TransGrid's Submission to the
Australian Competition & Consumer Commission

Revised Transmission Capital Investment Program 2004-2009

Section 1 of 10

Summary and Overview

November 2004

1 SUMMARY

Introduction

The original program for setting TransGrid's revenue cap for each year of the period 2004/05 to 2008/09 was based around a final Australian Competition and Consumer Commission (Commission) decision in about April 2004. However, it has been decided to apply new regulatory principles to transmission businesses in the National Electricity Market. It has also been decided that it would be appropriate for these principles to be applied to the current TransGrid revenue cap Application. As a result the Commission has established a revised timetable for TransGrid's revenue cap decision involving a revised revenue cap Application from TransGrid.

This Summary Section is the first Section of ten separate Sections that, together with the detailed supporting information (referred to therein), and information provided in response to past and future Commission information requests, constitute TransGrid's second revenue cap Application. The primary focus of this second Application, as agreed with the Commission, is on TransGrid's future capital expenditure needs.

The objective of this Summary Section is to provide guidance on the content of the other Sections of the Application and to summarise the key points arising from each Section. It does not, of itself, constitute TransGrid's position on any particular matter. It also includes a Master Project List (Attachment 1B) and a high level summary of the key projected base costs associated with TransGrid's proposed capital program. The Master Project List includes extensive references to key supporting documents and is intended to assist the Commission and their advisers in managing the detailed review of this information.

The ten Sections forming the basis of the revised TransGrid Application are:

- Section 1 Summary and Overview (This Section)
- Section 2: The Relevant Regulatory Framework
- Section 3: TransGrid's Capital Expenditure Program – Context and Needs
- Section 4: Plant Replacement Capital Expenditure
- Section 5: Customer Demand (Load) Driven Reliability Capital Expenditure
- Section 6: Main System (Generation and Load Driven) Capital Expenditure
- Section 7: Interconnection Capital Expenditure
- Section 8: Technical Services Capital Expenditure
- Section 9: Support the Business Capital Expenditure
- Section 10:Consolidated Capital Expenditure Requirements

The remainder of this Section summarises the content and key points arising from each Section of the Application.

Section 2 - The Relevant Regulatory Framework

<u>Content</u>

At the time of finalising this revised Application, the regulatory principles to apply to TransGrid's future capital expenditure were the subject of extensive consultation. The status of this consultation was contained in a number of documents ranging from the Commission's Draft Decision on the Statement of Regulatory Principles, Commission staff papers on possible incentive arrangements, and records of meetings and correspondence between TransGrid and the Commission.

Section 2 sets out TransGrid's understanding of the Commission's proposed arrangements at the time of drafting of this Application. It also sets out TransGrid's concerns with those arrangements and possible alternatives that would meet the objectives of the National Electricity Code and the Commission.

Section 2 also identifies specific matters that need to be addressed in the Commission's final decision to ensure clear and fair administration of the final decision over the full regulatory period.

This Section 2 does not consider the most recent proposals by Commission staff (confirmed in correspondence dated 11 November 2004) because, at the time of formulating this Application, TransGrid had not fully considered these proposals.

<u>Key Conclusions</u>

1. The regime established by the Commission must:

   - support the delivery of TransGrid's legal obligations
   - have regard for the relevant Government policy context
   - deliver the regulatory outcomes required by the National Electricity Code
   - subject to the above, minimise the cost of regulatory processes to both TransGrid, the relevant regulator and other stakeholders.

2. A year-by-year '*ex ante'* capital expenditure cap would be set based on a forecast of capital expenditure for the forthcoming regulatory period, with this forecast broken down by *principal purpose* of each significant capital project or development complex.

3. The *ex ante* cap and its associated consequences for annual regulatory depreciation would be incorporated into the maximum allowed revenue calculation underpinning TransGrid's revenue determination. Where possible to do so accurately the maximum allowable revenue calculation should be indexed to factors that will affect the *ex ante* cap in predetermined ways.

4. Any material capital expenditure item for which the occurrence of the principal purpose or critical assumptions are too uncertain to be capable of establishing a sensible probability weighted expenditure forecast (as described above) should be excluded from the forecast established above ('excluded projects'). This would include projects where timing uncertainties imply material uncertainty in the expenditure to be incurred during the relevant regulatory period.

5. In the event that capital expenditure is incurred on projects, or because of events, that were deemed to have been excluded from the original capital expenditure forecast (whether noted as such or not at the time of a revenue cap determination) then this expenditure will be treated on a basis similar to the Option 2 incentive arrangements proposed by ACCC staff in the paper entitled 'Incentivisation of Excluded Projects' (attached to the ACCC letter dated 1 October 04)

6. An allowance for excluded projects may or may not be incorporated into the revenue determination, although the existence of the principal purpose and critical assumptions for such projects should be noted as part of the revenue determination, if applicable.

7. At the commencement of next revenue-reset process, the opening regulatory asset value would be established by:

   - rolling-in all out-turn capital expenditure which had a principal purpose in line with those enumerated in the forecast *ex ante* cap established at the beginning of the prior regulatory period;

- such capex would be rolled-in to the regulatory asset base at its cost to TransGrid, after adjusting for changes in the price level in accordance with the applicable change in the consumer price index or some other agreed index;

- the roll-in process would involve no compensation or adjustment for any differences in the time value of money, i.e. there would be no adjustment – upward or downward – for any forgone (or over-compensation for) regulatory return on investment between the date the expenditure was incurred and the date at which the opening regulatory asset value is established for the next revenue determination; and

- the regulatory depreciation allowance applied to the roll-forward process would involve no adjustment in terms of either timing or magnitude from that established at the original revenue determination.

8. To the extent that certain or specified 'off ramp' events may result in specific and unanticipated projects being undertaken the actual costs of those projects will be fully included (including a time value of money element) in TransGrid's regulatory asset base at the time of the next regulatory reset. In this regard some correlation needs to be established between the definition of 'off ramp events' and the 'pass through' events discussed in relation to operating expenditure. This would simplify the definition of relevant classes of events and would help address situations where such an event impacted on both operating costs and capital costs.

9. The existence of specified 'off ramp' events would not limit the scope of potential *ex post* review as per 7 above. That is, the specified 'off ramp' events would not include all possible circumstances under which actual circumstances deviated materially from the assumptions underlying the *ex ante* cap.

10. Of particular importance is the need to explicitly define and 'lock in' the arrangements to apply to TransGrid during the 2004/05 to 2008/09 regulatory period.

Section 3 - TransGrid's Capital Expenditure Program – Context and Needs

Content

This Section provides an overview of the key strategic drivers on TransGrid's future capital expenditure. It outlines TransGrid's key service obligations and the relative importance of capital expenditure in ensuring the delivery of these obligations. The increasing need for both replacement capital expenditure and capital expenditure to lift network capability is briefly explained. This includes an outline of the key planning assumptions including the basis for forecasting the relevant future customer demand.

The challenge of simultaneously providing additional transmission capability to service increasing customer demand in major load areas, lifting the capability of the main interconnected system, and accommodating new and uncertain generation developments is also highlighted.

Key Conclusions

1. Electricity transmission is a capital intensive business with the existing transmission network, and augmentations to that network, playing a central role in meeting service obligations over time. The on-going performance of assets making up the network needs to be preserved, either by maintaining or replacing assets. Ultimately investment is essential to ensure that transmission capability is maintained and enhanced over time to meet current and future customer needs.

2. Since establishment in 1995 TransGrid has undertaken relatively modest levels of capital expenditure on asset replacement compared to average replacement costs over the life of the asset base and compared to the practices of other transmission businesses. This has been due to a combination of factors including reliance on asset condition information rather than asset age in making replacement decisions, a comprehensive ongoing asset maintenance program, and the relative average age of the asset stock.

3. Over time the age profile of TransGrid's network assets is changing. In 1999 there was only one major 330kV substation that had exceeded its nominal service life. By the end of the regulatory period covered by this Application the number of substations older than their nominal service life will have increased to about 12. In most instances these substations are large and 'system critical'.

4. For transmission planning purposes it is the capability of the transmission network during maximum demand periods that is usually most relevant. Maximum demand is forecast to continue growing at recent historical levels and summer demand, which is growing faster than winter demand, is becoming a primary driver of the need for new transmission capability.

5. In NSW, electricity demand has been growing steadily at, or above, median level forecasts since the last major electricity generator was commissioned at Mt Piper in 1993. This has been a reflection of buoyant economic conditions, changing household structures, and an increased penetration of electricity dependent technologies such as computers and air conditioners. In some areas, such as the coastal regions of NSW, population shifts have resulted in above average increases in demand, stretching the capability of all local infrastructure.

6. Over the same period historically low levels of additional new transmission lines and substations have been added. 90 % of TransGrid's existing 330/500kV transmission lines (in Km length) and substations (numerically) were established between 1960 and 1990. Only an additional 10% has been added in the past 14 years.

7. No major new generation sources have been established in NSW since 1993. Given the persistent increase in the demand for electricity since that time this does not appear to be a sustainable position. NEMMCO has recognised this in its 2004 Statement of Opportunities (SOO) in which NEMMCO forecasts the need for around 7,300 MW of new generation by about 2013/14 across the NEM over and above currently committed plant including the recently announced 750 MW Kogan Creek development in Queensland. The Scenario referred to in the SOO proposed that 2,800 MW of this generation would be in NSW.

8. Studies of the capability of the current main NSW interconnected transmission system show that, around summer 2008/09, transmission capability will most likely be insufficient to meet acceptable reliability standards. Exactly when this will occur, and how much transmission investment will be required to overcome these limits, depends on the location and sequence of new generation development. The continued development of 500kV capability in NSW is a key strategic option that accommodates most scenarios while minimising the need for future new line routes. Section 6 of this Application addresses these needs in more detail.

9. The Commission's approach to TransGrid's capital expenditure needs is vital to the ability of TransGrid to deliver adequate and timely transmission capability. Without this capability acceptable levels of power system reliability within NSW cannot be assured over the next 4 to 9 years.

10. The Commission's approach needs to recognise the challenges for TransGrid presented by accommodating the legitimate concerns of communities proximate to new transmission developments and the need to deliver new transmission investment in an environmentally sustainable fashion.

Section 4 - Plant Replacement Capital Expenditure

Content

This Section sets out TransGrid's capital expenditure requirements for asset replacement projects for 2004/05 to 2008/09. It also addresses the capital expenditure required to enhance physical security of network assets in the heightened physical threat environment and to meet public safety expectations.

Details are provided on:

- TransGrid's overall asset management processes and procedures
- How individual investment decisions fit with this strategy
- The rigour of the investment selection and costing process

Longer term strategic considerations are provided, including the level of asset replacement work expected to emerge in subsequent regulatory periods based on age and condition considerations. The impact of these considerations on the timing and prioritisation of expenditure is explained.

Information is also provided on linkages between asset replacement projects and network augmentation needs. For example, there are some older transmission lines needing to be replaced in the coming regulatory period that could also be up rated to meet a longer term augmentation need. The effect of this on timing of work to optimise overall outcomes is explained.

The aggregate investment proposed on asset replacement is benchmarked using comparisons between the proposal for this 5-year period and the subsequent 5-year periods, comparisons with the historic trend in TransGrid's asset replacement capital expenditure, and comparisons with asset replacement capital expenditure by other NEM transmission businesses.

Key Conclusions

1. TransGrid uses well-developed and documented processes to ensure that its existing assets are effectively and efficiently managed. Documents provided by TransGrid to support its replacement capital investment process should be evaluated in the context of this overall process. The quality of TransGrid's asset management process was recognised by the receipt of a National Engineering Excellence Award in 1997.

2. Augmentation and asset replacement capital expenditure investments are co-ordinated where practical and subject to compliance with National Electricity market code requirements. Documentation prepared to support the replacement capital expenditure decision and approval processes addresses potential augmentation impacts.

   Through this process TransGrid seeks to optimise the benefit occurring from an investment decision. As a result some investment projects provide both a replacement and an augmentation benefit. Where each component is significant the costs are apportioned between the replacement and the augmentation capital budget request in this revenue reset application.

3. The asset replacement capital expenditure proposal is divided into 4 categories as follows:

   - Individual Plant Replacement Projects: These are replacement projects relating to a class of asset across multiple locations. Examples of these projects are the replacement of a specific circuit breaker type identified under an asset management strategy for replacement. Individual plant replacement projects are subdivided into work streams. Individual projects may subsequently be aggregated into packages of work for effective project delivery.

- Major and Combined Projects: These are larger projects covering multiple strategies, generally requiring significant engineering input. Examples include the replacement of the Taree 132 kV Substation control system. Also included under this category are costs to complete the Yass Substation rebuild, the Sydney West Substation Static VAR Compensator and easement works associated with QNI interconnector projects, which have previously been examined by ACCC in its review of 1999-2004 historic capital expenditure.

- Regional Depot Projects: These investments relate to building and workshop projects at regional depots.

- Regulatory Projects: Capital investment in the identified projects is necessary to comply with specific regulatory requirements such as orders issued by the NSW Environmental Protection Authority, a Chemical Control Order issued under the Environmentally Hazardous Chemical Act 1985, and mines subsidence issues.

4. The levels of replacement capital expenditure proposed have been developed by expert groups in each functional area, using a rigorous a 'bottom up' approach. It is needs driven with the primary objective being to maintain network performance over the long term. Proposals are assessed and works timed using a risk-based approach to determine the quantum of work in the 5 year reset period now being addressed.

5. High level comparative measures set out in Section 3 confirm that the proposed expenditure is relatively efficient.

6. Analysis in TransGrid's 30 Year Network Plan shows that, as a result of the past construction timelines for the existing network, an increasingly significant proportion of assets will reach the end of their nominal economic lives over the next 5 to 20 years. This analysis also shows that the quantum of investment proposed is consistent with future expenditure trend lines and is appropriate for the long-term viability of the network.

7. The total asset replacement capital expenditure of $326 million proposed for the years to 2004/2005 to 2008/2009 is summarised in Attachment 1A (to Section 1) of this Application. These asset replacement capital expenditure cost projections are efficient and essential to maintain required network performance over time. Any short-term reductions in asset replacement or refurbishment effort will lead to deterioration in availability and reliability that will require time and substantial expenditure to recover.

Section 5 - Customer Demand (Load) Driven Reliability Capital Expenditure

Content

The network augmentations described in Section 5 are primarily driven by the need to satisfy NSW Jurisdictional and Code network reliability obligations in the face of growing demand on the network in various regions of NSW.

The documentation provided in Section 5 (or provided under separate cover in relation to Section 5) consists of the following:

- A brief description of the need for each project (or group of projects).
- Copies of relevant outline plans.
- Copies of relevant planning reports.

Projects covered by Section 5 are shown as such in Attachment 1B to Section 1 of this Application. Attachment 1B also includes the relevant reference in TransGrid's current Annual Planning Report, the classification of the project in terms of its size and likelihood of proceeding; and references to relevant outline plans and planning reports.

Outline plans give a broad outline of the currently envisaged development of the network in a particular area of NSW. They describe the major strategic issues to be considered and outline the envisaged network development in terms of major requirements, or specific developments where these are considered likely.

Planning reports detail specific emerging network constraints and describe one or more options for augmentations that will relieve the constraints over a suitable planning period.

Key Conclusions

1. The need, timing and scope of each of the network augmentation projects discussed in Section 5 provide an efficient basis for ensuring acceptable reliability standards as customer demand for electricity (load) grows.

2. The level of expenditure associated with these projects for inclusion in the 'ex-ante' capital expenditure profile totalling $765 million over the 2004/05 to 2008/09 regulatory period is appropriate.

3. Projects associated with the following development complexes should be treated on an excluded basis during the 2004/05 to 2008/09 regulatory period:

   - Mason Park 330/132kV GIS Substation and Associated Works.
   - Kemps Creek to Sydney South Development.
   - Associated easements and land.

Section 6 - Main System (Generation and Load Driven) Capital Expenditure

Content

The NSW main system comprises the 500 kV, 330 kV and 220 kV system that connects the major power stations to the major load centres and the interconnections with other States. This system extends from the Queensland border to the Victorian border and encompasses the Snowy transmission system. This system has been progressively developed over the last 50 years in response to load growth and power station development.

This Section of TransGrid's Revenue Reset Application covers the main system developments that are required over the 2004/5 to 2008/9 period.

The following projects are covered:

- Upgrading of the Bayswater – Mt Piper – Marulan system to 500 kV
- Transmission line development – 500kV:
  - Hunter Valley to Eraring / Richmond Vale
  - Bannaby to Sydney
  - Connection of a Ulan / Rylstone power station
- Capacitor bank installations
- Tamworth 330 kV shunt reactor
- Kemps Creek transformer capacity
- Line uprating
- Rearrangement of Central Coast circuits
- Switching rearrangement – Sydney West – Liverpool 330 kV line
- Bus coupling of 330 kV busbars

- Armidale SVC – system oscillatory damping
- Weather monitoring – line ratings
- Disturbance monitoring
- Multiple contingencies – Special Protection Scheme
- Quality of supply monitoring

Section 6 also explains the factors driving main system developments including the main system planning criteria adopted.

Main system development needs are characterised by considerable uncertainty, primarily due to the difficulties in predicting the location of new generation, both in NSW and across the NEM. Rates of future growth in customer demand, particularly in the Sydney – Newcastle – Wollongong region of NSW, also contribute to uncertainty about the future capability requirements of the main system. Coupled with the long lead times associated with transmission line developments this uncertainty presents TransGrid with a particular challenge in ensuring the timely delivery of main system developments.

This challenge is, in part, addressed by analysing a wide range of possible scenarios, or backgrounds, involving different load growth outcomes and generation development options in the NEM. Section 6 explains the use of this process, together with the findings arising from this process. The various generation and interconnection development options affecting NSW are discussed, the implications for main system capability are explained, the associated network augmentation requirements identified and the probabilities associated with each background assessed.

The uncertainty and scale of main system developments makes a number of these projects natural candidates for treatment as ‘excluded projects. Section 6 identifies these projects and sets out the rationale for this treatment.

<u>Key Conclusions</u>

1. The following are the main system transmission developments that will be required, based on the analysis of the range of Backgrounds (generation and demand scenarios):

    - Upgrading of the Bayswater – Mt Piper – Marulan system to 500 kV
    - Transmission line development – 500kV:
        - Hunter Valley to Eraring / Richmond Vale
        - Bannaby to Sydney
        - Connection of a Ulan / Rylstone power station
    - Capacitor bank installations
    - Kemps Creek transformer capacity
    - Line uprating
    - Rearrangement of Central Coast circuits

2. A number of other developments will be required, largely independent of the Backgrounds:

    - Tamworth 330 kV shunt reactor
    - Switching rearrangement – Sydney West – Liverpool 330 kV line
    - Bus coupling of 330 kV busbars
    - Armidale SVC – system oscillatory damping
    - Weather monitoring – line ratings
    - Disturbance monitoring
    - Multiple contingencies – Special Protection Scheme
    - Quality of supply monitoring

3. The upgrade of the Bayswater – Mt Piper – Marulan system to 500 kV operation is required by 2008/09 in all the medium load growth Backgrounds and the high load growth Backgrounds. In the low load growth Background the need is deferred by one year to 2009/10.

4. Whilst the first of the 500 kV line developments is expected to be required this decade it is expected that within 10 to 15 years reinforcement of the system from the Hunter Valley to the coast and from the south to Sydney will both be required. The order of development of the lines will be governed by the order of generation development. When these lines are developed the 500 kV ring in NSW will effectively be closed providing a high capacity for power transfer around the ring.

5. In addition to the 500 kV line developments that close sections of the 500 kV ring there will be a need to develop new lines to connect new power stations. It is assumed for example that, if developed, the Ulan / Rylstone power station could be connected to the proposed Wollar switchyard, which is along the route of the Bayswater – Mt Piper line. Other power station developments have been assumed to be connectable directly to existing switchyards or have required only minor line works for connection.

