/9 Coal-fired unit – Hunter Valley		0.67
F2	High	As above	As above	2008/9 Coal-fired unit – Ulan/Rylstone		0.67
F3	High	As above	As above	2008/9 Coal-fired unit – Mt Piper		0.67
F4	High	As above	As above		2008/9 Tomago + Eraring	0.91
F5	High	As above	As above		2008/9 Tomago + Munmorah	0.91
F6	High	As above	As above		2008/9 Eraring + Munmorah	0.91
F7	High	As above	As above		2008/9 Pt Kembla + Tallawarra	0.91
F8	High	As above	As above		2008/9 Tomerong area + Marulan	0.91
F9	High	As above	As above		2008/9 Marulan + Wagga / Victoria	3.43