Response to the ACCC's Draft Decision on TransGrid's 2004/05-2008/09 Revenue Caps:

Section 3 of 6

Optimisation of 500kV Assets

July 2004

3 OPTIMISATION OF 500KV ASSETS

3.1 Summary

The Commission's draft decision in relation to TransGrid's 500kV assets is, in effect, to exclude $70 million of re-optimised value from the regulated asset base for both the current regulatory period and future regulatory periods. This decision clearly has a material financial impact on TransGrid and it is important for the transparency of the regulatory process to be accompanied by an intellectually sound rationale.

A review of the relevant documents reveals a complex situation requiring a detailed assessment of a range of matters. This includes understanding clearly the meaning of service levels as they apply to transmission assets that form part of an integrated power system, identifying the relevant optimisation regime, and quantifying the required adjustments to the Regulatory Asset Base (RAB), both in terms of timing and value of the relevant adjustments.

To assist in this assessment TransGrid has reviewed the relevant facts and has come to the following four key conclusions.

- Aspects of the Commission's current interpretation of the previous TransGrid (2000) Revenue Decision on this matter need to be reassessed. Specifically, operation or otherwise of an asset at its design voltage is not the essential consideration in assessing whether there has been a change in the service level of that asset.

- The Bayswater-Mt Piper and Mt Piper-Marulan 500 kV lines (the Bayswater line) should not be excluded from TransGrid's asset base under any reasonable interpretation of the optimisation regime applying to TransGrid.

- If the optimised value relating to the 500kV assets is brought back into the RAB in the future, the draft Statement of Regulatory Principles (SORP) requires the roll-forward of the optimised value at TransGrid's WACC. This has the affect of leaving customers essentially no better off than leaving the asset in TransGrid's current asset base. That is, removing the value of 500kV assets from TransGrid's asset base creates costs and complexity that serves no substantive purpose.

- If the Commission remains of the view that operation at 500kV is the determining consideration for bringing the value of the 500kV assets into the RAB then this will almost certainly arise during the 2005 to 2009 regulatory period. As a matter of proper process TransGrid would expect the Commission's position on this be clearly set out in the final decision to ensure that there is no confusion about such treatment in the future.

Each of these points is discussed in more detail in the following sections.

3.2 Analysis of the Commission's Previous TransGrid (2000) Decision

The Commission's primary reason for excluding the Bayswater line from TransGrid's RAB seems to be that the line has not operated at 500 kV and that the Commission had foreshadowed in its 2000 Decision that the lines would be excluded if this level of operation was not achieved.

In the draft Decision the Commission said that:

> *"**It is clear from the previous TransGrid (2000) Decision** that, while the ACCC included the value of a 500 kV line in the RAB, it was concerned about whether this line **would operate at that service level (500 kV)**. The ACCC foreshadowed the possibility that it would consider re-optimising the asset if it operated at **a lower service level than the 500 kV** assumed for the purposes of the 2000 Decision". (Emphasis added)*

In TransGrid's opinion, this is a somewhat curious reading of the Commission's 2000 Decision. The actual words in the 2000 Decision are as follows:

> *"Although some interested parties argued that the future development of generation options in Queensland should preclude the need for re-optimisation, the Commission believes that the future pattern of generation investment remain highly uncertain. On this basis the Commission is not in a position to conclude that the reoptimisation suggested by its technical consultant is inappropriate at this time. Nevertheless, the situation could change by the time of the next regulatory review. For instance, if at the time there is evidence that new generation investment has meant that TransGrid's 500kV assets **have functioned, and are likely to continue to function at a lower service level,** then the Commission will have no hesitation in optimising the value of those assets accordingly."(Emphasis added)*

TransGrid submits that references to a "lower service level" in the 2000 Decision cannot be interpreted as meaning that the Bayswater line should have operated at 500 kV by the time of the current decision. That interpretation would not make sense in a context where:

- At the time of the 2000 Decision the Commission appeared to accept the application of the NSW Treasury Guidelines by the Commission's consultants Sinclair Knight Merz (SKM) as the basis for its position on asset valuation. These Guidelines make it quite clear (as discussed in Section 3.3 below) that it is the timing of future operation at full design capacity (i.e. within a 15 year time horizon) that is relevant rather than the operation at this capacity at the time of assessment.