6. The main system will require an ongoing installation of shunt switched capacitor banks and possible SVC’s. Approximately 400 MVAr of new plant is required per annum up to the time of upgrading of the western system to 500 kV operation. This is broadly common to all Backgrounds.

7. There are two 1200 MVA 500/330 kV transformers in service at Kemps Creek. The transformer capacity will need to be augmented to meet the high north to south power transfers that occur in some of the Backgrounds. These are Backgrounds that include additional northern generation and reinforcement of the Hunter Valley to coast system. The timing is 2009/10 except under three high load growth Backgrounds where the additional capacity would be required in 2008/9.

8. The following projects are proposed for treatment on an “excluded” basis:

   - Hunter Valley – Coast 500 kV Development: This development includes a new 500 kV line and possibly development of a Richmond Vale 500/330 kV Substation.

   - Bannaby Area – Sydney 500 kV Development: This development includes a new 500 kV line from the Marulan / Bannaby area to Sydney. It may require development of 500/330 kV transformation at Sydney West Substation.

9. Although both these projects are to be treated as excluded projects it is considered necessary to commence investigations into the potential route of the line and establish the feasibility of their construction to minimise lead-times in the future. It may also be necessary to acquire a site for a 500/330 kV substation in the Cobbitty area, depending on the feasibility of constructing a 500 kV line to Sydney West.

10. The main system development complexes to be included in the ex-ante capital expenditure targets for the 2004/05 to 2008/09 regulatory period are the Western 500kV upgrade and QNI upgrade proposal. As shown in Attachment 1A to Section 1 of this Application the total estimated cost of these projects during the regulatory period is $199 million.

Section 7 - Interconnection Capital Expenditure

Content

This Section is closely related to the matters considered in Section 6 and addresses the potential interconnection developments over the period from 2004/5 to 2008/9. Specifically the following matters are addressed:

- Drivers for interconnection development and the role of planning criteria
- Components of the NSW interconnections
- NSW interconnection capability
- Outcomes of Joint Planning Work with Powerlink and Vencorp
- Interconnector developments included in the various Backgrounds referred to in Section 6
- Maintaining and upgrading interconnection capability
- Projects to be treated as 'excluded'

Key Conclusions

1. NSW is heavily interconnected with Victoria and Queensland and also with the Snowy region. The interconnector capabilities are functions of load levels and generation dispatch. Most of the interconnector capabilities will decline over time and one will increase over time in response to load growth in NSW.

2. The power transfer capability of the interconnectors is determined by four factors:

   - Line thermal ratings;
   - Voltage control capability;
   - System oscillatory damping; and
   - Transient stability of the power system.

   Any one, or all four, of these factors may limit the power transfer over any interconnector at any time, the power transfer capability being determined by the most restrictive of the capabilities. The limitations are generally expressed as constraint equations, which define a technical envelope for the system. These constraint equations may include variables that cover system load levels, voltage profile, generation inertia etc.

3. The power transfer capability is based on the ability of the networks to withstand credible contingency events that are defined in the National Electricity Code. These events mainly cover forced outages of single generation or transmission elements, but also provide for multiple outages to be redefined as credible from time to time.

4. The main drivers for maintaining the present interconnection capability and for interconnection reinforcement are:

   - to meet the growing demand in NSW, relying in part on interstate generation;
   - to support the other States by sharing NSW surplus generation at time of reduced NSW demand; and
   - to facilitate the trading of power across the NEM.

5. As the NSW margin of supply over demand deteriorates with load growth during the 2004/05 to 2008/09 period, main system reliability requirements encourage a focus of at least maintaining the capability of the interconnections.

6. Accordingly the Backgrounds in Section 6 covering 2004/5 to 2008/9 have allowed for the works that maintain present capabilities with respect to the following:

   - NSW import from the south

- NSW import capability from Queensland

The associated works include:

- Refurbishing work on the Murray – Lower Tumut and Murray – Upper Tumut 330 kV lines.
- Uprating the Marulan – Dapto 330 kV lines.
- Reactive support at Canberra.
- Installation of power flow control on the Armidale – Kempsey 132 kV line

7. A preliminary cost/benefit study concluded that only the low cost schemes that provided an improvement in the NSW import capability may be able to be justifiable under the Regulatory Test. Since that study was completed the Kogan Ck Power Station became a committed project and the joint study is now being repeated. The competition benefits from interconnector development will need to be examined in the study.

8. The capability for NSW export to Queensland will decline over time as the northern load grows, exacerbating line rating limitations. In addition, the development of the Kogan Ck Power Station (750 MW unit), being significantly larger than the present Queensland units, will significantly reduce NSW export capability with respect to transient stability.

9. The Victorian import capability is determined by the ratings of lines south of Murray and voltage control limitations. The capability is declining over time with the growth in the NSW south west area load.

10. Significant upgrade of the interconnection is feasible but it would require new line works, which could not be completed in the five year Revenue Reset period. The development of a Yass – Wagga 330 kV line is one option for improving the Victorian import capability[1].

11. It is not considered feasible to complete a major new interconnector in the 2004/05 to 2008/09 period as a significant upgrade of the interconnectors would be expected to require major new line works

12. The projects related to the possible upgrade of interconnection capability and that are expected to involve expenditure in the 2004/05 to 2008/09 period are:

    - Development of a Yass – Wagga 330 kV line
    - Series compensation of the QNI lines

    It is intended that these projects be treated, essentially, as "excluded" projects. However, it is considered necessary to include some related expenditure in the proposed ex-ante capital expenditure targets for the 2004/05 to 2008/09 period. This is required to further develop the design of these projects, and to commence investigations into the potential route of the Yass Wagga 330 kV line and establish the feasibility of its construction to minimise lead-times in the future.

[1] It should be noted that the line may also improve NSW import capability from the south as well as improving Victorian import capability. The benefits for NSW import are addressed in section 7.10.1.

Section 8 - Technical Services Capital Expenditure

Content

The planned or committed network reinforcements discussed in Sections 5, 6 and 7 require associated communication system works. These works facilitate the provision of control of the power system and substation elements, network protection, data acquisition, plant monitoring and physical security arrangements.

In addition to these works there are requirements for the provision of communications systems that are not aligned to any project. This Section 8 focuses on these 'non-aligned' projects, usually associated with corporate data and operational systems. In particular, it discusses projects required to meet standards established by NEMMCO in accordance with NEMMCO's powers and obligations as set out in the National Electricity Code.

The projects covered are:

- North coast microwave system
- Darlington Pt – Wagga microwave radio
- Snowy area OPGW augmentation
- South western system SCADA
- New England area SCADA
- SCADA disaster recovery facility
- Western system redundancy augmentation
- Southern system redundancy augmentation
- Metropolitan system redundancy augmentation

Key Conclusions

1. The main drivers for the development of the additional links in the telecommunication system are

    - Provision of SCADA facilities to 132 kV substations
    - Communication of corporate data to staff at all sites
    - Operational communications
    - Monitoring of plant
    - Physical security
    - NEMMCO Power Systems Data Communications Standard (PSCDS).

2. These projects, together with the technical services costs associated with network augmentation projects, involve a total expected expenditure of about $23 million over the regulatory period from 2004/05 to 2008/09.

Section 9 - Support the Business Capital Expenditure

Content

This Section covers the additional capital expenditure needed to support the core operations of the business. Examples of this kind of expenditure include Information Technology, mobile plant, and miscellaneous office equipment. Information Technology is a major component of this expenditure.

Key Conclusions

Information Technology

1. IT investments in the organisation are managed in accordance with TransGrid's IT governance procedure (described in Attachment 9A). The key components of this procedure that govern the capital projects are:

   - IT Strategic Plan which sets the overall objectives of IT strategies;
   - Annual IT planning process which requires prioritisation and ranking of all IT capital projects; and
   - Business cases for each project that quantifies the costs and benefits.

2. The preparation of five year estimates for Information Technology needs to be able to anticipate:

   - changes in technology; and
   - volatility of the IT market place.

3. To try and address the changes in the regulatory framework the estimates for IT have been restructured so that the estimates are broken into three broad categories:

   - cyclical system upgrades and replacements;
   - business performance improvement projects; and
   - a factor to mitigate uncertainty.

4. The major categories of cyclical system upgrades and replacement for the five years are show below with detailed estimates of each category in Attachment 9B.

Cyclical System Upgrade and Replacement	
Applications	$15.7m
Infrastructure	$18.7m
Corporate Data Network	$5.9m
Desktop Hardware and Software	$12.9m
SCADA	$5.2m
Total	**$58.4m**

5. The cost estimates in point 4 above are based on TransGrid's historical experience of the upgrades and replacements. The estimates are built up from the current number of systems, servers, routers etc with the estimated number of replacements in the regulatory period. Each estimates is based on:

   - the current prices of software or equipment; and
   - historical unit cost services and labour in managing, configuring and implementing the component.

6. In addition to the cyclical replacement of and upgrade of IT systems there are opportunities to improve business performance or compliance though the utilization of IT. Any projects to be implemented in TransGrid will be controlled through the IT governance processes including:

   - IT Strategic Plan
   - Annual Project Planning cycle; and
   - Approval of projects based on business cases.

7. Discussions with the IT research company Gartner has indicated that companies should provide for at least 20% of their IT spending on new developments and application overhaul to keep itself healthy and competitive. On this basis TransGrid would expect that investment in business performance improvement is at least 20% of the total IT capital expenditure i.e. $14.6 million.

8. As noted in Section 3 of this Application, TransGrid faces a number of significant challenges in delivering the required network capability enhancement over the next two regulatory periods. For the first time since its establishment in 1995 new transmission capability is simultaneously required to meet local reliability needs, reinforce the main interconnected system, and accommodate new generation developments. It is also the first time that this confluence of events has occurred in NSW since the establishment of competitive market arrangements in the electricity sector.

9. TransGrid has adopted the generic estimate by Gartner because of uncertainty, at the time this Application was being prepared, as to which improvement projects would have the strongest business cases. However, it is clear that a significant proportion of this type of expenditure is likely to be associated with supporting capital project delivery processes. That is, in light of the challenges now facing TransGrid in developing the capability of the NSW transmission network (refer point 8 above) it is likely that the generic estimate based on the Gartner work is conservative.

10. The uncertainty in the area of IT is of concern to TransGrid in submitting its estimates under the new framework. TransGrid requires this risk to be mitigated with a mechanism such as:

    - inclusion of a specific provision to address the large amount of uncertainty in this area;
    - off ramps for large unexpected events, or
    - excluded projects be included in the IT area.

    TransGrid would like to work with the ACCC staff to design the parameters for these measures.

<u>Motor Vehicles and Mobile Plant</u>

1. TransGrid manages assets that are geographically dispersed across NSW. To service these assets a range of motor vehicles is required. TransGrid has adopted a strategy of purchasing and reselling these assets. Specialised mobile plant such as cranes and bucket trucks are also required. Where plant is specialised in nature and/or is not readily available from plant hire companies then purchasing of plant is undertaken.

2. The gross cost of motor vehicles and mobile plant over the regulatory period is $ 39.5 million. While this has been included in the capital expenditure forecast, an adjustment in the Commission's Post Tax Revenue Model is required to properly reflect the expected disposal value of these assets during the regulatory period. This is currently estimated at about $ 25 million.

<u>Miscellaneous Assets and State Records Security Upgrade</u>

An allowance of $ 9.2 million has been included over the regulatory period for these assets associated with servicing TransGrid's sites across NSW.

Section 10 - Consolidated Capital Expenditure Requirements

Content

This Section outlines the 'build-up' of capital expenditure requirements for the period 2004/05 to 2008/09. It provides a guide to the linkages between this 'build-up' and the following key 'build-up' elements:

- capital expenditure drivers
- capital expenditure projects
- capital expenditure build-up structure
- cost estimates and scope definition of the projects
- the pooled contingency
- planning backgrounds
- the effect of excluded projects and the excluded projects capital expenditure summary
- summary

Key Conclusions

1. A high level summary of the capital expenditure requirements proposed in this Application is shown below ($2004 millions):

Included Projects

Capex Components	Total over 5 years	2004/05	2005/06	2006/07	2007/08	2008/09
Asset Replacement Projects	326	67	74	67	57	61
Support the Business Projects	122	24	24	24	24	24
Augmentation Projects	987	70	125	170	350	273
Pooled Contingency	92	10	14	17	29	23
Total Capex	1527	171	237	278	460	382

Excluded Projects

Capex Components	Total over 5 years	2004/05	2005/06	2006/07	2007/08	2008/09
Total Excluded Projects	620	0	3	26	239	353

2. A more detailed summary of the capital expenditure requirements proposed in this Application is provided in Attachment 1A to Section 1.

TransGrid’s Submission to the
Australian Competition & Consumer Commission

Revised Transmission Capital Investment Program 2004-2009

Section 2 of 10
The Relevant Regulatory Framework

November 2004

2 THE RELEVANT REGULATORY FRAMEWORK

2.1 Introduction

This Application has been prepared without having the regulatory rules that will apply to TransGrid for the relevant regulatory period fully settled. Notably the arrangements for setting and administering that component of TransGrid's revenue cap associated with capital expenditure remain open for general consultation at this time. Questions also remain as to whether the regime is fully Code compliant.

TransGrid acknowledges and appreciates that Commission staff have been open about their thinking and have engaged on the specifics of the framework as it will apply to TransGrid. The Commission's objectives of improving the arrangements for regulating transmission capital expenditure, including improving incentive arrangements and simplifying the administration of the regime are recognised.

However, the fact remains that many aspects of the regime remain unsettled and, in some cases involve unresolved practical issues. The regime, as it will apply to TransGrid, remains a collection of evolving consultation documents, staff papers, working papers and associated analysis, and meeting notes, often without formal Commission endorsement.

TransGrid has also had very little time to reorientate its business systems to accommodate the move from an 'ex-post' regime for setting capital expenditure needs to an 'ex-ante' style regime with a very different risk profile for managing the formidable and relatively complex task of maintaining and developing network capability. This task is compounded by uncertainties about the type and location of future generation sources in a market context, fragmented responsibilities for power system reliability, a range of possible future load growth patterns, uncertainties about future costs and the scope of various development options, and long lead times associated with many of the more economic network development options.

In this context TransGrid has considered the Commission's proposals carefully[1]. It is TransGrid's view that the Commission's proposed regime needs amendment to achieve compliance with relevant legal instruments and Government policy positions. In addition, greater clarity on the application of the regime to TransGrid is required in some areas.

This Section of TransGrid's Application this section attempts to address these issues and set out the framework assumed by TransGrid formulating this Application. In so doing TransGrid has used the Commission's most recent proposals[2] as the starting point and attempted to understand and incorporate the Commission's objectives in developing any proposed changes to the framework. The approach taken is to first consider the relevant legal and policy context for the Commission's framework, then set out TransGrid's understanding of the Commission's proposed framework, and, finally explain TransGrid's position on each aspect of the proposed framework

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[1] At the time of finalising this Application Commission staff provided a new proposal that, if implemented, would appear to address some of TransGrid's key concerns. However, this Application does not include consideration of this proposal (as summarised in a letter from staff dated 11 November 04) because of limited to time to fully consider the matters raised. TransGrid is appreciative of the willingness of Commission staff to develop a workable regime that meets Code objectives and will be seeking to have the final arrangements settled and clearly articulated in the Commission's draft decision for consideration by interested parties.

[2] ibid

2.2 Relevant Legal and Policy Context

The regime established by the Commission must:

- support the delivery of TransGrid's legal obligations,
- have regard for the relevant Government policy context,
- deliver the regulatory outcomes required by the National Electricity Code.

The following sections of this Application set out the relevant requirements in each of these areas.

2.2.1 TransGrid's Legal Obligations

These obligations are discussed more detail in Section 3 and in TransGrid's original revenue cap application provided to the Commission in September 2003. Essentially there is a substantial body of legislation that imposes obligations on TransGrid. This includes the State Owned Corporations Act that requires TransGrid to provide reliable, safe, and environmentally sustainable transmission services. TransGrid's processes for achieving these outcomes, including the transmission planning standards to be adhered to within NSW, are set out in TransGrid's Network Management Plan as submitted to the NSW Department of Energy, Utilities and Sustainability for review on annual basis.

TransGrid (and the Commission) must also meet the requirements of the National Electricity Law and National Electricity Code. Together these instruments impose a range of obligations, both to individual Code Participants, and the National Electricity Market and the wider community generally.

Capital expenditure is primarily driven by the need ensure that these obligations are met.

2.2.2 MCE Policy Statements

While TransGrid's service and other obligations are defined at any point in time by relevant legislation, Codes and licences, guidance on the future direction of these obligations is provided by relevant Government policy. In the NEM the primary vehicle for developing and articulating energy market policy is currently the Ministerial Council of Energy (MCE).

Among other matters the MCE has recently (December 2003) adopted the following principles to underpin transmission policy in the NEM:

- The transmission system fulfils three key roles – it provides a transportation service from generation source to load centre, facilitates competition, and ensures secure and reliable supply.
- There is a central ongoing role for the regulated provision of transmission, with some scope for competitive (market) provision.
- Transmission investment decisions should be timely, transparent, predictable and nationally consistent, at the lowest sustainable cost.
- The regulatory framework should maximise the economic value of transmission, including through the efficient removal of regional price differences in the operation of the NEM.

In recent times the impact of inadequate reliability has received increasing focus. This follows the major social and economic impacts of widespread blackouts in the US and Europe. More recently public inquiries have been conducted into the adequacy of distribution networks in Queensland.

2.2.3 Requirements of the National Electricity Code

Section 6.2.2 of the Code sets out the objectives of the transmission revenue regulatory regime to be administered by the Commission as follows:

> The *transmission* revenue regulatory regime to be administered by the *ACCC* pursuant to this *Code* must seek to achieve the following outcomes:
>
> (a) an efficient and cost-effective regulatory environment;
>
> (b) an incentive-based regulatory regime which:
>
> (1) provides an equitable allocation between *Transmission Network Users* and *Transmission Network Owners* and/or *Transmission Network Service Providers* (as appropriate) of efficiency gains reasonably expected by the *ACCC* to be achievable by the *Transmission Network Owners* and/or *Transmission Network Service Providers* (as appropriate); and
>
> (2) provides for, on a prospective basis, a sustainable commercial revenue stream which includes a fair and reasonable rate of return to *Transmission Network Owners* and/or *Transmission Network Service Providers* (as appropriate) on efficient investment, given efficient operating and maintenance practices of the *Transmission Network Owners* and/or *Transmission Network Service Providers* (as appropriate);
>
> (c) prevention of monopoly rent extraction by *Transmission Network Owners* and/or *Transmission Network Service Providers* (as appropriate);
>
> (d) an environment which fosters an efficient level of investment within the *transmission* sector, and upstream and downstream of the *transmission* sector;
>
> (e) an environment which fosters efficient operating and maintenance practices within the *transmission* sector;
>
> (f) an environment which fosters efficient use of existing infrastructure;
>
> (g) reasonable recognition of pre-existing policies of governments regarding *transmission* asset values, revenue paths and prices;
>
> (h) promotion of competition in upstream and downstream markets and promotion of competition in the provision of *network services* where economically feasible;
>
> (i) reasonable regulatory accountability through transparency and public disclosure of regulatory processes and the basis of regulatory decisions;
>
> (j) reasonable certainty and consistency over time of the outcomes of regulatory processes, recognising the adaptive capacities of *Code Participants* in the provision and use of *transmission network* assets;
>
> (k) reasonable and well defined regulatory discretion which permits an acceptable balancing of the interests of *Transmission Network Owners* and/or *Transmission Network Service Providers* (as appropriate), *Transmission Network Users* and the public interest as required of the *ACCC* under the provisions of Part IIIA of the Trade Practices Act.

2.3 TransGrid's Understanding of the Commission's Proposals

This section summarises TransGrid's understanding of the Commission's proposed ex-ante capital incentive framework. This understanding takes into account the draft SRP released in August 2004 and subsequent information provided to TransGrid regarding the excluded project and off-ramp mechanisms[3].

2.3.1 Capital expenditure efficiency mechanism - firm ex-ante cap

- Ex-ante review of capital projects included in the cap with **no ex-post review**.
- Projects under the ex-ante cap would be specified up front, but the business would have full discretion as to what projects it constructs.
- The cap would be firm. Any spend over and above the cap would not be recognised in the asset base at any stage and therefore would not form the basis of the allowed revenues stream at subsequent regulatory reviews.
- The difference in revenues between the allowed amount and any spend under the cap would be kept by the business for the remainder of the period. However, only the capital invested up to the cap would be included in the asset base moving forward.
- The cap is to be set where possible using probability analysis and scenario modelling;
- The cap can also be linked to key business drivers such as load growth.

2.3.2 Excluded projects

- Some large and/or uncertain projects may be nominated to be excluded from the cap. The Commission has set out materiality criteria for such projects as a guide but will also use its discretion to decide which projects should be outside the cap. The Commission exclusion threshold is based on whether the expected error of including the project in the revenue line results in a greater than 10% error if the project does not go ahead.
- Excluded projects are those that are identifiable at the time of the review, however, are sufficiently uncertain in terms of timing and scope that it would be unreasonable to include in a firm cap.
- Projects will be excluded at the discretion of the Commission at the time of the review.
- An estimate of the excluded project's costs will be included in the revenue line in advance, but actual spend on excluded projects will be included in the RAB at the end of the period.
- An incentive mechanism will apply to excluded projects. A project specific cap will be agreed prior to the project's construction. The project specific cap will apply for a period of five years which may or may not align to the five year regulatory period.
- If a TNSP spends more than the amount agreed to, it will lost the carrying costs of any overspend. However, the actual cost of the investment is rolled in to the RAB.
- If the TNSP spends less than the cap, the TNSP benefits by retaining the return on any underspend for a 5 year period, with the actual lower cost of the asset rolled in to the asset base.

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[3] At the time of finalising this Application Commission staff provided a new proposal that, if implemented, would appear to address some of TransGrid's key concerns. However, this Application does not include consideration of this proposal (as summarised in a letter from staff dated 11 November 04) because of limited to time to fully consider the matters raised. TransGrid is appreciative of the willingness of Commission staff to develop a workable regime that meets Code objectives and will be seeking to have the final arrangements settled and clearly articulated in the Commission's draft decision for consideration by interested parties.

- This incentive mechanism differs from that which applies to the overall firm cap. In the case of excluded projects, the incentive penalty/benefit is symmetric. Actual cost regardless of whether it is higher or lower than the agreed cap is included in the asset base.

2.3.3 Off ramps

- Off-ramps are designed to address circumstances that are unexpected and unforeseen at the time of the review. Typically off-ramps will include force majeure events or changes in taxation rules etc.
- The off-ramp criteria are to be specified and negotiated between the TNSP and the Commission as far as is possible at the time of the review. The Commission proposes an annual materiality threshold equivalent to 5% of the average annual capital expenditure (in other words, one percent of the total capital expenditure target). The threshold will apply annually and to each off-ramp event. "If the present value of the investment following an off-ramp event exceeds the "threshold", then the full cost will be recoverable from consumers". This is different from the Commission's previous position, as set out in its draft decision on the SRP, which proposed that an "excess" would apply to each off-ramp event which TNSPs would bear. The "excess" proposal has now been withdrawn.
- "Off-ramp events" can only be invoked by TNSPs – in other words TNSPs will be covered (subject to the event meeting the threshold) against cost increases resulting from off ramp events. However, the off ramp mechanism will not be used to reduce the ex-ante cap should forecast events not occur. This aspect is also different from that proposed in the Commission's draft decision on the SRP.
- The adjustment of revenues to take account of off-ramp events has not been determined specifically (i.e. annual versus end of period adjustment). However, Commission proposes that "(t)he TNSP…will be allowed to include the actual expenditure incurred on the off-ramp project during the regulatory period in which the off-ramp occurred…".

2.4 TransGrid's Concerns with the Proposed Framework

TransGrid considers that the two primary objectives of the regulatory framework applying to capital expenditure should be:

- to ensure that TransGrid has an incentive to meet its statutory and other obligations in the most efficient manner; and
- subject to the above, to minimise the cost of regulatory processes to both TransGrid, the relevant regulator and other stakeholders.

TransGrid does not believe that the Commission's proposed incentive arrangement for capital expenditure is consistent with the Code requirements which require that the regulatory regime administered by the Commission must seek to achieve an incentive based regulatory regime and which provides for a sustainable commercial revenue stream including a rate of return on efficient investment.

The Commission's capital expenditure framework is not designed to meet the objective of providing a return on efficient investment, in fact it explicitly countenances that there could be no return on efficient investment. Nor does the regime provide an adequate incentive for TransGrid to meet its statutory and other obligations. In particular, TransGrid is concerned that the proposed methodology places too great an emphasis on reducing the regulator's responsibilities and costs and giving TransGrid an incentive to *reduce costs. T*his will inevitably be in conflict with TransGrid's overarching responsibilities to ensure reliable transmission of electricity in a safe and environmentally sustainable fashion. In sum, we believe that the proposed incentive regime gives too much emphasis to the incentive to reduce costs rather than the incentive to invest and operate efficiently.

At the core of the Commission's proposed regime is that any expenditure during the regulatory period above the level of the *ex ante* cap will not be incorporated into TransGrid's regulatory asset base at the end of the regulatory period. The Commission has indicated that it does not intend for there to be any scope for an *ex post* adjustment to the *ex ante* cap to reflect, for example, developments in the NEM that were unforseen at the time the cap was set. In effect, the Commission is proposing a regime whereby TransGrid will lose 100 per cent of the value of any dollar it spends in excess of the *ex ante* cap.

Notwithstanding the proposals for 'excluded projects' and off-ramps' aimed at addressing uncertainty, the scheme involving loss of 100 per cent of expenditure in excess of the ex-ante cap clearly does not have an objective of providing recovery of efficient investment. Further, it can be expected to put TransGrid's management and Board in an impossible position. To the extent that there is any purpose in introducing such an *ex ante* cap there must be a material probability that it will at some stage be a binding constraint. In such a scenario TransGrid's board will be placed in a position where it must choose between making sound financial decisions for the benefit of the company and shareholders or meeting its statutory responsibilities and responsibilities as a good corporate citizen.

For example, it is quite conceivable that a combination of factors in the NEM could require TransGrid, for reliability purposes, to bring forward into the current regulatory period $100m of investment that was previously expected to take place in the next regulatory period. Assuming this were to cause TransGrid to breach its *ex ante* cap the cost to TransGrid would be $100m dollars. The imposition of an unreviewable *ex ante* cap gives TransGrid a strong incentive to compromise its obligations rather than to meet its obligations efficiently.

It is important to recognise that the penalty imposed on TransGrid for meeting its obligations will inevitably be higher than the magnitude of the any potential inefficiencies that may have caused it to breach the *ex ante* cap. In the above case, even if TransGrid was somehow responsible for the need to bring forward expenditure of $100m, the cost to society is limited to the time value of money. At a real discount rate of 8 per cent TransGrid would have to be responsible for a project being brought forward nine years before the cost to society is greater than the cost to TransGrid of that expenditure being in excess of the *ex ante* cap. In other words, situations where TransGrid does exceed the *ex ante* cap it can expect to be penalised at more than the cost to customers of any potential inefficiencies. Of course, this also assumes the additional costs arise from 'inefficiency', rather than 'new information'.

TransGrid is also concerned that the proposed asymmetric treatment of expenditures under and in excess of the cap will, in order to meet the Code requirements for prospective financial viability, require that the cap be set at a level higher than the expected capital expenditure for each regulatory period. TransGrid believes that the proper derivation of such a cap is a complex task requiring assumptions on a wide range of critical variables – such as the cost weighted probability distribution of all potential outcomes for each project. To date, the Commission has only provided generic statements on how it intends to approach this issue, yet this is vital for evaluating the appropriateness and practicability of this element of its proposal.

It is also not clear that imposition of an *ex ante* cap meets the Commission's stated objective of reducing costly regulatory intervention. Given the potential magnitude of the penalties arising from the cap being set too low, TransGrid believes it is incumbent on the regulator to devote at least as much effort to evaluating uncertain future expenditures - and to monitoring outcomes by reference to the scope of projects that fall 'in' and 'out' of the cap - as it would have to devote to reviewing actual expenditures under an *ex post* review.

2.5 An Alternative Approach

TransGrid believes it is possible to bring about some strengthening of the incentives to meet its statutory and other obligations in the most efficient manner, relative to the default position where all capital expenditure is rolled into the regulatory asset base without penalty in terms of the timing or magnitude, subject to the potential for ex post review as to its efficiency.

The proposal outlined below is a modification of that set out to date by the Commission, and involves the following key principles:

- that the forecast capital expenditure program should identify the *principal purpose* and *critical assumptions* for each significant (implying a materiality threshold) project or development complex, thereby providing a reference point for *ex post* review of expenditure where this turns out to be necessary;
- that the regulated business can access incentive regime options where the financial penalties and rewards embodied in an incentive mechanism are symmetric when evaluated on a forward looking basis, and where such symmetry should be achieved by identical mechanisms for the treatment of underspend and overspend;
- that, to the extent that asymmetric incentive arrangements are proposed they are offered as options for the regulated business to adopt on a voluntary basis in lieu of symmetric incentive arrangements;
- penalties and rewards for over- or under-spend should decline for years later in the regulatory period, reflecting the increasing uncertainty of expenditure forecasts further into the future; and
- the arrangements should provide for *ex post* review of expenditure in circumstances where the principal purpose or critical assumptions concerning any particular project materialise differently from expectations (in this regard there is scope for a project materiality threshold given that there are probably a large number of relatively small projects involved in the build up of the ex ante capital expenditure targets).

The key elements of such an arrangement would be as follows:

1. As described above, a year-by-year '*ex ante'* cap would be set based on a forecast of capital expenditure for the forthcoming regulatory period, with this forecast broken down by *principal purpose* of each significant capital expenditure project or development complex. This forecast would be developed in accordance with the expected value principle, ie. material risk asymmetries associated with any particular capital expenditure item would be assessed and the expected cost adjusted accordingly. The principal purpose categorisation would identify such matters as:

   - Committed projects i.e. projects that satisfy the criteria to be classified as committed as set out in NEMMCO's Statement of Opportunities. This would include projects already under construction.
   - Likely projects i.e. projects that are expected to satisfy the requirements of Regulatory Test or other relevant approval process required by the NEC. Likely projects will consist of augmentation projects that are not yet committed but have already passed the regulatory test or met other approval requirements as set out in the NEC, as well as refurbishment/replacement projects resulting from an asset management strategy or other agreed justifications. (These projects would include 'approved' augmentations where 'approved' is as defined in the NSW Annual Planning Report).
   - Possible projects i.e. projects that are neither committed nor likely but are sufficiently small in magnitude and large in number such that the probable sum value of expenditure on these projects within a regulatory reset period can be estimated in advance with high levels of confidence.

The expected variance in the sum present value of all ‘likely’ and ‘possible’ projects must be sufficiently small when expressed as a percentage of the expected mean for the sum cost of those projects. If this is not the case then the most uncertain projects must be removed and treated as ‘excluded projects’ (see below) until this is the case.

Critical assumptions for each significant capital expenditure project or development complex should also be identified, eg:

- principle purpose of the capital expenditure item e.g. reliability, generator/customer access to market, environment, public safety;
- load growth (both average and locational) and timing;
- basis for cost estimates e.g. project scopes, previous cost of similar projects, relevant exchange rates, expected future market conditions;
- the expected location and output of generators in the NEM; and
- other relevant assumptions.

2 The above *ex ante* cap and its associated consequences for annual regulatory depreciation would be incorporated into the maximum allowed revenue calculation underpinning TransGrid’s revenue determination. Where possible to do so accurately the maximum allowable revenue calculation should be indexed to factors that will affect the *ex ante* cap in predetermined ways. Examples of such variables may be:

- construction price indexes;
- the value of the Australian dollar against the trade weighted index or other exchange rate indicator; or
- average load growth.

3 Any material capital expenditure item for which the occurrence of the principal purpose or critical assumptions are too uncertain to be capable of establishing a sensible probability weighted expenditure forecast (as described above) should be excluded from the forecast established above (‘excluded projects’). This would include projects where timing uncertainties imply material uncertainty in the expenditure to be incurred during the relevant regulatory period.

An example a project likely to be treated as an excluded project would be one where an investment with expected cost of $100m to support the development of a new gas fired generation facility may be required, but the probability of that generation facility being developed may be, say, 20 per cent. In that event the probability weighted cost would be $20m, even though the cost outcome can only be either $100m or zero. This example assumes that the probability weighting of the cost can be measured. Where the probability cannot be ascertained with certainty on such a project then that project would also be an excluded project.

Excluded projects would include both projects that were identified in the process of setting the *ex ante* cap but were excluded from that cap and projects arising from exogenous events that were unanticipated at the time of setting the *ex ante* cap. For example, a project necessitated by a customer connection that was not previously anticipated would still be treated as an excluded project.

In order for an unanticipated event to qualify a project for treatment on an excluded basis the cost impact of the event must meet some materiality threshold (results in a cost impact that is more than 5% of the ex-ante capital expenditure target in any one year of the regulatory period or $5 million – whichever is the lesser).

4 In the event that capital expenditure is incurred on projects, or because of events, that were deemed to have been excluded from the original capital expenditure forecast (whether noted as such or not at the time of a revenue cap determination) then this

expenditure will be treated on a basis similar to the Option 2 incentive arrangements proposed by Commission staff in the paper entitled 'Incentivisation of Excluded Projects' (attached to the Commission letter dated 1 October 04). Specifically, the Commission and TransGrid will agree whether the project should be subject to a separate incentive arrangement. If such an arrangement is to apply the Commission and TransGrid will agree on a present value of forecast expenditure for that project and TransGrid will be penalised/rewarded by the foregone/surplus returns on capital arising on any difference between actual and estimated present value at the completion of the project. The forecast cost of that project will be agreed at the time the project becomes committed. The actual expenditure on the project will be rolled into the RAB at the completion of the project.

If it is decided that no such incentive arrangement is to apply TransGrid's actual expenditure will be rolled-in to the new regulatory asset base at its cost to TransGrid, after adjustment for both changes in the CPI and to include the foregone regulatory return between the date the expenditure was incurred and the date of inclusion in the opening regulatory asset base. Examples of where incentive arrangements may not apply could include projects that are urgently required to meet a statutory requirement and the project cost is considered of relatively low priority compared with the importance and timeliness of meeting the statutory requirement. Major reconstruction (following, for example, sabotage or destruction due to natural events such as earthquakes, storms, or bushfires) needed to urgently restore reliable power supplies to large numbers of customers may be an example of this. In cases where there is no incentive scheme in operation the Commission could undertake an ex-post assessment of the efficiency of the expenditure immediately upon completion of the work.

In some instances unanticipated exogenous events may affect the need for and/or cost of a number of projects simultaneously. The affected projects could be projects included in forming the annual ex-ante expenditure targets as well as various excluded projects. Examples include changes to reliability or environmental standards, new Code requirements, new easement compensation requirements, new taxes, or major movements in market costs. This type of 'off ramp' event and the treatment of such events is discussed further below.

5 An allowance for excluded projects may or may not be incorporated into the revenue determination, although the existence of the principal purpose and critical assumptions for such projects should be noted as part of the revenue determination, if applicable.

6 At the commencement of next revenue-reset process, the opening regulatory asset value would be established by:

- rolling-in all out-turn capital expenditure which had a principal purpose in line with those enumerated in the forecast *ex ante* cap established at the beginning of the prior regulatory period;
- such capital expenditure would be rolled-in to the regulatory asset base at its cost to TransGrid, after adjusting for changes in the price level in accordance with the applicable change in the consumer price index or some other agreed index;
- the roll-in process would involve no compensation or adjustment for any differences in the time value of money, ie, there would be no adjustment – upward or downward – for any forgone (or over-compensation for) the regulatory return on investment between the date the expenditure was incurred and the date at which the opening regulatory asset value is established for the next revenue determination, and
- the regulatory depreciation allowance applied to the roll-forward process would involve no adjustment in terms of either timing or magnitude from that established at the original revenue determination.

7 For the absence of doubt the Commission and TransGrid will specify a number of ‘off ramp’ events that are clearly not reflected in the *ex ante* cap. Examples of such ‘off ramp’ events are acts of terrorism, natural disaster and changes in planning standards. To the extent the ‘off ramp’ event results in specific and unanticipated projects being undertaken the actual costs of those projects will be fully included (including a time value of money element) in TransGrid’s regulatory asset base at the time of the next regulatory reset. In this regard it appears that there needs to be some correlation established between off ramp events and the pass through events discussed in relation to operating expenditure. This would simplify the definition of relevant classes of events and would help address situations where events impact on both operating costs and capital costs.

In order to invoke an ‘off ramp’ event the impact on TransGrid’s costs of such an event must be material (i.e. the event results in a cost impact that is more than either 5% of the ex-ante capital expenditure target in any one year of the regulatory period or $5 million). Once this threshold is exceeded the entire cost attributed to the event that is efficient is rolled into the RAB.

To the extent that the ‘off ramp’ event results in higher costs for other projects (ie, projects included in the *ex ante* cap or excluded projects) then an appropriate adjustment to the forecast cost of those projects will be made (ie. the *ex ante* cap increased or the forecast cost of the excluded projects increased). If a change to the *ex ante* cap must be made that can not be reflected in current period revenues then TransGrid’s regulatory asset base at the next regulatory reset must be set to include the value of lost revenues as a result of the use of a lower than appropriate *ex ante* cap.[4] Actual expenditure would also be rolled into TransGrid’s asset base (as per 4 above).

[Note that if planning standards change and everything in the *ex ante* cap gets made a little ‘bigger’ to comply then we can’t just say ‘roll in actual expenditure’ associated with the event because this will not be unambiguously measurable relative to performance on the old *ex ante* cap. If revenues can’t be there and then changed to reflect the revised *ex ante* cap then an adjustment at the end of the period will probably be necessary.]

8 The existence of specified ‘off ramp’ events would not limit the scope of potential *ex post* review as per 7 above. That is, the specified ‘off ramp’ events would not include all possible circumstances under which actual circumstances deviated materially from the assumptions underlying the *ex ante* cap.

9 As an alternative, and in addition to, the symmetrical *ex ante* cap described above, TransGrid sees benefits in the Commission also offering an *ex ante* cap that is not symmetrical – along the lines originally proposed by the Commission. In that circumstance TransGrid would be given the opportunity to choose between the two caps. A particular advantage of this approach is that it would explicitly reveal to interested parties the Commission’s assessment of the extent to which the ex-ante cap needs to be adjusted (as a result of being able to compare the level of the proposed cap with the symmetric incentive ex-ante cap option) to compensate for a given level of asymmetry in the incentive regime. As such the Commission would overcome one of the key shortcomings of its current regime – lack of transparency. In addition, TransGrid would only adopt this option where there was a high level of confidence that the target level was set sufficiently high to ensure that the risk of spending above the cap on required investment was acceptably low.

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4 That is, ‘off ramp’ event adjusted revenues must be re-estimated using a retrospective run of the PTRM with the ‘off ramp’ adjusted *ex ante* cap. The difference in the present value of revenues between this and actual revenues must be incorporated into TransGrid’s regulatory asset base at the beginning of the next regulatory reset.

2.6 Conclusion

In summary, this proposal (the above mentioned 9 points taken together) achieves the outcome of delivering an incentive based regulatory regime which provides for a sustainable commercial stream of revenue including a fair and reasonable rate of return on efficient investment, as required by the National Electricity Code. The resulting incentive regime would encourage TransGrid to undertake efficient capital expenditure without excessive penalties being imposed on TransGrid because of additional expenditure required to meet statutory and other legitimate service obligations. Accordingly, the regime would also obviate the need, except in limited and more clearly defined circumstances, to undertake a detailed ex post review of ex ante forecast expenditure, given the incentive properties are such as to lead to efficient investment expenditure.