- The 2000 Decision acknowledges that future service levels (rather than service levels at the time of a determination) are relevant in its statement that it would consider

whether TransGrid's 500 kV assets "… are likely to continue to function at a lower service level".

- None of the capital expenditure programs provided by TransGrid, reviewed by the Commission, or ultimately adopted by the Commission in the 2000 Decision, included any proposal to lift the operating voltage of the Bayswater line to 500kV during the 1999 to 2004 regulatory period. This supports other comments in the SKM report and the 2000 Decision that the service level increase of the 500kV assets referred to by the Commission in the 2000 Decision was linked more to accommodating QNI and new generation than operation of the Bayswater line at 500kV.

- The service level of a transmission asset can be significantly enhanced by a change in network configuration, load or generation. The asset in question may carry an increased share of the load, ensure continuity of supply during critical outages in ways that did not apply in the past, and / or reduce the level of system losses. These additional services can result without any change in service voltage. The comparable situation in reverse is that the service value of an asset can be reduced by it being bypassed, or by a reduction in the level of load / generation being served, as may result from the closure of a major customer / generator.

What does seem clear, in terms of the requirements of the 2000 Decision, is that the Commission was concerned, at the time, that the value of the 500kV assets would be included in the RAB in anticipation of an increased service level only to find that this did not arise. This has certainly not been the case for TransGrid's 500kV assets. Not only did the service level of these assets increase over the 1999 to 2004 regulatory period but the 500 kV capability of these assets will be a central component in meeting TransGrid's very real and increasing service challenges in the next few years.

Specifically the 500kV assets have enabled the accommodation of increases in load since 1999, new generation capacity in the Bayswater area, new generation in Queensland (Millmerran), as well as the advent of QNI. Further details of these matters were provided in TransGrid's letter to the Commission dated 27 February 2004. This letter included a diagram showing that the north to south flows over QNI have increased significantly since the commissioning of QNI.

As explained below, and as set out in more detail in Appendix 3A, TransGrid's 500kV assets will be crucial in the next few years in ensuring that NSW generation capacity, as well as supplies from other States, are not 'choked off' to the point where Newcastle-Sydney-Wollongong load growth cannot be met because of inadequate NSW transmission capability. Under these circumstances the future increased service level of these assets cannot be seriously questioned.

3.3 The Relevant Optimisation Regime is Set Out in the NSW Treasury Guidelines

TransGrid submits that the relevant principles to apply for the optimisation of TransGrid's assets are the "Policy Guidelines for Valuation of Network Assets of Electricity Network Business" developed by NSW Treasury dated December 1995 (NSW Treasury Guidelines). The NSW Treasury Guidelines were used by Worley/GHD when they undertook a valuation of TransGrid's assets for NSW Treasury in 1999. Later in the same year, the Commission engaged Sinclair Knight Merz (SKM) to review the Worley/GHD valuation. SKM did not question or argue against the use of the NSW Treasury Guidelines. Instead, they noted that the TransGrid optimisation generally followed the NSW Treasury Guidelines, particularly in relation to the use of a planning horizon of 15 years (see p17 of these Guidelines). The Commission accepted SKM's report and essentially adopted its recommendations in its 2000 Revenue Decision.

The NSW Treasury Guidelines are not only relevant for historical reasons, they are the only optimisation guidelines available to TransGrid. In this regard we note that in the draft SORP the Commission had announced it would develop, by 31 December 2002, guidelines for revaluations and resets (S4.2 of the draft SORP), but these guidelines have never been developed.

Against this background, if the Commission wanted to use guidelines or principles different from the NSW Treasury Guidelines, then the Commission should give TransGrid early notice of its intentions and of the new guidelines that would apply. TransGrid should also be given an opportunity to comment on the proposed changes.