This regime, largely as a result of the revised symmetrical incentive applying to the ex-ante cap, would also reduce concerns about the design of thresholds used in determining whether projects should be treated on an excluded basis and whether events can be treated as off ramps. This is because costs and risks to regulated businesses arising from the presence of materiality thresholds only impact on within period returns rather than the value of the Regulatory Asset Base in perpetuity.

TransGrid’s Submission to the Australian Competition & Consumer Commission

Revised Transmission Capital Investment Program 2004-2009

Section 3 of 10

TransGrid’s Capital Expenditure Program - Context and Needs

November 2004

3 TRANSGRID'S CAPITAL EXPENDITURE PROGRAM – CONTEXT AND NEEDS

3.1 Introduction

There is no disputing the need for electricity transmission networks. These networks ensure reliable delivery of bulk electricity from generation sources to major load centres. In the context of electricity market reform the role of a strong transmission grid in facilitating competition and providing customers with access to the lowest cost generation sources in real time has also been widely recognised. This need was clearly articulated in the policy statement by the Ministerial Council of Energy in December 2003[1].

However, there is often debate about how much transmission is enough transmission. In the early days of Australian electricity market reform a number of commentators spoke confidently about over investment, or 'gold plating', in the electricity sector. As electricity market reform has evolved, both in Australia and internationally, there has been increasing concern about under investment in electricity transmission[2]. The debate on the adequacy of transmission networks involves considerations of economic efficiency, community expectations, and ultimately, judgement informed, hopefully, by sound analysis of the relevant information and understanding of the issues involved.

The assessments carried out by TransGrid and expert third parties, present a compelling case for increasing the level of investment in the TransGrid network over the next two to seven years. Without this it will not be possible to continue maintaining transmission service performance at levels acceptable to the community and NEM Participants. Indeed, the work that needs to be done will extend TransGrid's capability to new limits. Innovation will be required to find new ways of 'stretching' network capability, influencing the demands placed upon the network, and delivering new capability in a timely fashion without unduly burdening local communities with new transmission lines.

This Section, Section 3, of TransGrid's Application sets out, in general terms, the processes for delivering new transmission capability, the factors driving the need for increased investment in TransGrid's network, and the challenges faced in delivering that investment in a timely fashion. It is intended to provide an appropriate strategic context for the Commission, their advisers and other stakeholders within which to assess the remainder of this Application. It is naturally hoped that, as a result, the Commission's final revenue cap decision will be framed in a way that contributes to, rather than hinders, the efficient and timely delivery of the required transmission capability.

[1] Among other matters the MCE has recently (December 2003) adopted the following principles to underpin transmission policy in the NEM:

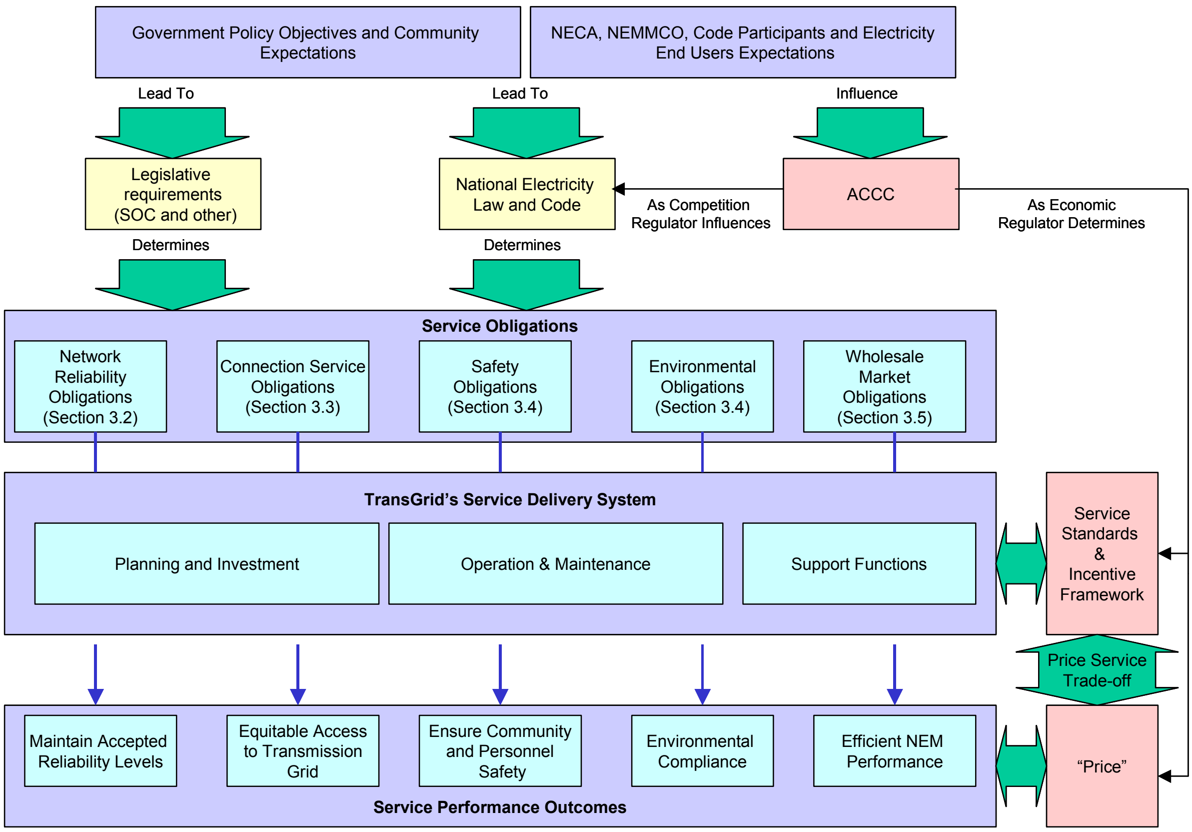
- The transmission system fulfils three key roles – it provides a transportation service from generation source to load centre, facilitates competition, and ensures secure and reliable supply.
- There is a central ongoing role for the regulated provision of transmission, with some scope for competitive (market) provision.
- Transmission investment decisions should be timely, transparent, predictable and nationally consistent, at the lowest sustainable cost.
- The regulatory framework should maximise the economic value of transmission, including through the efficient removal of regional price differences in the operation of the NEM.

[2] Global Transmission Expansion – recipres for Success, Fiona Woolf, Penn Well Corporation, 2003, p14-15.

3.2 Transmission Capability and the Role of Capital Expenditure

In TransGrid's original revenue cap Application (submitted September 2003) TransGrid's service obligations and the delivery system for meeting those obligations were explained. This overall process is repeated in *Figure 3.1* below.

Figure 3.1

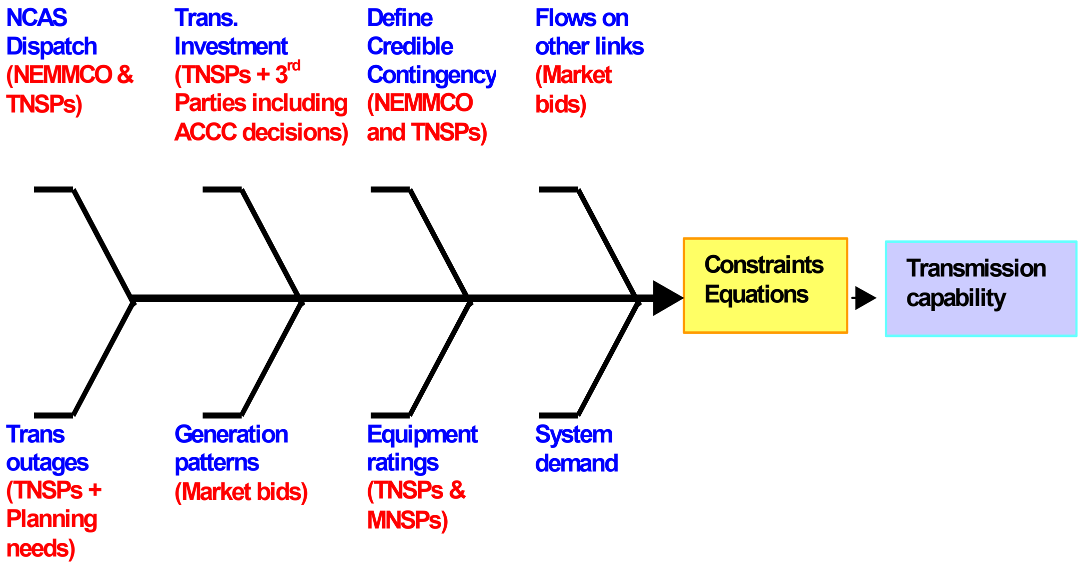


In essence TransGrid is required to ensure that electricity transmission is continuous (reliable), safe, environmentally sustainable, and supports the objectives of the National Electricity Market as required by the National Electricity Code (NEC). TransGrid's obligations are set out in a range of instruments including the NSW State Owned Corporations Act, the NEC, and planning criteria approved by the NSW Government.

In terms of the service expectations of Stakeholders, that may ultimately be reflected in future obligations, the Ministerial Council of Energy (the peak Government policy making body for the National Electricity Market) has provided helpful guidance in its December 2003 policy statement[1]. Essentially the MCE defines the role of transmission as providing the means of transporting electricity from generation to load, providing adequate levels of reliability, and supporting competitive wholesale trading arrangements in the NEM.

The factors impacting on the capability of the main interconnected transmission system required to meet these obligations are shown in *Figure 3.2* below.

Figure 3.2



Broadly, at any point in time, network capability between any two points on the main interconnected transmission system depends on a range of variables and their interaction with the constraint equations used within NEMMCO's market dispatch engine. These variables include:

- The availability and dispatch of network control ancillary services ("NCAS"), some of which are procured by NEMMCO from generators and some of which are delivered by TNSPs.
- Generation dispatch patterns resulting from market driven bidding behaviour.
- Patterns of customer demand at the various "take off" points from the transmission network.
- The nature of contingencies considered as being 'credible'. Credible contingencies are events the occurrence of which NEMMCO considers being reasonably possible under the prevailing conditions at the time (eg. the unexpected disconnection of a transmission line).
- Outages of transmission network elements and the timing of these outages.

Some of these variables, such as generation bids, change in relatively short time frames during which the constraint equations themselves do not change. Under these circumstances, in the short term, transmission capability is essentially outside of TransGrid's control.

The flow patterns that can be accommodated by TransGrid's existing network are essentially determined by the existing network topology. Historically, this topology reflects the needs of past, more predictable, flow patterns associated with a centrally operated and planned power authority.

The flow patterns driven by market conditions (generator bids and increased variation in interconnector flows) are far more dynamic and demanding of this topology and result in new network constraints, even when there are no transmission outages.

Other variables, such as a planned transmission outage, lead to new constraint equations being applied by NEMMCO in the dispatch engine during the period of the outage. In this case, the representation of the outage within the constraint equations, and the transmission capability that results, is largely determined by NEMMCO's assessment of the system security implications. While

TransGrid may have some control over the timing of an outage, it has far less control over the resulting impact on transmission capability.

To achieve more permanent changes in transmission capability investment in new transmission augmentations is ultimately required, particularly when load continues to grow and more generation is located at sites remote from load. Investment leads to a more permanent change in the constraint equations used by NEMMCO in its dispatch engine, and hence, improved transmission performance across a wider range of generation and load scenarios.

In regional areas the need for investment to improve transmission capability is usually a simpler proposition. Experience, embodied in the notion of good industry practice and/or mandated planning standards, has shown that acceptable reliability can be delivered by investing in sufficient capacity to meet maximum forecast demand at times of maximum customer demand. Investment can, on occasions, be deferred by influencing customer usage patterns to reduce maximum or by encouraging local generation. These options are considered and encouraged where feasible and economic.

Electricity transmission is a capital intensive business with the existing transmission network and augmentations to that network playing a central role in meeting service obligations over time. The performance of assets making up the network needs to be preserved either by maintaining or replacing assets. Ultimately investment is essential to ensure that transmission capability is maintained and enhanced over time.

TransGrid's network is comprised of over 12,400 km of transmission circuits operating at voltages up to 500kV and 81 substations. It spans an area that extends from the Queensland to Victorian borders and 400km inland from the east coast with extension along the Murray River and up to Broken Hill. The coverage of TransGrid's network is set out in *Figure 3.3* and *Figure 3.4* below.

Figure 3.3

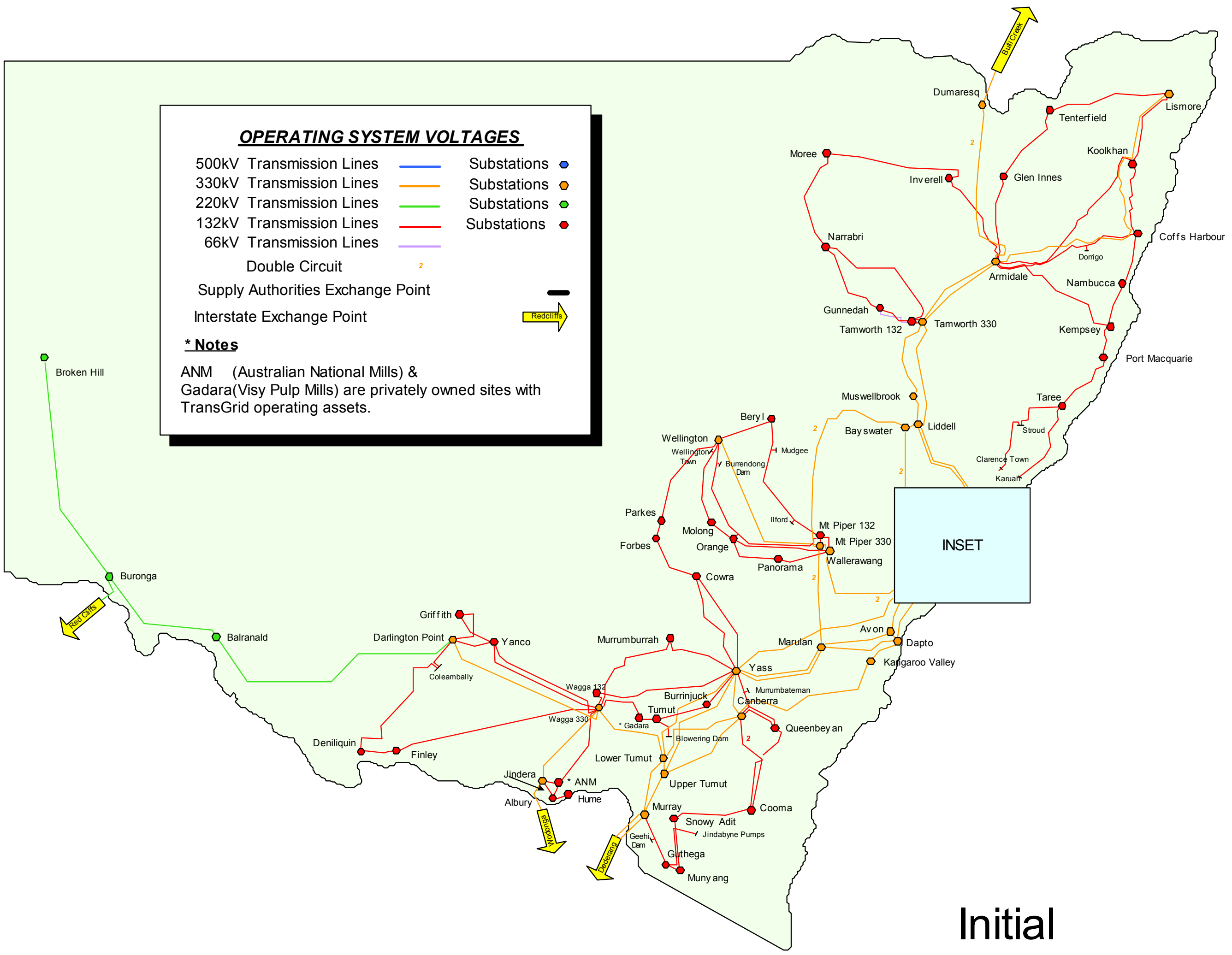
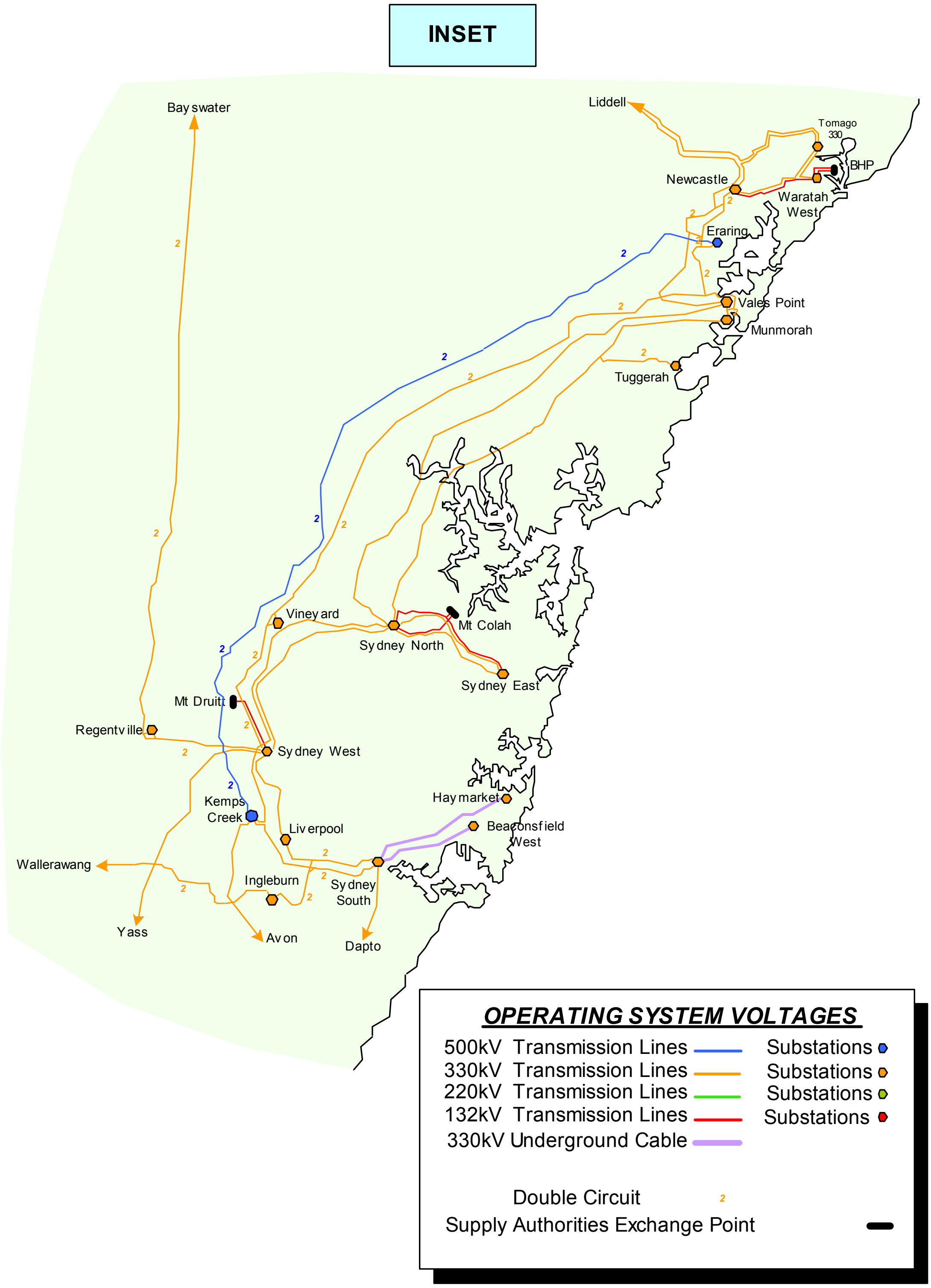


Figure 3.4


INSET
Bayswater
Liddell
Tomago
330
BHP
Newcastle
Waratah
West
Eraring
Vales Point
Munmorah
Tuggerah
Vineyard
Sydney North
Mt Colah
Sydney East
Mt Druitt
Regentville
Sydney West
Kemps
Creek
Liverpool
Haymarket
Beaconsfield
West
Wallerawang
Ingleburn
Sydney
South
Yass
Avon
Dapto
OPERATING SYSTEM VOLTAGES
500kV Transmission Lines
330kV Transmission Lines
220kV Transmission Lines
132kV Transmission Lines
330kV Underground Cable
Substations
Substations
Substations
Substations
Double Circuit
Supply Authorities Exchange Point

3.3 The Need for Increased Investment

Capital investment in transmission network businesses tends to fall into one of three categories as follows:

- Plant replacement where plant performance falls due to factors such as wear and tear and inability to maintain plant because of unavailability of spare parts;
- The need to increase transmission capability to meet increasing customer demand and/or new generation sources; and
- Expenditure to support business processes and operations such as expenditure on mobile plant or information technology.

There is an increasing need for capital expenditure in each of these categories within TransGrid. This is briefly explained in the following sub-sections.

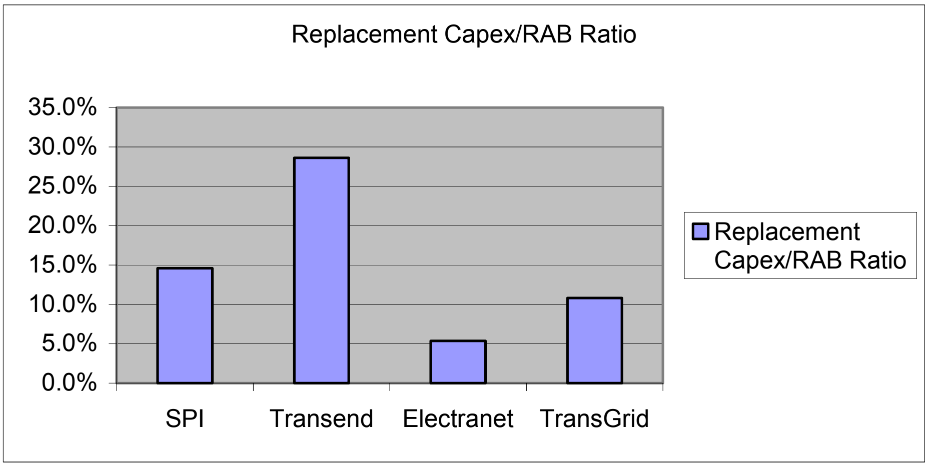
3.3.1 Maintaining Existing Network Performance Levels - The Increasing Need for Replacement Capex

Transmission network performance is critically dependent on the performance of individual assets making up the network. As assets age their performance deteriorates, sometimes in crucial ways. This could include reduced rating, lower speed of operation, inability to respond appropriately to system conditions, increased risk to the environment, creating a safety hazard to personnel and the general public, or becoming expensive or impossible to maintain. Ultimately major refurbishment or replacement becomes necessary.

Since establishment in 1995 TransGrid has undertaken relatively modest levels of capital expenditure on asset replacement when compared to expectations, and to other transmission businesses. This has been due to a combination of factors including reliance on asset condition information rather than asset age in making replacement decisions, a comprehensive ongoing asset maintenance program, and the relative average age of the asset stock.

TransGrid spent approximately $40 million ($2004) per annum over the past 5 years on asset replacement on an asset base with an estimated replacement value of about $5 billion. Assuming that the average economic life of a network asset is 50 years, then the average replacement expenditure per annum would be expected to be closer to $100 million[3] per annum.

Figure 3.5

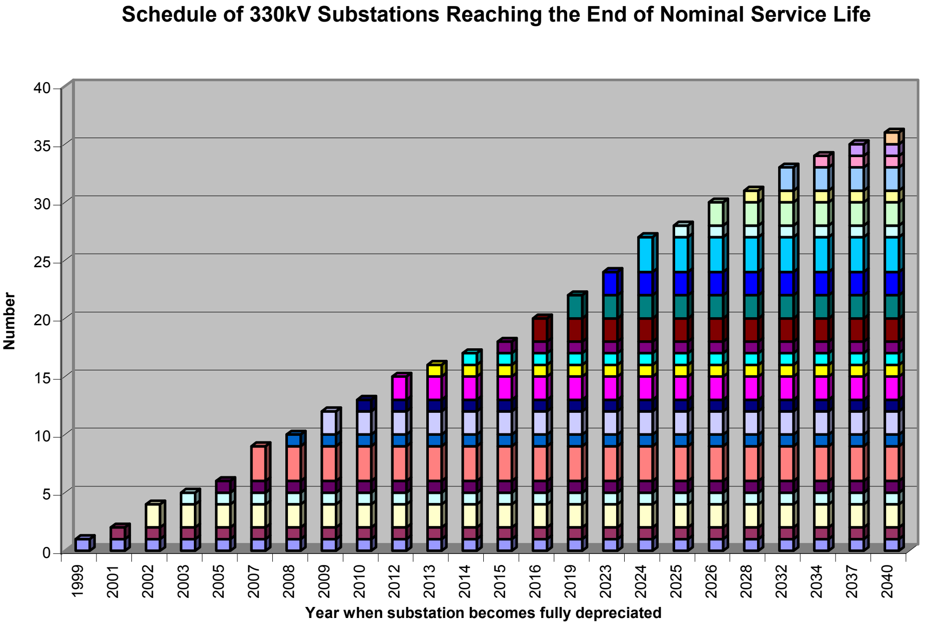


[3] Assuming economic depreciation occurs on a straight line basis over the life of the asset then replacement expenditure would be $5 billion/50 years = $100 million/year.

Comparison with other transmission businesses also suggests that TransGrid's proposed asset replacement expenditure remains relatively low. This is shown in *Figure 3.5* above where the ratio of replacement capital expenditure to the value of the Regulatory Asset Base is compared across a number of transmission companies. In most cases[4], the level of expenditure proposed by TransGrid in this Application appears to be significantly lower.

Over time the age profile of TransGrid's network assets is also changing. While this is dealt with in more detail in Section 4 of this Application, *Figure 3.6* below shows this trend in relation to TransGrid's 'fleet' of 330kV substations. In 1999 there was only one major 330kV substation that had exceeded its nominal economic life. By the end of the regulatory period covered by this Application the number of substations older than their nominal service life will have increased to about 12. In most instances these substations are large and 'system critical'.

Figure 3.6



This is not to say that these substations are in urgent need of replacement, progressive replacement or refurbishment of key components has been taking place as condition dictates. However, this is prima facie evidence of fundamental changes taking place in the replacement life cycle of TransGrid's assets.

The detailed process for assessing the need for asset replacement is set out in Section 4 of this Application. This process takes into account asset age, asset condition information, and risk assessments in formulating strategies for maintaining asset performance over time.

[4] Powerlink is not included because the relevant data has not been published. The data for Transend, ElectraNet, and SPIPowernet is from the most recently available ACCC revenue cap decisions.

3.3.2 Investment to Increase Network Capability

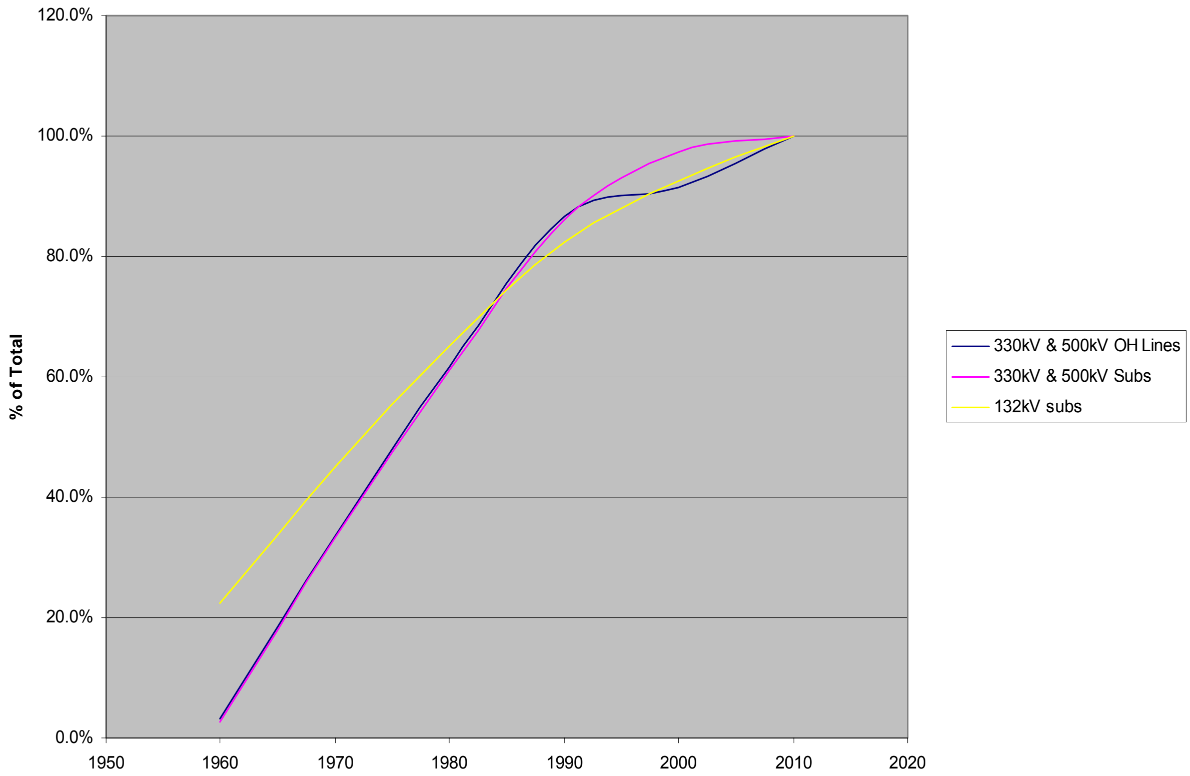
There are a number of factors that are combining to drive the need for additional transmission network capability. These include the need to maintain accepted performance standards, particularly transmission reliability, as the utilisation of the network increases. In turn, network utilisation increases because of growth in demand for electricity and/or new patterns of electricity generation.

In NSW, electricity demand has been growing steadily and at, or above, median level forecasts since the last major electricity generator was commissioned at Mt Piper in 1993. This has been a reflection of buoyant economic conditions, changing household structures, and an increased penetration of electricity dependent technologies such as computers and air conditioners. In some areas, such as the coastal regions of NSW, population shifts have resulted in above average increases in demand, stretching the capability of all local infrastructure.

Over the same period, historically low levels of additional new transmission lines and substations have been added. This is clearly shown in *Figure 3.7* below. 90 % of TransGrid's existing 330/500kV transmission lines (in Km length) and substations (numerically.) were established between 1960 and 1990. Only an additional 10% has been added in the past 14 years.

Figure 3.7

Development of the TransGrid System



In addition, over the same period, restructuring of the electricity market has been undertaken leading to increased uncertainty in the future location and timing of new generation sources, a greater role for interstate interconnection and new and less predictable pattens of transmission network utilisation.

Based on detailed assessments of future load growth expectations, and the need for new generation developments, the low levels of network capability development of the recent past are not sustainable. Without a concerted effort to lift capability over the next two to seven years acceptable performance levels will not be maintained.

Transmission Planning Standards

In addition to service obligations as set out in legislation, TransGrid is required to meet service obligations as set out in the National Electricity Code. In relation to investment the Code defines efficient investment as that developed by transmission service provider acting in accordance with good industry practice.

Furthermore, and to provide clarity on what is considered good industry practice, the transmission planning criteria to be applied within NSW are those approved by the NSW Government. These criteria are set out in TransGrid's Network Management Plan that is reviewed each year by the NSW Department of Energy, Utilities and Sustainability (DEUS). These planning criteria are set out in *Attachment 5A* to Section 5 of this Application.

In essence, these planning standards require TransGrid to ensure that the transmission network is capable of meeting the maximum expected demand with any single transmission element out of service. This standard can be varied by agreement with the relevant distribution body. For example, in the case of the Sydney area, the current standard requires maximum demand to be met without interruption, in some situations, where more than one transmission element is out of service.

Assumptions About Future Customer Demand

In carrying out assessments of the capability of the transmission system to meet future customer demand, robust forecasts of that demand need to be developed. More detail on the development of these forecasts, and the level of customer demand assumed in determining the need for transmission augmentation, is set out in TransGrid's Annual Planning Review[5]. For easy reference an extract from that document is provided in Attachment 3A to this Section of the Application.

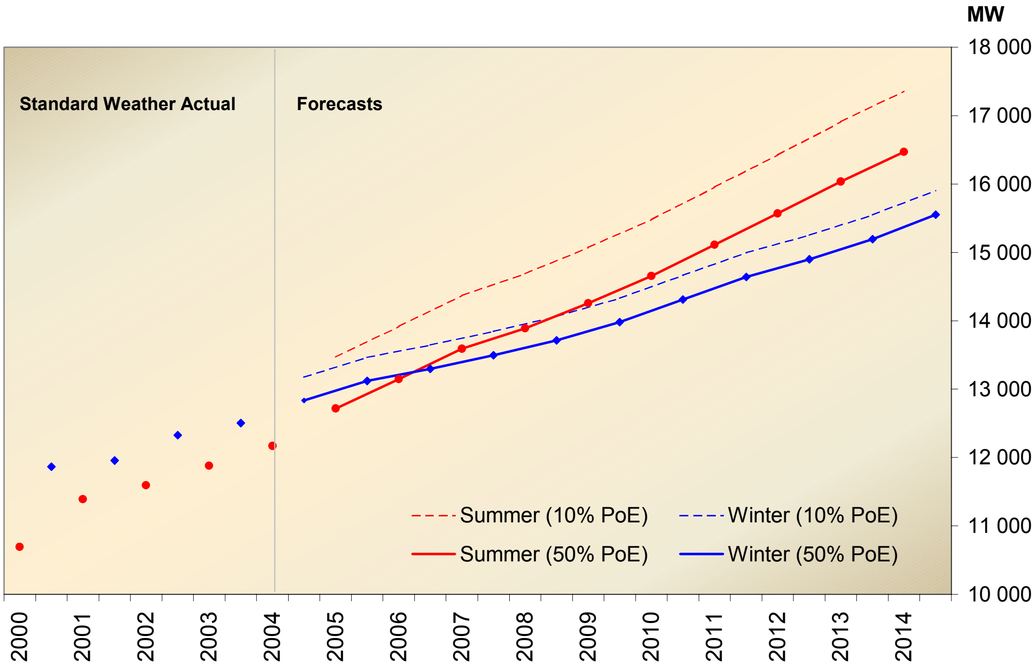
The key points to note here are that:

- Flows on the transmission network fluctuate and the network is planned to accommodate peak flows when key network elements are unavailable.
- For transmission planning purposes it is the capability of the transmission network during maximum demand periods that is usually most relevant.
- Planned transmission capability is determined using demand forecasts based on median (rather than high or low) economic growth assumptions.
- The level of customer demand can vary widely due to temperature with demand being highest on hot summer days and cold winter days. Transmission system capability improvement of the main interconnected system is planned on the basis of meeting the one in ten year temperature conditions. Networks servicing major load areas are planned to meet one in two year temperature conditions.
- Maximum demand is forecast to continue growing at recent historical levels and summer demand, which is growing faster than winter demand, is becoming a primary driver of the need for new transmission capability.

Figure 3.8 shows that based on the latest forecast, a NSW summer peak is likely to be the predominant pattern by the end of the decade under the medium economic growth scenario. In the interim, the prevailing weather conditions during the winter and summer months will greatly influence when the actual peak occurs.

[5] Forwarded to the ACCC under separate cover and available online from TransGrid's website.

Figure 3.8: NSW Summer and Winter SWPD



In addition to National and State wide forecasts, regional forecasts of customer demand are developed in close consultation with TransGrid's customers, the electricity distribution businesses. The key point about regional demand growth is that it can vary quite significantly from the State average. Notably, the coastal areas of NSW, particularly the northern coastal areas, are experiencing growth in customer demand significantly above the rest of the State driven primarily by demographic changes. This, in turn, accelerates the need transmission capability enhancement in those areas.

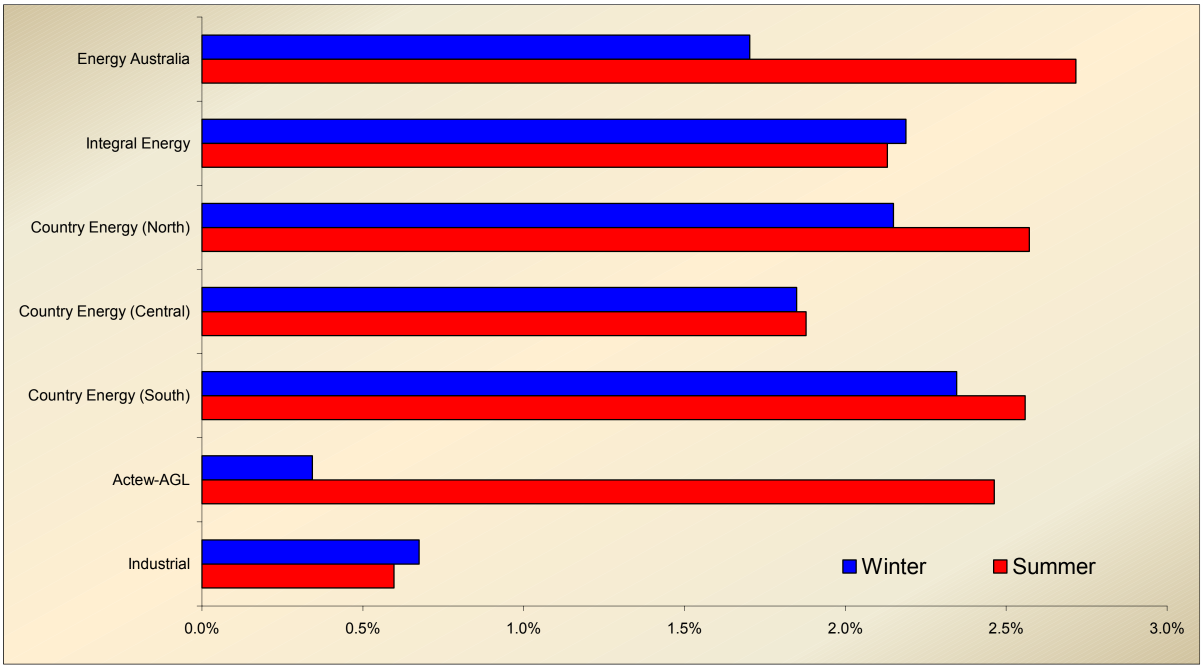
The Newcastle – Sydney – Wollongong region is experiencing growth broadly in line with the State average, primarily because the majority of NSW electricity consumption occurs in this region, and this growth dominates the calculation of overall growth forecasts.

Even though demand in the inland areas of the State tends to grow more slowly than the State average, demand can increase significantly and quickly as a result of large local developments. Examples include processing plants and mines. As a result, the need for reinforcement of the local transmission system can sometimes accelerate rapidly.

Figure 3.9 shows summer and winter peak demand growth forecasts for each of TransGrid's customers. These growth rates are based on TransGrid's estimate of the diversified total network demand for each franchise area and do not necessarily equate with forecast information published by the Distributors themselves.

The current forecasts, without significant demand side interventions, indicate that, in most areas of the State, growth in summer peak demand is expected to exceed winter peak demand, particularly in the Energy Australia, Actew-AGL, and Country Energy northern franchise areas.

Figure 3.9: Compound Annual Peak Demand Growth 2004-2014



Notes: Based on the latest Distributor connection point forecasts provided to TransGrid. Individual connection point forecasts have been aggregated for each Distribution area, excluding identifiable industrial loads, and then scaled using diversity factors calculated by TransGrid. A large step load has been excluded from the growth rate for the Country Energy southern region.