In this case, the Commission has not made any announcement of a desire to depart from the use of the NSW Treasury Guidelines, therefore TransGrid submits that the NSW Treasury Guidelines should continue to apply.

3.4 Applying the NSW Treasury Guidelines to the 500kV Lines

3.4.1 The NSW Treasury Guidelines – Relevant Considerations

The NSW Treasury Guidelines cover all aspects of developing a DORC valuation. Optimisation is dealt with in Section 1.4 and Section 2.4 of these Guidelines.

Essentially optimisation involves:

1 Assessing whether the asset in question has a capacity in excess of the "expected capacity in use"; and, if so

2 Developing an estimate of the cost of an asset which provides the appropriate level of service.

3.4.1.1 Assessment of Whether Excess Capacity Exists

The NSW Treasury Guidelines define "expected capacity in use" in Section 1.4.3 as:

> *"The replacement cost of individual assets should be based on the "expected capacity in use" of the existing assets. "Expected capacity in use" is the required level of service potential or output consistent with both the future growth in demand and the objective of minimising the whole of life cost of assets under 'total asset management' concepts and business planning horizons. As systems expand and change, a degree of suboptimality at any one time is inevitable and is part of the total cost of output".*

Excess capacity is considered in Section 1.4.4:

> *"Where assets are over designed, have excess capacity, or are redundant, then an adjustment needs to be made so that the resulting valuation reflects the cost of replacing the existing service potential that would be replaced by the entity based on an efficient set of modern equivalent assets to achieve the required level of service output ("capacity in use") within the entity's planning horizon.*
>
> *Overcapacity or redundant assets may be defined as assets with greater service capacity than is necessary to meet the service delivery outputs within the entity's business and total asset management planning horizon".*

Section 2.4.6 gives examples of optimisation of network assets which should be considered. The first example is particularly relevant:

> *"Circuits operating at less than their design voltage should be valued at their present operating voltage unless the line will be required to operate at the higher voltage within the appropriate planning period".*

A key consideration is the planning period (or planning horizon). The NSW Treasury Guidelines offer the following guidance in Section 2.4.2:

> *"The planning period assumed for future growth in power flows should be consistent with that used for business planning and Total Asset Management planning. These would typically be:*
>
> - *up to 15 years for transmission and subtransmission networks except zone substation transformers;*
> - *up to 10 years for zone substation transformers; and*
> - *5 years for distribution networks".*

In relation to planning periods, the National Electricity Code specifies a period of at least ten years. Under Clauses 5.6.2 (b):

> *"each Transmission Network Service Provider (TNSP) must conduct an annual planning review with each Distribution Network Service Provider connected to that transmission network within each region."*

Clause 5.6.2 (d), states that:

> *"The minimum planning period for the purposes of the annual planning review is 5 years for distribution networks and 10 years for transmission networks".*

Thus, for optimisation purposes the appropriate planning period is a minimum of ten years (and up to 15 years).

3.4.1.2 Estimate of the cost of the asset

Establishing the cost of an efficient set of assets which provide the appropriate level of service, entails review of the network configuration and the actual assets employed, followed by costing of the optimised assets in the revised configuration.

In reviewing the network configuration and assets employed, a number of factors are considered to be "fixed", for example the location of generators and supply points. In addition, for TransGrid's network, the optimised network must;

- utilise only existing line and cable routes; and

- have an import/export capacity similar to the existing network.

Optimising the network configuration involves developing (if possible) a more efficient network arrangement (within the constraints outlined above). Optimising the assets employed involves determining the appropriate number and rating of the necessary items of equipment (such as transformers, switchbays, etc).

3.4.2 Application of the NSW Treasury Guidelines to the 500 kV Lines

As previously indicated the example given in Section 2.4.6 of the NSW Treasury Guidelines is particularly relevant. In relation to the 500 kV lines, optimisation is only appropriate if they will not be required to operate at 500 kV within ten to 15 years.