<u>New Generation</u>

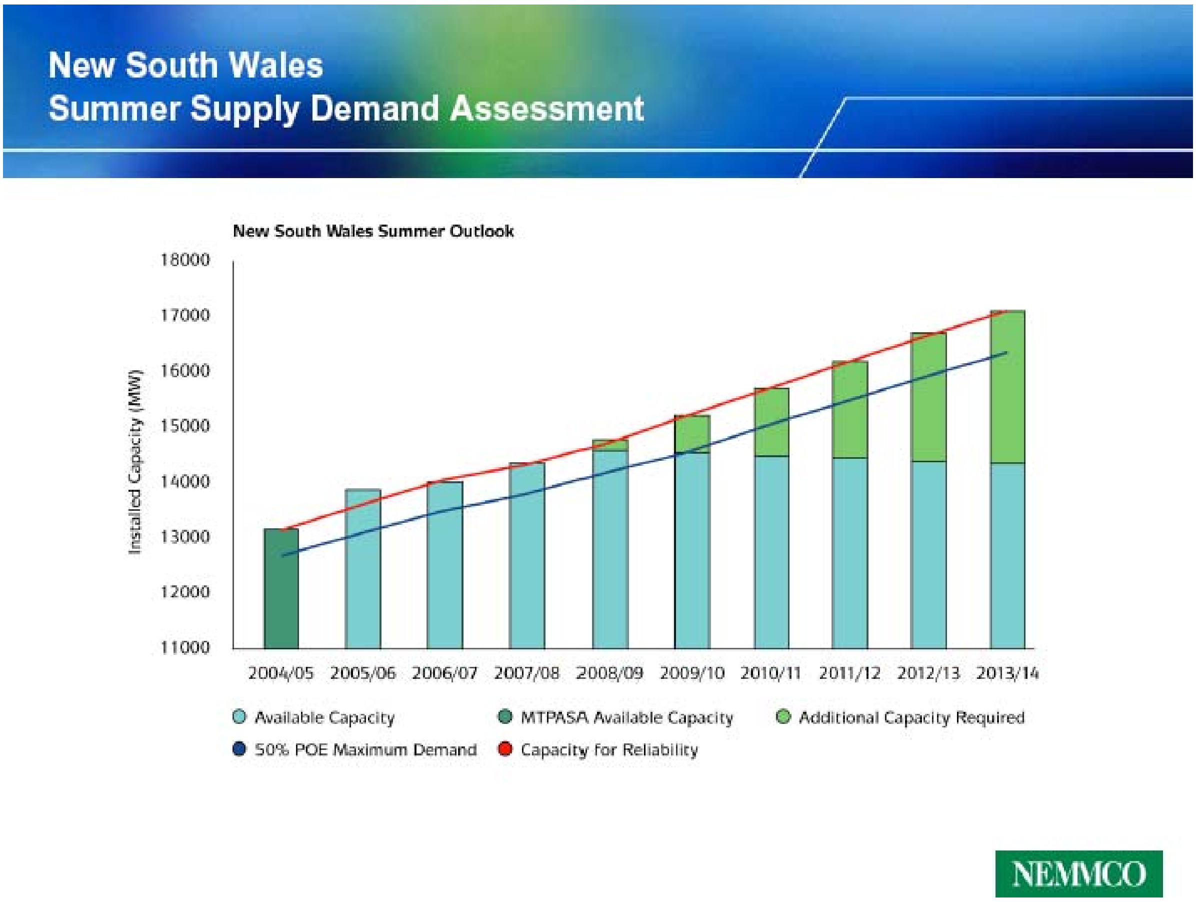
No major new generation sources have been established in NSW since 1993. Given the persistent increase in the demand for electricity since that time this is not a sustainable position. NEMMCO has recognised this in its 2004 Statement of Opportunities (SOO) in which NEMMCO forecasts the need for around 7,300 MW of new generation by about 2013/14 across the NEM over and above currently committed plant, including the recently announced 750 MW Kogan Creek development in Queensland. The Scenario referred to in the SOO proposed that 2,800 MW of this generation would be in NSW.

While NEMMCO predicts that, without additional investment in new generation, some regions in the NEM will be short of generation capacity by about 2007/08, NSW should cope until about 2008/09 (refer *Figure 3.10* below). In all probability the recent trend where new generation capacity (in MW) in the NEM consists of either open cycle gas turbines (mostly located in Victoria or South Australia) or base load coal fired generators (mostly located in Queensland) will continue. Recent studies by ROAM consulting conducted for TransGrid (Attachment 6A) tend to confirm this development pattern arising in about 75% of the ROAM scenarios.

TransGrid's own studies of the capability of the main NSW interconnected transmission system show that, around summer 2008/09, transmission capability will most likely be insufficient to meet acceptable reliability standards. Exactly when this will occur, and how much transmission investment will be required to overcome these limits, depends on the location and sequence of new generation development. The continued development of 500kV capability in NSW is a key strategic option that accommodates most scenarios.

What is certain is that material levels of investment will be required ahead of the majority of feasible new generation developments. This implies a need for major expenditure on the main NSW grid in the latter years of the current regulatory reset period. Section 6 of this Application addresses these needs in more detail.

Figure 3.10



3.3.3 Major Challenges in Delivering New Augmentations

TransGrid faces a number of significant challenges in delivering the required network capability enhancement over the next two regulatory periods. For the first time since its establishment in 1995 TransGrid simultaneously needs new transmission capability to meet local reliability needs as well as reinforcing the main interconnected system and accommodating new but uncertain generation developments. It is also the first time that this confluence of events has occurred in NSW since the establishment of competitive market arrangements in the electricity sector.

Factors underlining this challenge include:

- The long lead times usually associated with transmission line projects, due in no small part to more complex regulatory approval processes including the public conduct of the regulatory test process and environmental approvals. Other factors include procurement of suitable sites and line routes, detailed design, and manufacturing, procurement and erection of large specialised plant items. Limitations are also imposed by the need to carry out key construction and commissioning activities with important power system components out of service. These 'outage windows' are often limited by the need to continuously meet demand and ensure the security of the main transmission system.

- Increased planning uncertainty, particularly due to uncertainty about the location and nature of future generators and major customer developments. Competitive market arrangements involve a range of possible generation development scenarios, with some generation options involving relatively short lead times once project commitment is confirmed. For example, while TransGrid has confidence that new generation is required in the NEM towards the end of the current regulatory period, this could be gas or coal and be located in one of a number of sites in southern or northern NSW, or interstate.

- Supplier market capability concerns are emerging as an increasing number of electricity network businesses in Australia face the need to expand network capability simultaneously. Distribution businesses in Queensland, NSW and, more recently, Victoria have foreshadowed major capital expenditure programs. In the transmission sector, Powerlink in Queensland is expected to continue a major development program. Much of this activity will stretch the limited supplier capability available within Australia. Internationally, pressures from growth in China, India and elsewhere are currently driving up equipment prices.

- TransGrid's own capability is under pressure as skill shortages in relevant specialties drive up labour market costs and limit resource availability.

TransGrid has a range of strategies in place to address these challenges, including greater use of existing transmission line routes, operation at higher voltages (e.g. 500kV), planning based on a range of scenarios or backgrounds, development of new processes for streamlining project delivery, increased staff development programs, and multi skilling of staff in key areas. Information technology may also have an important role to play. This is discussed further in the next section.

3.3.4 Support the Business Capital Expenditure

The need to meet a challenging capital project delivery program outlined above has implications for information technology and, possibly, other support the business capital expenditure. In Section 9 of this Application three categories of information technology expenditure are referred to as follows:

- Cyclical system upgrades and replacements;
- Business performance improvement projects; and
- A factor to offset uncertainty.

Based on generic analysis by Information Technology research company, Gartner, only a modest proportion (20%) of the intended Information Technology expenditure is likely to be on business performance improvement projects. This generic estimate has been adopted by TransGrid because of uncertainty, at the time this Application was being prepared, as to which improvement projects would have the strongest business cases. However, what is clear is that a significant proportion of this type of expenditure is likely to be associated with supporting capital project delivery processes. That is, in light of the challenges now facing TransGrid in developing the capability of the NSW transmission network, it is likely that the generic estimate attributed to Gartner is conservative.

3.4 Conclusion

The Commission's approach to TransGrid's capital expenditure needs is vital to the ability of TransGrid to deliver adequate and timely transmission capability. Without this capability acceptable levels of power system reliability within NSW cannot be assured over the next 4 to 9 years. TransGrid faces an unprecedented need to undertake capital expenditure during the current regulatory period in order to replace existing assets and to deliver new transmission capability in a challenging environment. The Commission's approach to the Application needs to properly recognise these challenges and make adequate provision for the required capital expenditure over the current regulatory period.

TransGrid

TransGrid's Submission to the
Australian Competition & Consumer Commission

Revised Transmission Capital

Investment Program 2004-2009

Section 4 of 10

Plant Replacement Capital Expenditure

November 2004

4 PLANT REPLACEMENT CAPITAL EXPENDITURE

This Section of TransGrid's revised revenue cap Application sets out TransGrid's capital expenditure requirements for asset replacement projects for 2004/05 to 2008/09.

This Section also addresses capital expenditure requirements to address physical security of network assets in the heightened threat environment and to meet public safety expectations.

Further background information relating to these proposed capital expenditures is contained in other Sections of this Application as well as in supplementary documentation provided separately to ACCC.

Details will be provided on:

- TransGrid's overall asset management processes and procedures;
- How individual investment decisions fit with this strategy; and
- The rigour of the investment selection and costing process.

A brief explanation for the need to replace of Queanbeyan 132KV Substation, which is the only new project exceeding $10 million in this submission will be provided.

Longer term strategic considerations will be provided, including the level of replacement work expected to emerge in subsequent regulatory periods based on age and condition considerations. The impact of these considerations on the timing and prioritisation of expenditure will be explained.

Information will also be provided on linkages between replacement projects and augmentation needs. For example, there are some older transmission lines needing to be replaced in the coming regulatory period that could also be uprated to meet a longer term augmentation need. The effect of this on timing of work to optimise overall outcomes will be explained.

Benchmarking of the aggregate investment proposed on replacement projects is undertaken by comparing the proposal for this 5-year period with subsequent 5-year periods, the historic trend in TransGrid's replacement capital expenditure, and by conducting comparisons with other transmission businesses.

Substantial additional documentation to support the proposed replacement capital expenditure submission is available. Documentation itemised in *Attachment 4A* relating to asset replacement capital expenditure has already been provided to the Commission. Significant replacement projects are supported by additional documentation that will be provided separately.

4.1 External Asset Management Environment

TransGrid's asset management plans are developed to take account of a number of regulatory and non-regulatory external requirements. These include:

- NSW Government enabling legislation that requires TransGrid to operate efficient, safe and reliable facilities for the transmission of electricity and to be environmentally and socially responsible, with equal weighting on each.
- NSW Occupational Health and Safety Legislation that requires TransGrid to provide a safe workplace.
- NSW Environmental Legislation that requires TransGrid to minimize its impact on the environment.

- NSW Electricity Supply (Safety and Network Management) Regulation 2002 which requires TransGrid to have in place a Network Management Plan and a Bushfire Management Plan and to report on performance against these Plans.
- ACCC regulatory determinations in relation to operating and capital expenditure and service levels.
- Market Participants' expectations in terms of high plant availability and minimal unplanned outages.
- Customer expectations in terms of high reliability and quality of supply.
- Community expectations in terms of public safety and the environmental impacts.

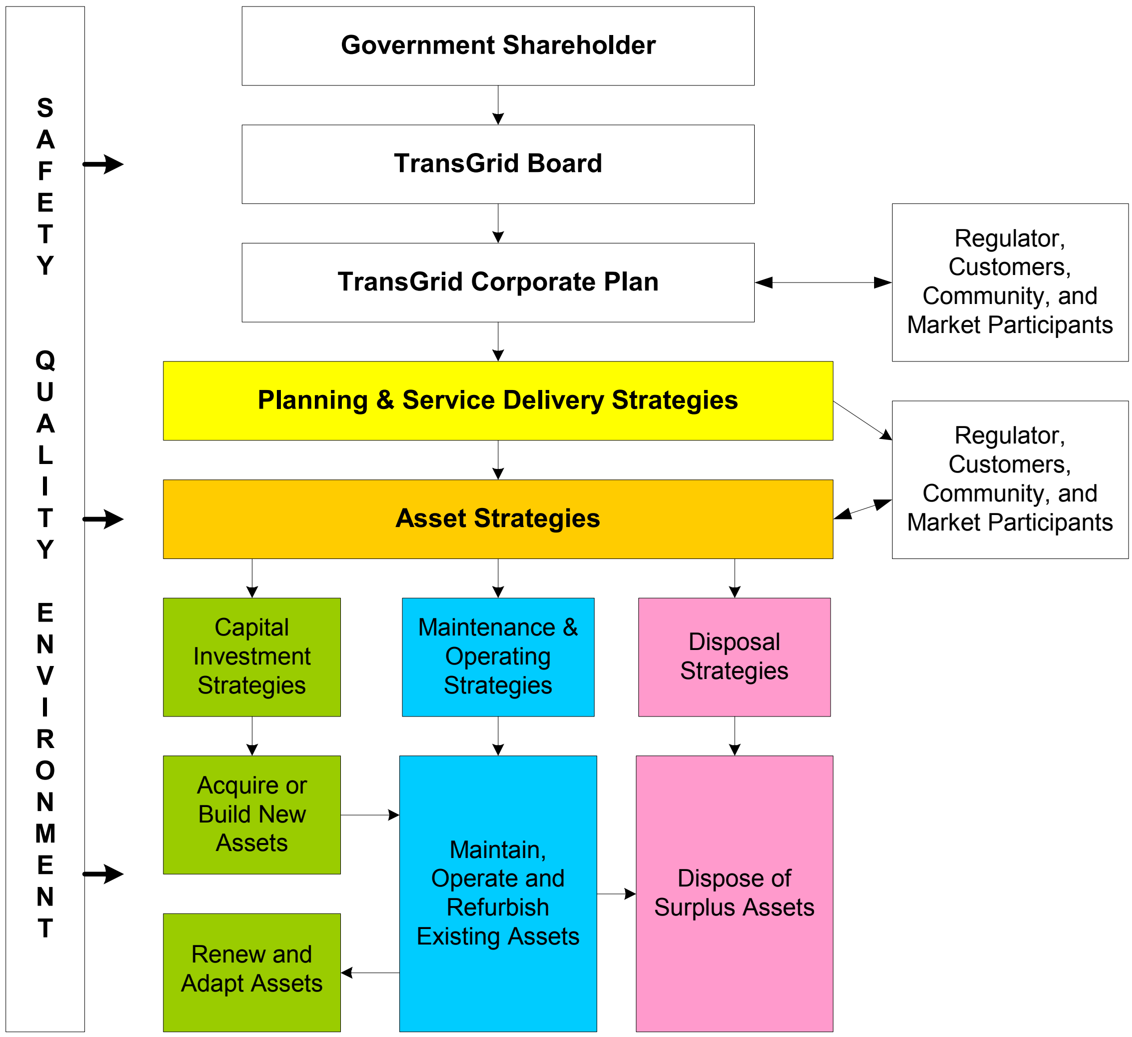
4.2 Internal Asset Management Environment

Capital replacement programs in TransGrid are now entering a new phase. The network has been developed steadily over the last 50 years beginning in the mid-1950's. The chart "Development of the TransGrid system" in Section 3 of this Application shows the trend. Original plant installed in the 1950's is now around 50 years old, an age comparable with or exceeding the nominal service life. In future 'plant replacement programs' will be more 'asset renewal programs' characteristic of older infrastructure utilities, such as water and transport. Where previously asset replacement initiatives tended to focus on equipment classes (where performance or longevity was below normal expectation due to design, quality, severity of service or similar drivers), in future the driver will largely be deterioration due to end-of-life issues.

Within TransGrid, and against this background, the asset management plans are developed taking account of the following additional factors:

- Future network developments and augmentations, which may impact on the management of the existing assets;
- Organisation policies on occupational health and safety and the environment; and
- New asset technologies and information system technologies that will provide long term benefits.

Figure 4.1


SAFETY
QUALITY
ENVIRONMENT
Government Shareholder
TransGrid Board
TransGrid Corporate Plan
Regulator, Customers, Community, and Market Participants
Planning & Service Delivery Strategies
Regulator, Customers, Community, and Market Participants
Asset Strategies
Capital Investment Strategies
Maintenance & Operating Strategies
Disposal Strategies
Acquire or Build New Assets
Maintain, Operate and Refurbish Existing Assets
Dispose of Surplus Assets
Renew and Adapt Assets

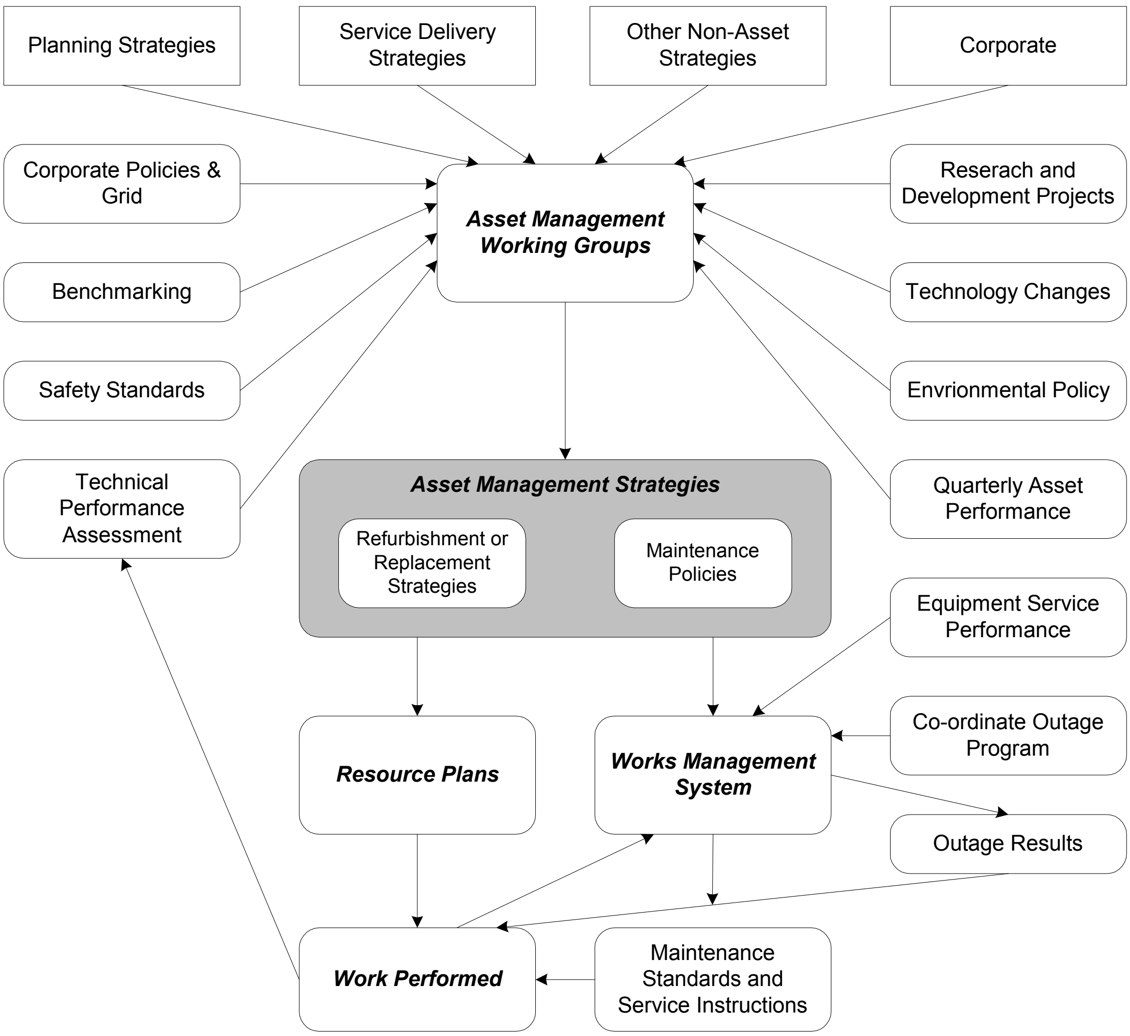
4.3 Description of the TransGrid Asset Management Process

4.3.1 Principles of TransGrid's Asset Management Strategy Processes

TransGrid uses well-developed and documented processes to ensure that its existing assets are effectively and efficiently managed. Documents provided by TransGrid to support its replacement capital investment process should be evaluated in the context of this overall process.

A simple overview of the Asset Management Strategy Process is shown below in Figure 4.2.

Figure 4.2



The quality of TransGrid's asset management process was recognised by the receipt of a National Engineering Excellence Award in 1997.

4.3.2 Elements of TransGrid's Management Strategy Process

4.3.2.1 Structure

The development and updating of both the Asset Management Strategies and the Maintenance Policies is carried out by Working Groups made up of a cross-section of maintenance, design and asset management staff. The Working Groups meet regularly to discuss issues and resolve problems identified.

4.3.2.2 The Network Management Plan and The Network 30-year Plan

The Network Management Plan and the Network 30-Year Plan are essential to the effective ongoing management of TransGrid's network. They provide an intermediate and a long-term view of the likely emerging issues and trends that may impact on the ability of the network to deliver stakeholder expectations.

The asset management process operates against the background established in these plans. This ensures that short-term decisions are taken in the context of maintaining network performance over the long-term and that responses to emerging issues are implemented in a timely project plan.

4.3.2.3 Asset Management Policy

The key Corporate Policy is the Asset Management Policy which is a high level document describing the principles of asset management that apply to all of TransGrid's assets.

The work identified as necessary is categorised as either Capital or Operating for budgetary purposes in accordance with accounting Standards. The operating work is further split into two categories.

(i) Maintenance work - which is routine and repetitive in nature and specified by the relevant maintenance policy.

(ii) Major Operating Projects - these are non-repetitive and require the investment of significant resources on a one off basis. Refurbishment work and some replacements fall into this category. The performance issues and proposed solutions are detailed in the relevant Asset Management Strategy.

The development and updating of both the Asset Management Strategies and the Maintenance Policies is carried out by Working Groups made up of a cross-section of maintenance, design and asset management staff. The Working Groups meet regularly to discuss issues and resolve problems identified.

4.3.2.4 Asset Management Strategies

Asset Management Strategies are prepared for each of the following functional areas:

- Substations
- Underground Cables
- Transmission lines
- Protection Schemes
- Metering Installations
- Communications & Control

These Strategies are updated generally annually and detail both the short and medium term strategies used to address issues beyond the scope of routine maintenance activities.

Information including the performance of the assets, maintenance history, and defect history are all used in the review process to determine if any action is required on a specific issue.

Condition monitoring information is used extensively to identify equipment approaching the end of its useful service life, thus allowing for planned replacement or refurbishment programs to be implemented.

Cost estimates for projects are developed bottom up using functionality within TransGrid's Works Management System and these estimates are benchmarked against previous work.

4.3.2.5 Asset Maintenance Policies

Maintenance Policies for each of the functional areas are also reviewed and updated generally annually. As with the Asset Management Strategies extensive use is made of maintenance history, defect history, benchmarking and condition monitoring data.

The maintenance policies are implemented through a computerised Works Management System (WMS) that schedules, initiates and records both routine and non-routine maintenance and defect repairs.

TransGrid has a policy of minimal intrusive maintenance, preferring instead to carry out diagnostic testing to determine if a need exists for any further work. Maintenance is generally targeted according to the following criteria:

- Significance of failure of the item
- Past reliability and service performance
- Physical location/environmental factors
- Operating history

4.3.2.6 Maintenance Planning

Asset maintenance plans are detailed in a Maintenance Policy and Asset Strategy for each asset category. Each Maintenance Policy describes the routine maintenance frequency and extent of routine maintenance for each item of plant. The Asset Strategies take a broader perspective and detail refurbishment / replacement / repair strategies for particular types, makes or categories of equipment.

In planning any routine or non-routine work (including new project or construction work), that involves a system outage a significant effort is made to package as much work as possible to minimise the number and duration of any outages as these may impact on the Availability of the network.

4.3.2.7 Risk Management

In addition to developing, enhancing and maintaining its transmission network, TransGrid ensures that risks to the system are understood and quantified.

Both the Maintenance Polices and Asset Strategies are reviewed using risk management principles, considering the criticality and exposure associated with a particular course of action that could materially affect the network and the quality, availability and reliability of supply to our customers. The application of risk methodologies is a structured, numerically based, process which permits comparison and ranking of projects.

4.3.2.8 Contingency Planning

TransGrid works closely with the civil defence organisations (such as the police, ambulance, fire brigade) for natural disaster events and is suitably prepared to manage operations and restorations of supplies. However, customer expectations for the security and reliability of electricity supplies are high, and regional and State economies are very dependent on achievement of these expectations.

Contingency planning is an integral part of the risk management process and, although it is not realistic to plan for all possible events, there needs to be a common understanding of the extent of anticipated events and the extent of the contingency planning necessary to cover these events.

A Corporate Emergency Management Plan (CEMP) has been prepared to coordinate the Management measures necessary to ensure that TransGrid is prepared for emergencies which may impact upon reliability of supply, the safety of staff and the public or the environment. Business continuity plans are currently being reviewed and updated where necessary.

4.3.2.9 Loss of Equipment

The outcome of most risk events will be the temporary or permanent loss of specific network equipment.

TransGrid's asset procurement policy ensures that, for reasons of economy, there is a reasonable degree of commonality across the State. There are a number of unique installations where there is only limited opportunity for direct interchange of spare equipment. In most cases, however, spare equipment can be readily obtained and modified if necessary to effect temporary repairs.

TransGrid holds emergency transmission line structures that can be quickly assembled and erected, in the unlikely event of major line failures. These are held at key sites throughout the State and are suitable for most tower line locations.

A number of spare transformers are held at strategic locations throughout the State. A formal policy exists defining the number of spares of a given type to be held based on the size of the transformer population. Other spares such as circuit breakers, instrument transformers, surge arrestors, protection relays, are constantly monitored to ensure optimal levels are held.

4.3.2.10 Asset Performance Reviews

The ultimate measure of whether the asset management process is achieving its stated goals is determined by the performance of the transmission network. Consequently within TransGrid a number of methods are used to objectively measure the outcomes of the process and these are used to indicate whether:

- Policies are appropriate
- Policies are being applied
- Equipment performance is satisfactory
- Performance/costs are comparable

The actual methods used to perform this function include the following.

4.3.2.11 Technical Performance Assessments

Technical Performance Assessments are carried out in each of TransGrid's major maintenance areas or regions on a yearly basis. Each Assessment formally audits the technical performance of the local maintenance groups. The Assessment is conducted over a number of days and checks processes, documentation and the physical condition of the assets. The scope includes regional compliance with both maintenance policies and replacement/refurbishment strategies.

Independent auditors with specialist knowledge of the functional area conduct the Assessments. A formal report detailing non-conformances, observations and improvement opportunities is prepared, and follow up reports ensure that any issues identified are addressed.

4.3.2.12 Quarterly Asset Performance Reviews

Once each quarter, senior design, maintenance, operating and asset management staff are brought together to specifically review the performance of the network assets during the previous three months.

All forced and emergency outages during the period are reviewed in detail and, where necessary, further action initiated. This group also reviews the long-term outage/reliability trends to determine issues requiring further investigation.

Issues identified by either a Technical Performance Assessment, or the Quarterly Asset Performance Review, are passed on to the relevant Working Group for inclusion in their policy/strategy deliberations.

4.3.2.13 ISO 9001 Quality Audits and ISO 14001 Environmental Audits

Despite the large geographical distances between maintenance regions and network assets, TransGrid ensures confidence in the effective application of identical policies and practices across the network through maintaining its certification to AS/NZS ISO9001 for Quality Management and AS/NZS ISO14001 for Environmental Management Systems.

To achieve the maintenance of both these certifications, TransGrid follows a 3 year cycle consisting of 6 monthly audits and a 3 yearly certification assessment by an appropriate Certification Body.

4.3.2.14 Electricity (Safety Plan) Regulation Audits

The health and safety of all TransGrid staff, the general public, contractors and visitors to TransGrid's sites is of prime importance. Occupational health and safety are essential to the successful performance of every task.

In accordance with the Electricity Supply (Safety and Network Management) Regulation 2002, under the Electricity Supply Act 1995, TransGrid has prepared a Network Management Plan, a Bush Fire risk Management Plan and a Public Electrical Safety Awareness Plan which bring together all the documents pertaining to health and safety, maintenance and training within the organisation.

These three Plans, and their associated annual Electricity Network Performance Report, are audited by an independent external Auditor to ensure compliance with the Regulation.

4.3.2.15 External Benchmarking

Since 1995 TransGrid has been a participant in the International Transmission Operating and Maintenance Study (ITOMS) that benchmarks maintenance activities performed by high voltage transmission utilities. The study involves some 23 organisations from Australia, New Zealand, USA, Europe, Asia, Britain and Scandinavia.

The ITOMS results are used by TransGrid as a basis to carry out a detailed review of the various maintenance policies and strategies being adopted by not only overseas utilities but also most of the Australian utilities. The results from ITOMS99, ITOM2001 and ITOMS2003 confirmed the success of TransGrid's revised policies and provided data for further policy revisions in other maintenance areas.

The impact of these policy revisions and changes in work practices will be assessed in the forthcoming 2005 ITOMS study, which will review 2004-2005 data.

4.3.2.16 Internal Benchmarking

TransGrid has developed an Internal Benchmarking Plan that provides a framework of internal benchmarking processes for network maintenance activities. Implementing this Plan has focused effort and guided maintenance and asset management practices towards improving TransGrid's overall maintenance performance and performance in specific maintenance functions.

By internally benchmarking its three maintenance regions, utilising a format similar to ITOMS, TransGrid is able to identify those locations that impact on TransGrid's combined performance in specific maintenance activities providing a driver to improve that local performance.

Internal benchmarking reports are prepared bi-annually.

4.3.2.17 Asset Management Research and Development

Current and recent R&D activities in the field of Asset Management include:

- Remote Condition Monitoring of Network Assets
- Installation of Remote Video Cameras in Substations
- On-Line Circuit Breaker Monitor
- Quality of Supply Measurements
- On-Line Current Transformer and Bushing Monitoring Systems
- On-Line Gas in Oil Monitoring for Power Transformers
- Return Voltage Measurement (RVM) for predicting remaining life of aged power transformers.
- Partial Discharge Monitors on Power Transformers
- Remote Monitoring of Communication Facilities
- Optical current and voltage transformers

4.4 Coordination of Augmentation and Replacement Capital Expenditure Investments

Augmentation and replacement capital expenditure investments are co-ordinated where practical and subject to compliance with National Electricity Code requirements.

Documentation prepared to support the replacement capital expenditure investment decision and approval processes addresses potential augmentation impacts.

Individual plant replacement projects can be aggregated over time by substation sites to facilitate assessment of the overlay between replacement and augmentation needs on a site-by-site basis.

Larger replacement projects, generally of the order of $1M, are formally reviewed by Transmission Planning Group and are delivered through Transmission Project Scoping Report/Project Definition Report project delivery process used for the delivery of augmentation projects.

Through this process TransGrid seeks to optimise the benefit occurring from an investment decision. As a result, some investment projects provide both a replacement and an augmentation benefit. Where each component is significant the costs are apportioned between the replacement and the augmentation capital expenditure provisions proposed in this revenue reset Application. If a combined project was to be eliminated from either the augmentation or the replacement Sections of this Application as a result of the Commission's decision there may be a consequential increase in the remaining portion.

A particular case in point is the rebuilding of 990 and 875 wood pole transmission lines with concrete pole construction on a condition basis. As a planning initiative TransGrid is proposing that each of these lines be up-rated to a higher voltage to provide additional power transfer capability.

Bringing forward the up-rating, and coordinating this work with the condition-based reconstruction, may provide a significant cost benefit. This Application reflects the apportionment of these costs between replacement and augmentation budget proposals.

4.5 Replacement Capital Expenditure Investment Proposal

Details of the replacement capital expenditure proposed for the years to 2004/2005 to 2008/2009 are set out in Attachment 1A to Section 1 of this Application.

The replacement capital expenditure proposal is divided into 4 categories:

4.5.1 Individual Plant Replacement Projects

These are replacement projects relating to a class of asset across multiple locations. Examples of these projects are the replacement of a specific circuit breaker type identified under an asset management strategy for replacement. Individual plant replacement projects are subdivided into work streams. Individual projects may subsequently be aggregated into packages of work to facilitate efficient project delivering.

4.5.2 Committed Asset Replacement Projects

Included under this category are costs to complete the Yass Substation rebuild, the Sydney West Substation Static VAR Compensator, and completion of easement works associated with QNI interconnector projects, which have previously been examined by the Commission in its review of 1999-2004 historic capital expenditure.

4.5.3 Major and Combined Projects

The major and combined projects are larger projects structured to address multiple asset replacement strategies at a single site, or projects generally requiring significant engineering design and procurement input. Proposed projects include:

- Replacement of the aged Taree 132 kV Substation control system including protection, metering and control panels, secondary cabling and marshalling kiosks.
- Replacement of a 330KV protection tunnel board and panels at Canberra 330KV Substation
- Replacement of wood pole structures by single concrete pole structures on two transmission lines as part of TransGrid’s ongoing wood pole replacement program.
- Rebuilding of the Queanbeyan 132KV substation that was originally constructed in 1957, including both primary and secondary assets.
- Upgrading of the complete protection systems at selected sites from largely aged electromechanical relays to modern digital equipment.
- Replacement of 17 selected power transformers on basis of their condition.

The Taree and Queanbeyan substations projects will also provide an opportunity to develop and test a process for the replacement of aged infrastructure at major substations, particularly in the Sydney metropolitan area where risks to supply during the work may be high unless appropriately controlled. Work on these system critical substations is expected to start in the 2010-2014 revenue reset period.

4.5.4 Regional Depot Projects

These investments relate to construction projects at regional works depots.

4.5.5 Regulatory Projects

Capital expenditure investment in the identified projects is necessary to comply with specific regulatory requirements.

- Vales Point 330/132/33 kV station transformers are to be replaced as a result of a noise reduction order issued by the NSW Environmental Protection Authority;
- Scheduled PCB contaminated equipment has to be replaced and disposed of under a Chemical Control Order issued under the Environmentally Hazardous Chemical Act 1985;
- An investment is required to address mines subsidence issues; and
- A provision has been included for regulatory issues requiring plant replacements that may emerge in years 4 and 5 of the regulatory period.

4.6 Appropriateness of the Forward Capital expenditure Investment

The replacement capital expenditure levels proposed in this Application are based on a bottom up approach to determine the needs in the context of an essential objective maintaining network performance over the long term. It has been prepared by expert groups in each functional area. Proposals are assessed and works timed using a risk-based approach to determine the quantum of work in the 5 year reset period now being addressed. Therefore it is TransGrid’s position that the replacement capital expenditure levels proposed in this Application are appropriate and responsible.

In order to further validate that these expenditure levels are reasonable, TransGrid has compared the replacement capital expenditure requested against a number of high-level comparative measures. In Section 3 TransGrid’s replacement capital expenditure proposed for this reset period has been compared with SPI Powernet, Transend and Electranet as a percentage of RAB. Secondly proposed spend is compared with financial depreciation allowances. By these comparisons, TransGrid’s proposed replacement Capital expenditure budget is conservative.

TransGrid has also looked forward in its Network 30 Year Plan at likely long-term network replacement investment requirements. As would be expected, as a result of the past construction timeline for the existing network described in Section 3, significant assets will reach the end of their technical lives over the next 20 years. Replacement expenditures in the 2010/2014 and the 2015/2019 reset periods will be similar to that proposed for the 2005/2009 period. The 30-Year Network Plan describes the issues and the anticipated investment requirements in detail. It is therefore TransGrid’s view that the quantum of investment proposed is consistent with future trend line and is appropriate for the long-term viability of the network.

4.7 Summary

TransGrid’s asset management process is essentially a highly structured ‘bottom up’ process utilising specialists in each functional area. This is supplemented by high level strategic direction for network management provided by senior managers who direct the working group structure, and by standing committees of senior managers who review network performance against targets, benchmark performance levels and initiate corrective action as required.

The cost projections detailed in this Application are essential to maintain the ongoing performance of the network. Any short-term reductions in replacement or refurbishment effort will lead to long-term deterioration in availability and reliability.

TransGrid's Submission to the
Australian Competition & Consumer Commission

Revised Transmission Capital Investment Program 2004-2009

Section 5 of 10

Customer Demand (Load) Driven Reliability Capital Expenditure

November 2004

5 Customer Demand (Load) Driven Reliability Capital Expenditure

5.1 Introduction

The augmentations described in this section are primarily driven by the need to satisfy NSW Jurisdictional and Code reliability obligations in the face of growing demand which has resulted in TransGrid's network approaching, or having reached, the limit of its capacity in many areas.

This Section briefly describes:

- TransGrid's planning approach;
- Load driven excluded projects;
- Projects driven by both load growth and asset condition; and
- The need for each load driven planning complex (a project or group of projects).

Developments related to the main interconnected transmission system including connection of generators, and increasing interconnection capability, are described in Section 6 and Section 7 respectively.

5.2 TransGrid's Planning Approach

TransGrid's planning approach is described in the Annual Planning Report, and the Network Management Plan, which is submitted to the NSW jurisdiction for review on an annual basis. Essentially, TransGrid applies N-1 planning criteria modified to suit particular local requirements as agreed with connected customers. The section of the 2004 Annual Planning Report which describes TransGrid's planning approach, including jurisdictional requirements, is included as *Attachment 5A.*

When planning developments of networks, other than the main 500 kV and 330 kV system, TransGrid uses medium economic growth, 50% probability of exceedence load forecasts.

TransGrid is facing a challenging capital works programme. Under the proposed programme some projects would be completed at a time later than would be dictated under a strict N-1 criterion. In prioritising projects, the risk and extent of potential interruptions to supply has been considered.

5.3 Excluded Projects

Joint planning with connected customers is an important part of TransGrid's planning processes. In particular, supplies to the inner metropolitan area are jointly planned with EnergyAustralia. A number of options to augment supply to the inner metropolitan area are being considered to meet the growing load. However, the optimal development has yet to be determined. Consequently, augmentation of supply to the inner metropolitan area is an excluded project. The trigger for implementation of the optimal development would be completion of joint planning with Energy Australia.

Another project in the greater Sydney area, which is particularly uncertain, is reinforcement of the 330 kV system between Kemps Creek and Sydney South. The key uncertainty is the availability of line routes, which can have considerable impact on the cost of easements as well as on construction costs and the timing of works (particularly if existing lines are to be rebuilt). The trigger for implementation would be completion of investigations sufficient to identify the most appropriate development.

5.4 Combined Augmentation/Replacement Projects

A number of projects are driven by both load growth and asset condition considerations. These projects are designated with a project type of "Combined" in Attachment 1B.

5.5 Descriptions of Planning Complexes

Load driven projects are designated with a project type of "Load" in Attachment 1B. For these projects Attachment 1B provides:

- A reference to the project in the 2004 Annual Planning Report.
- Classifications of the project in terms of its size and likelihood of proceeding.
- References to relevant outline plans and planning reports, drafts of which have previously been provided to the Commission. The outline plans give a broad outline of the currently envisaged development of the network in a particular area of the State. They describe the major strategic issues to be considered and outline the envisaged network developments in terms of major requirements, or specific developments where these are considered likely.

  The planning reports detail specific emerging network constraints and describe one or more options for augmentations that will relieve the constraints over a suitable planning period.

The following sections provide a brief description of load driven projects.