Analysis undertaken by TransGrid shows that the lines will be required to operate at 500 kV within the next five years. In essence, the operation at this voltage is needed as a pressing priority as this is the most efficient option for ensuring that the NSW transmission network has sufficient capability to supply the Newcastle-Sydney-Wollongong load area. Without this being implemented by about 2007/08 it is considered unlikely that the reliability of supply to this vital load area would meet an N-1 reliability criterion for a number of credible

outages. A detailed description of TransGrid's assessment of this situation is contained in Appendix 3A.

The Commission's draft decision to optimise the Bayswater – Mount Piper and Mount Piper – Marulan 500 kV lines is inconsistent with the accepted guidelines on optimisation.

Significantly, at the time of TransGrid's previous revenue reset, when the lines were expected to operate at 500 kV within ten years, the decision to optimise them was also inconsistent with the accepted guidelines.

3.5 The Commission's Position on Optimisation of Existing Assets

TransGrid is unclear on how the Commission sees its draft decision fitting with its recently stated position on optimisation of existing assets. TransGrid believes that it is entirely understandable that the Commission has not promulgated any optimisation criteria to be applied to existing assets. The Commission has publicly stated that it wishes to remove from TNSPs the risk that the regulatory value of existing assets will be optimised. The Commission puts forward a convincing case as to why optimisation risk should only apply to assets at the time they are built and that once an asset enters a TNSP's asset base its value should be protected. In particular, the Commission concludes in its discussion paper on the review of the draft statement of regulatory principles that:

> *"…the Commission's initial view is that there are a number of positive outcomes from locking-in the jurisdictional asset base. The main reasons are that a lock-in does not generate the uncertainty and deter investment as a revaluation might. In addition, the Commission avoids the multiple of subjective choices that is embodied in the DORC."*

TransGrid believes that this logic applies equally to its 500kV assets. TransGrid believes that the complexity associated with continual reassessment of whether existing assets should be removed/re-introduced into the regulatory asset base is not warranted. The Commission has made it clear in the above document and in public forums since then that its preferred option is to eschew applying an optimisation regime to existing assets. The Commission has also been clear that it intends to avoid promulgating rules as to how that optimisation regime would operate – in terms of both optimisation and re-optimisation.

TransGrid notes that, assuming that the Commission does not adopt the NSW Treasury Guidelines, optimising TransGrid's 500kV assets in the current regulatory decision would re-introduce the need for the Commission to clearly develop precisely such a regulatory regime.

3.6 Optimisation Creates Costs for No Benefit to Consumers

TransGrid submits that, to be consistent with the draft SORP, any values of optimised assets must re-enter the RAB carried forward at WACC. The effect of this is that consumers will

derive uncertain benefits from a temporary optimisation of the assets. Given that the Bayswater line is forecast to operate at 500kV within the next five years it is TransGrid's opinion that optimising it in the present decision creates unnecessary regulatory uncertainty and costs for no benefit to any of the parties involved – be they customers, the Commission or TransGrid.

Page 51 of the Commission's draft SORP addresses the issue of the value at which optimised assets will return to the RAB.

> *Where assets are optimised out of the asset base, at some future time they may be brought back in. This situation may arise where for example there was over building of the network in a particular area in anticipation of future growth. This growth may not have occurred in a timely manner and the assets are removed from the asset base. Sometime in the future these assets may be added back into the asset base as they become utilised. The Commission will carry assets that have been optimised out of the system forward in the regulatory accounts at the regulatory rate of return, but if optimised back into the RAB their value will be at the lesser (sic) of the depreciated replacement cost and their value in the regulatory accounts.*

TransGrid considers that the draft SORP's intention in this regard is clear. If an asset is optimised out of the asset base due to 'under utilisation' then, when it ceases to be 'under utilised' the presumption is that customers should pay an amount no more than the asset's value to them at that time (ie, depreciated replacement cost). However, it is possible that this amount could exceed the actual cost to the TNSP of the asset – even after taking account of carrying costs. For example, the replacement cost of an easement can easily exceed the initial cost of that easement plus carrying costs. For this reason the draft SORP places an additional cap on the value at which the asset may re-enter a TNSP's RAB – being the initial cost of the asset plus carrying costs. In this way customers never pay more for the asset at the time of re-optimisation than:

- the value of the asset (depreciated replacement cost); or
- the cost to the TNSP of constructing and holding the asset (the carry-forward value of the assets).

Assuming the value in question was $70 million in 1998 then the carry-forward value to 2004 at TransGrid's WACC would be around $112 million.

Even assuming that this value related specifically to the Bayswater line (this is not clear from the SKM report), it is uncertain what the relevant replacement cost difference would be. This would depend on assumptions about what type of 330kV construction is adopted as the alternative, assumptions about environmental requirements for each of the 330kV and 500kV alternatives, capacity requirements for the 330kV alternative, and so on.

At the very least the outcome of this valuation would be uncertain for TransGrid and customers alike. There is no assurance that the value would ultimately be less than the carry-forward value (of around $112 million). There would certainly be extensive debate about the assumptions between the Commission, TransGrid and their respective advisers. However, desktop estimates, based on comparison of the replacement costs of a typical 330 kV construction configurations over the same route as the Bayswater line result in values comparable to $112 million.

On the basis of this analysis TransGrid considers that if the Bayswater line were to be optimised by the Commission in its final decision and re-introduced at some stage over the next five years then, consistent with the SORP, customers would receive minimal advantage. The whole process would be complex and involve administrative costs on the part of TransGrid and the Commission with little net benefit in improved regulation.

3.7 Clarity on the Future Treatment of These Assets

While TransGrid does not agree with the Commission that $70 million should be removed from the RAB from 2001 onwards, a clear articulation of the future treatment of this matter needs to be included in the final decision.

In this regard, it is almost certain that the Bayswater line will be operating at 500kV before the end of the 2005 to 2009 regulatory period. Adopting the Commission's position, as set out in the draft decision, that operating at 500kV is the condition that needs to met in order to reinstate this value implies that reinstatement of this value during the 2005 to 2009 regulatory period is also almost certain.

Accordingly, in the interests of future certainty on this matter, and having regard for the material nature of the decision, TransGrid asks that the final decision clearly and unequivocally sets out the conditions upon which reinstatement will occur and the value that will be reinstated.

APPENDIX 3A

TIMING OF UPGRADING OF BAYSWATER-MT PIPER AND MT PIPER-MARULAN LINES TO 500KV OPERATION (IN THE ABSENCE OF ANY NEW POWER STATION DEVELOPMENT)

The timing for the upgrade to 500 kV operation has been assessed through examination of the future supply/demand balance in NSW and the NSW network limitations associated with the forecast peak load for 2007/8.

1. UTILISATION OF NSW THERMAL GENERATION AND INTERCONNECTORS TO MEET NSW LOAD

The installed summer generation capacity in NSW is[1]:

Generation source	**MW**
Thermal generation	11891
Hydro (Blowering)	80
Hydro – water supply (Kangaroo Valley, Bendeela)	240
Black start GT (Hunter Valley)	44
Total	**12255**

The above total thermal generation includes the upgrading of the Bayswater 660 MW units to 700 MW, and the upgrading of the four Liddell units to 515 MW.

There is potential to upgrade a further six 660 MW units to 700 MW, although these upgrades are not committed at present.

The full capability of Vales Pt has been included in the above total but its output may be restricted by 220 MW in summer.

[1] NEMMCO Statement of Opportunity 2003 – Chapter 3

The balance of the NSW supply must be transferred from adjoining regions over the interconnections. The interconnections have the following nominal capability[2]:

Interconnector	3.7.1 Nominal MW capability – NSW import
QNI	950
Directlink	0
Snowy	2820
Total MW	3770

In reality it is expected that further testing of QNI will provide a nominal NSW import capability of about 1000 MW. The nominal import capability from Snowy may also be of the order of 3100 MW in practice. The resulting total import capability to the NSW region is expected to be about 4100 MW.

Under normal peak load supply conditions the black start GT's and hydro stations related to water supply (Kangaroo Valley and Bendeela) would not be expected to operate implying a total of 11971 MW of NSW generation.

The expected import to NSW over the interconnectors to meet the summer peak load (10% probability of exceedence, medium economic growth[3]), ignoring any requirement to carry reserve generation in the state and ignoring variations in total system losses as a result of interconnector loading, is as follows:

Summer of	Forecast peak MW load	Total MW import
2004 / 5	13430	1459
2005 / 6	13880	1909
2006 / 7	14310	2339
2007 / 8	14620	2649
2008 / 9	15020	3049
2009 / 10	15460	3489
2010 / 11	15960	3989

There has been considerable discussion in various forums about the supply / demand balance in NSW. Whilst the above table describes the required import over the

[2] The interconnections have a variable capability determined by many factors, the nominal maximum capability is shown here as a single figure for simplicity. Figures are derived from the NEMMCO MT PASA for 2005/6 and updated according to expected conditions

[3] TransGrid Annual Planning Report 2004 forecast

interconnectors it should be noted that the growing supply / demand restrictions in the adjoining states will limit the available capacity on the interconnectors[4].

There are no new committed generators in NSW. Barring the development of a major new NSW power station the above table highlights two significant factors as the NSW load grows:

- There will be a growing emphasis on the maximum utilisation of the existing thermal generators; and
- The utilisation of the interconnectors will increase.

Both factors imply the need to ensure that intra-regional network limitations will not unduly restrict the output of the power stations and the capability to import power over the interconnectors. This is a necessity for the reliability of supply to the NSW load.

By summer 2007/8 it is expected that with all NSW generation in service about 2600 MW will need to be able to be imported. Past history suggests that this will be from both Queensland and the south.

2. INTRA-REGIONAL NETWORK LIMITATIONS 2007/08

Analysis has been carried out to establish the adequacy of the NSW network in 2007/8 to meet the forecast load (refer Appendices to TransGrid Internal report – available under separate cover).

There are five major intra-regional network limitations that will affect the ongoing ability for the generators to generate power according to their rated capacity and the ability to import high levels of power over the interconnectors:

1. Voltage control limitations on import of power from Victoria / Snowy;
2. Line thermal limitations in the northern NSW 132 kV network that will limit the ability to import power from Queensland;
3. Line thermal limitations in the Hunter Valley – coast 330 kV network that limit the range of feasible dispatch patterns and import from Queensland;

[4] NEMMCO Statement of Opportunities 2003 – supply / demand balance calculator

4. Voltage control limitations that affect the capability to import power from Queensland whilst generating at high power levels at the NSW thermal power stations; and

5. Transient stability limitations affecting both the output of the thermal generators and import from Victoria / Snowy and Queensland.

The first factor will be addressed with the ongoing installation of switched shunt capacitor support in the southern area of the state (APR 2004).

The second factor relates to localised supply conditions on the mid north coast and is addressed in TransGrid's 2004 APR. It is not directly relevant to this report.

The last three factors are germane to this report.

2.1 Line thermal limitations in the Hunter Valley – coast 330 kV network

Detailed analysis shows that the rating of the 330 kV lines between the Hunter Valley and Newcastle area will restrict the total output from the Hunter Valley power stations and import from Queensland.

The following issues can be concluded from the analysis:

- With the existing system it will not be possible to import above about 1000 MW from Queensland and operate all the Hunter Valley units at maximum output (with all NSW thermal units at maximum output) at time of peak load.

- As the load in the Newcastle area grows there will need to be a trade-off between import from Queensland and output from the Hunter Valley units – there will not be sufficient transmission capability for the combined capability of the import and Hunter Valley generation.

- If the generation on the central coast is reduced from the maximum (whether as a result of plant failure, plant unavailability, reduced output in summer etc) there is a corresponding reduction in capability to import from Queensland or generate in the Hunter Valley. Alternatively in order to maximise import from Queensland and the Hunter Valley it is necessary to constrain all units on the Central Coast at maximum generating output.

It is necessary to relieve the line thermal limitations to ensure that the state load can be met.

2.2 Voltage Control Limitations

TransGrid has progressively installed switched shunt capacitors and SVC's on the NSW main system to manage the growing load and consequent increase in reactive power load and reactive power losses. The upgrade of the 660 MW units to 700 MW also increases the demand for reactive power both directly as a result of the reduced over-excitation capability of the units and indirectly due to the higher power transfers from the power stations to the load centres.

There are two very significant network developments in 2004 that support overall voltage control on the NSW main system:

- In 2004 the Sydney South – Haymarket 330 kV cable will effectively provide about 330 Mvar of capacitive support to the main system.

- The Sydney West SVC to be completed in 2004 will replace the Sydney South syncons but also provide an additional 130 Mvar of dynamic reactive power support.

In 2005 there are plans for an additional 200 Mvar capacitor support in Sydney and a further 400 Mvar capacitor support at a central coast power station (APR 2004).

There are practical limits to the ability to meet the overall NSW system needs by installing shunt switched capacitors and SVC's. These limits arise due to stability considerations and physical space limitations.

The practical limits on the installation of shunt capacitor support in the Sydney area may be exceeded by about 2007/8. Present analysis indicates that in that year it is expected that it will not be feasible to meet the reactive power deficiency allowing for the outage of a single element on the NSW main system (ie under N-1 contingency conditions). Supporting documents are available that describe the reactive power deficiencies that arise in providing for the need to secure the system following a critical contingency.

If the reactive deficiency is not addressed there would need to be limitations placed on import over the interconnectors or output from the thermal power stations. Such limitations would require load shedding in NSW in advance of any contingency to preserve system security. Hence network reinforcement or extensive DSM is required to ensure the security of the NSW system.

2.3 Long-term / Transient Stability Limitations

Analysis of the 2007/8 peak load conditions with:

- 1000 MW import from Queensland;
- all NSW thermal generators at high output;
- Bayswater units operating at 700 MW; and
- high import from Victoria / Snowy to supply the balance of the load

shows that the existing system would be unstable.

This situation is being investigated but it is likely that the import to NSW from both the north and south would need to be reduced to achieve adequate stability.

To absorb high levels of import and high output from the generators there is a need to reduce the system impedance between the Hunter Valley area and the south of the state.

3 OPTIONS FOR ADDRESSING THE 2007/8 NETWORK LIMITATIONS

There are three possible network solutions to the system limitations in summer 2007/8 that are being investigated as part of the future planning process:

- New 500 kV or 330 kV line development from the Hunter Valley;
- Line series compensation and a program of additional shunt capacitor compensation; and
- Upgrading the western 500 kV system to 500 kV operation and supporting works.

It is highly unlikely that a new line could be developed where other options involving only substation works are feasible, due to cost and environmental issues.

The series compensation option involves work in existing substations but it is not presently favoured due to:

- The number of series compensation installations that are required to cover all critical contingencies has been found to be extensive;

- There is a need to address the potential for sub-synchronous resonance. Controllable series compensation may be required entailing increased cost; and

- Present short circuit ratings would most likely require large-scale replacement or reconstruction of a number of 330 kV switchyards. During this work it would be necessary to maintain the existing reliability of the connections to the generators and load. The switchyards to be uprated/replaced would include:

  - Sydney West
  - Bayswater
  - Liddell

The presently preferred option is upgrading the 500kV western system to 500 kV operation and supporting works. This involves work in existing switchyards only and hence can be managed so as to not have a significant environmental impact.

The 500kV development provides a significant improvement to the line loading and voltage control capability of the existing system.

4. LIKELY SCOPE OF WORKS FOR THE 500kV UPGRADE

The works for the upgrade can be confined to existing substation sites. The works are expected to include:

Bayswater

- Development of a 500 kV switchyard
- Installation of two 500/330 kV tie transformers
- Conversion of two generator units to 500 kV

Mt Piper

- Development of a 500 kV switchyard
- Installation of two 500/330 kV tie transformers

Marulan

- Development of a 500 kV switchyard
- Installation of two or three 500/330 kV tie transformers

Supporting Works

- Sydney area and selected power station switchyards - Shunt capacitive support (static-switched and possibly dynamic plant)
- System protection and control developments