5.5.1 ACT Supply

The transformer capacity of Canberra 330/132 kV substation is expected to be adequate over a five year planning period. However, the substation is poorly located to efficiently supply newly identified urban growth areas. In addition, stakeholders have requested that alternatives to provide diversified supply to the region be identified to ensure greater security of supply to essential services.

Possible options to address this issue include:

- Establishing a 330/132 kV substation in the Royalla/Williamsdale area;
- Development of a 330/132kV substation at Bungendore and the construction of multiple 132 kV lines to new urban development areas and the existing 132 kV network; or
- Local generation.

5.5.2 ANM – Albury Supply

Following expansion of the paper mill at ANM and consequently the ANM load, the ratings of the Jindera – Albury, Jindera – ANM and ANM – Albury 132 kV lines line are limited by terminal equipment at Albury and ANM.

Planned developments to meet this limitation are:

1. Uprate line terminal equipment at Albury and ANM;
2. Construct a double circuit 132 kV line between Jindera and the Albury – Mulwala line to form a Jindera – Mulwala circuit and a second Jindera – Albury circuit; or
3. Reconstruct the section of the existing Albury – Mulwala line near Albury so that the rating of the second Jindera - Albury circuit is similar to that of the first.

5.5.3 Armidale 132/66 kV Transformer Replacement

The load at Armidale 132/66 kV Substation has exceeded the firm rating of the two 30 MVA 132/66 kV transformers over the past several winters. The existing transformers are 38 years old and are approaching the end of their serviceable lives. It is planned to replace them with new 60 MVA units to meet both asset condition and load growth requirements.

5.5.4 Armidale, Marulan, Vales Point, Vineyard, Wellington, Yass 330/132 kV Transformers

330/132 kV transformer installations are required at the above sites over the next few years, for a variety of load growth and asset condition reasons. The needs at each site are independent but the installations are interdependent, because in some cases serviceable 200 MVA transformers are to be re-located for re-use.

5.5.5 Boggabri Supply

Boggabri is presently supplied via a 66 kV network (owned by Country Energy) between Gunnedah and Narrabri. The normal supply is from Country Energy's Gunnedah 66kV Substation, which is supplied from TransGrid's Gunnedah 132/66kV substation over two 66kV lines. The Gunnedah to Boggabri 66kV line is over 50 years old.

The capacity of this 66 kV network is being approached and it is therefore necessary to augment the supply system in the area. Voltage levels at Boggabri are below planning standards for an outage of either of the two Gunnedah 132kV to Gunnedah 66kV, 66kV lines. The thermal capacity of these two lines is exceeded under some conditions.

At a recent Joint Planning Committee meeting Country Energy indicated its preference to construct a new 132/66 kV substation near Boggabri. The substation would be supplied from the 9U3 Gunnedah – Narrabri 132 kV transmission line.

5.5.6 Bulahdelah Supply

Bulahdelah is located approximately 75 kilometres south of Taree. It is presently supplied via a 33 kV network (owned by Country Energy) that originates from the Stroud132/33 kV substation. The thermal capacity and voltage limits of this 33 kV network have been reached and it is therefore necessary to augment the supply system in the area.

The preferred option is to construct a new 132/33 kV substation at Bulahdelah. The substation would be supplied from the 963 Tomago – Taree 132 kV transmission line.

5.5.7 Coffs Harbour Substation

The mid north coast is supplied via long 132 kV lines from remote 330/132 kV substations at Lismore, Armidale and Newcastle. In recent years load growth in the Coffs Harbour to Port Macquarie area has been approximately 4% p.a., significantly above the state average. Above average load growth is expected to continue.

The capacity of the 132 kV system supplying the area is limited by unacceptably low voltages at Port Macquarie and Kempsey on outage of the 965 Armidale - Kempsey 132 kV line and at Coffs Harbour on outage of the 96C Armidale – Coffs Harbour 132 kV line. It is expected that the capacity of this system will be exceeded by winter 2005.

In 2003 TransGrid and Country Energy consulted with Code participants and other interested parties and applied the Regulatory Test to options for development of supply to the mid north Coast of NSW. This consultation included a public request for demand management proposals.

The consultation culminated in a decision to construct a 330/132 kV substation adjacent to the existing 132/66 kV substation at Coffs Harbour, supplied from the existing Armidale – Lismore 330 kV line which passes close to Coffs Harbour 132/66 kV Substation, by winter 2006. Associated works include the construction of an additional switchbay at Armidale 330/132/66 kV Substation.

5.5.8 Coffs Harbour: 89 Line Connections at Armidale

It is planned to establish Coffs Harbour 330/132 kV substation by winter 2006. That substation would be supplied from the existing 89 Armidale – Coffs Harbour 330 kV line.

At Armidale, 89 line has a single 330 kV switchbay. Under the present configuration it is necessary to take 89 line out of service to maintain the switchbay. Following commissioning of Coffs Harbour 330/132 kV substation, it will be increasingly difficult to obtain maintenance outages as supply to two 330/132 kV substations would be interrupted.

In order to facilitate maintenance of 89 line switchgear at Armidale, it is planned to provide an additional line switchbay for 89 line.

5.5.9 Coleambally

A second 132/33 kV transformer has been installed at Coleambally. A small amount of expenditure this financial year is required to finalise the work.

5.5.10 Cooma and Bega Supply

The Cooma/Bega area is supplied by two 132 kV circuits, each around 125 km long, from Canberra to Cooma. The section between Canberra and Royalla is a double circuit 132 kV strung on single circuit 330 kV structures. Country Energy owns the 92 km long 132 kV line from Cooma to Bega.

The capability of this 132 kV network is limited by unacceptably low voltages at Bega, Cooma and Munyang on outage of one of the Canberra – Cooma 132 kV lines at times of high demand.

Country Energy is considering constructing a second 132 kV line to Bega and installing a second 66 kV capacitor at Bega. To avoid further congestion of lines near the existing Cooma 132/66/11 kV substation, it is expected that a new 132 kV switching station in the Cooma area will be established to connect the new Bega line. That switching station could become part of a future 330/132 kV substation.

A number of wind farms in the Cooma area have been proposed. Depending on the magnitude of generation installed, additional transmission capacity may be required to accommodate high levels of generation at times of reduced local load.

Planned developments to meet the above limitations and requirements are:

1. Installation of a 10 MVAr 66 kV capacitor at Cooma;
2. Establishment of a 132 kV switching station near Cooma to connect additional capacitors and Country Energy's second 132 kV line to Bega;
3. Construction of a 132 kV switching station near Royalla; or
4. Construction of a Royalla – Cooma 330 kV transmission line which would initially operate at 132 kV.

5.5.11 Cowra 132/66 kV Transformer Capacity

The firm capacity of the existing 30 MVA 132/66 kV transformers at Cowra is expected to be exceeded by summer 2009/10.

Options to relieve this constraint include:

- Replacement of the existing transformers by larger units; or
- Local generation and/or demand management.

5.5.12 Cowra, Forbes and Parkes Capacitor Banks and Manildra – Parkes 132 kV Line

The Cowra,/Parkes/Forbes area is supplied via a 132 kV transmission network emanating from 330/132 kV substations at Yass and Wellington. The capacity of the existing 132 kV system has two limitations on outage of the 94K Wellington – Parkes line. These are:

1. Unacceptably low voltages at Parkes and Forbes in both winter and summer.
2. The loading of the 999 Yass – Cowra 132 kV line exceeding its rating in summer.

To ameliorate possible low voltage conditions, prior to the time at which an additional line to the area can be constructed, it is proposed to install two 6 MVAr 66 kV capacitors at Cowra, a 12 MVAr 132 kV capacitor at Forbes and an 8 MVar 66 kV capacitor at Parkes.

In the medium term it is planned to construct a 132 kV line from Manildra to Parkes and to uprate the 999 Yass – Cowra line. Depending on the duration of outages to uprate 999 line this work may not be undertaken until the Manildra – Parkes line is completed.

5.5.13 Dapto 330/132 kV Substation - Fault Levels, Capacitors, and Transformer Capacity

Dapto 330/132 kV Substation was commissioned in 1962. The fault current capability of the existing equipment is being investigated. Depending on the outcome of that investigation, operational limitations may be applied or equipment replaced.

The fuses on the existing 132 kV capacitors are a special current limiting type, which have experienced some problems and need to be replaced. To provide additional reactive compensation and to mitigate potential harmonic amplification, it is planned to replace the existing capacitors with larger tuned banks.

Dapto has three 375 MVA transformers. A large proportion of the load supplied from Dapto is industrial. Consequently the load factor is high and, for a number of years, it has been difficult to obtain outages to enable maintenance to be carried out on the transformers.

To minimise wear on the tap-changers, which are all in need of major overhauls, the transformers have been placed on a regime which minimises the number of tap-changer operations. This has lead to an increase in the number of tap-changer operations at Integral Energy's 132 kV substations.

To enable maintenance to be carried out on the existing transformers it is planned to install a fourth 375 MVA 330/132 kV transformer at Dapto, which would also be considered as an in service spare for other 375 MVA 330/132 kV transformers in the network.

5.5.14 Darlington Point Communications

Some expenditure is required this financial year to complete the first stage of works to develop a microwave system from Wagga to Darlington Point.

5.5.15 Darlington Point Capacitors

Load levels in the Darlington Point area have risen to the level where an outage of the Wagga – Darlington Point 330 kV at times of high load periods will result in unacceptably low voltages in the area. Consequently, it is planned to install two 40 MVAr 132 kV capacitors at Darlington Point.

5.5.16 Deniliquin Capacitor Bank

Finley and Deniliquin 132/66 kV substations are supplied by a 132 kV network some 400 kilometres long, between Wagga and Darlington Point 330/132 kV Substations. The capability of the network is limited by unacceptably low voltages at those substations on outage of the Wagga – Deniliquin tee Finley and Coleambally - Deniliquin 132 kV lines at times of high demand. This constraint has been managed in past years by installation of 66 kV capacitor banks at Finley and Deniliquin.

Continuing growth in the loads supplied from these substations has resulted in the constraint re-emerging. To enable it to be overcome in the short term, it is proposed to install a 10 MVar 132 kV capacitor bank at Deniliquin.

5.5.17 Finley 132/66 kV Transformer Capacity

Finley substation was established in 1991. It has a single 30 MVA 132/66kV transformer and 66kV connections to Deniliquin and Mulwala. The transformer was manufactured in 1961 and is approaching the end of its serviceable life. It is anticipated that it will be replaced by a 60 MVA unit within the next few years.

5.5.18 Glen Innes Supply

Glen Innes 132/66 kV substation was established in 1970 as a low cost temporary substation. It has two transformers tee connected to the Armidale – Tenterfield 132 kV line and supplies a single Country Energy 66 kV line to their Glen Innes zone substation. Outages of the 132 kV line, both planned and unplanned, result in supply to the substation being interrupted. The load at Glen Innes is around 20 MW and Country Energy plans to construct a second 66 kV line to provide a firm supply to their zone substation.

To improve the security of supply to Glen Innes and surrounding areas to an acceptable standard and to accommodate an additional 66 kV line, it is planned to establish a new “conventional” 132/66 kV substation adjacent to the existing temporary substation.

5.5.19 Glen Innes/Inverell Supply

The Inverell area is supplied primarily by a 132 kV line from Armidale. On outage of this line, Inverell is supplied from Tamworth via Narrabri and Moree, a distance of over 400 km. The capacity of this system is limited by unacceptably low voltages on outage of critical lines at times of high demand. A number of banks of capacitors have been installed at Inverell, Moree and Narrabri over the years to manage voltage conditions on this 132 kV network. In the medium term, load growth in the Inverell area is expected to result in the capacity of the network being exceeded.

Options to address this limitation include:

- Construction of a 132 kV line between Glen Innes and Inverell, which would improve security of supply to both Inverell and Glen Innes; or
- Demand management and/or local generation.

5.5.20 Holroyd Complex: Holroyd 132 kV Switching Station

Over recent years demand in the Parramatta area has grown strongly due to various developments and this growth is expected to continue.

Supply to the Parramatta area includes four 132 kV cables from Integral Energy's Guildford Substation. Guildford is supplied via two double circuit 132 kV overhead lines from Sydney West 330/132 kV Substation via TransGrid's Holroyd substation site. The capacity of supply to the Parramatta area is limited by the rating of the three remaining 132 kV cables when the fourth cable is out of service at times of high load. This constraint is expected to emerge within the next few years.

When additional 132 kV cables are required to supply Parramatta they will not be able to be terminated at Guildford due to limitations at that site. Consequently the preferred solution is to establish a 132 kV switching station at Holroyd. This would form part of a future 330 kV substation.

5.5.21 Holroyd Complex: Holroyd 330 kV Substation

Over recent years demand in the Western Sydney area, which is supplied from Sydney West, Liverpool, Vineyard and Regentville 330 kV Substations, has grown strongly and this growth is expected to continue. Despite recent and planned transformer augmentations at three of these sites it is envisaged that 330/132 kV transformer capacity in this area may be inadequate within about five years.

The establishment of 330/132 kV transformation at Holroyd would reduce transformer loading, particularly at Sydney West. Establishment of a 330 kV supply to Holroyd would also facilitate installation of a future 330 kV cable to the Homebush/Chullora area.

5.5.22 Holroyd Complex: 330 kV Cable to the Homebush/Chullora Area

The southern and inner city areas of Sydney are presently supplied primarily by Sydney North (Dural), Sydney South (Picnic Point), Beaconsfield West and Haymarket 330 /132 kV substations.

Failure of either of the Sydney South – Beaconsfield West or Sydney South – Haymarket 330 kV cables and another critical 132 kV circuit or transformer may result in the rating of some remaining network elements being exceeded at or near high load periods. Also it is expected that it will become increasingly uneconomic to maintain some aged and deteriorating 132 kV cables in the area in a satisfactory condition.

A number of options are being considered to address these constraints including:

- Reinforcement within EnergyAustralia's 132 kV network;
- Establishment of an additional 330/132 kV substation and associated 330 kV supply; or
- Local generation and demand management.

Establishment of a 330/132 kV substation in the Homebush/Chullora area, supplied by a 330 kV cable from Holroyd, would increase supply capacity to the inner west of Sydney, and relieve loading on the existing 330/132 kV substations, particularly Sydney South. In the medium to longer term a second cable from Holroyd may be required.

Alternatively establishment of a new 330/132 kV substation in the inner metropolitan area supplied from an existing 330/132 kV substation such as Sydney East , would relieve the loading on both the existing 330/132 kV substations and EnergyAustralia's 132 kV cable network.

5.5.23 Kemps Creek – Sydney South Development: Kemps Creek – Liverpool and Liverpool – Sydney South

To meet the growing Sydney load the 330 kV system between Kemps Creek and Sydney South will require reinforcement. The need arises after the 2004/5 to 2008/9 period.

The development will however need to be advanced to allow the maximum use of existing easements. Lines will need to be withdrawn from service for extended periods for reconstruction and it is not feasible to delay the works until the time of the technical need.

There are a number of alternative means to achieve the reinforcement, including new line development and reconstruction of existing lines. The development will also require staging to meet the needs of the loads.

The options include the application of high temperature conductors and the development of switching stations where lines running south of Kemps Creek intersect with the Wallerawang – Sydney South / Ingleburn double circuit line.

There are a number of alternative means to achieve the reinforcement. The preferred development can only be developed in consultation with the community. The cost of easements is expected to be very high. Hence this project is considered an "excluded" project.

5.5.24 Kempsey Port Macquarie Line

Port Macquarie 132/33 kV Substation is supplied by 132 kV lines from Kempsey and Taree. The capacity of this system is limited by unacceptably low voltages at Port Macquarie on outage of the line from Kempsey.

To date this contingency has been managed by installation of capacitors in the area. Four banks of capacitors, totalling 39 MVar have been installed at Port Macquarie and five banks totalling 52 MVar at Taree. Installation of additional capacitors is of marginal benefit as the reactive loads at each location are already more than fully compensated.

Over recent years load growth in the Port Macquarie area has been approximately 4% p.a., significantly above the level for the state overall. Above average growth is expected to continue. From winter 2004 onwards periods of risk have emerged, in which the capacity of this system to meet agreed reliability standards may be exceeded.

The most suitable transmission option to overcome this constraint, is to construct an additional transmission line between Port Macquarie and Kempsey. This line could be primarily of 330 kV construction, initially operating at 132 kV, while in the medium term it would form part of a 330 kV supply to the area.

5.5.25 Kempsey 132/33 kV Transformer Capacity

The load supplied at 33 kV from Kempsey 132/33/66 kV substation is growing steadily. Based on Country Energy's most recent load forecast the firm capacity of the existing 30 MVA 132/33 kV transformers will be exceeded by around winter 2009.

It is planned to replace the existing transformers by 60 MVA units.

5.5.26 Koolkhan 132/66 kV Substation

A series of works has been undertaken at Koolkhan over recent years, including replacement of old transformers and construction of additional 66 kV line switchbays to connect Country Energy lines. A small amount of expenditure is required this financial year to complete these works.

5.5.27 Koolkhan 132/66 kV Transformer Capacity

The load supplied from Koolkhan 132/66 kV substation is growing rapidly. Installation of two banks of 66 kV capacitors is proposed to help manage voltage levels during an outage of the 89 Armidale – Lismore 330 kV line and to reduce the loading on the two existing 60 MVA transformers.

Based on Country Energy's most recent load forecast the firm capacity of the existing transformers will be exceeded by around summer 2009/10. It is planned to install a third 60 MVA transformer or to replace the existing transformers by larger units, by that time.

5.5.28 Lismore Area (Far North Coast) Supply

Supply to the far north coast is via long 132 kV lines from remote 330/132 kV substations. Consequently, its capacity is limited by unacceptably low voltages on outage of critical elements at times of high demand.

Planned developments to address this limitation are:

1. Install two 10 MVAr 66 kV capacitors at each of Koolkhan and Nambucca 132/66 kV substations (2005/06).
2. Uprate the 966 Armidale – Koolkhan 132 kV line.

5.5.29 Liverpool Third 330/132 kV Transformer

Liverpool 330/132 kV substation supplies the Liverpool area as well as some of the load in the Camden area. In recent years, development in the Liverpool/Camden/Campbelltown area has resulted in high growth in demand for electricity, which is expected to continue. The firm capacity of the two 375 MVA 330/132 kV transformers at Liverpool 330/132 kV Substation was exceeded in summer 2002/3 and is expected to be exceeded in future summers.

Installation of a third transformer is programmed for completion in 2004/05.

5.5.30 MetroGrid

The MetroGrid project consists of three major elements:

- Cable 42 design and installation
- 3.6 kms of cable tunnel from Sydney Park to Haymarket
- Haymarket Substation including the Gas-insulated transformers

The works have been undertaken under four major contracts together with a large number of smaller contracts, orders, and consultancies as well as significant TransGrid labour and expenses.

Additional expenditure is required in 2004/05 to complete the works.

5.5.31 Mid North Coast: Armidale - Kempsey 132 kV Line, Coffs Harbour - Kempsey 132 kV Line and Port Macquarie 330 kV Substation

Over recent years load growth on the mid North Coast has been approximately 4% p.a., significantly above the level for the state overall. Above average growth is expected to continue.

The 132 kV system is heavily loaded and the scope to continue to reinforce it with 132 kV developments is limited. It is expected that unacceptably low voltages and overloading of some network elements will occur in the medium term, on outage of key elements of the network. It is expected that establishment of a 330 kV supply to the area will be necessary to cater for the growing loads.

It is anticipated that this could entail:

- Operating both circuits of the Coffs Harbour – Nambucca – Kempsey 132 kV double circuit line at 132 kV, which would necessitate conversion of existing Country Energy 66 kV substations to 132 kV or establishment of new 132 kV substations.
- Construction of a 330 kV line between the Armidale and Kempsey areas. This may require reconstruction of parts of the existing Armidale – Kempsey 132 kV line.
- Construction of a 330/132 kV substation near Port Macquarie, supplied from Armidale via an Armidale – Kempsey 330 kV line and a new section of 330 kV line between Kempsey and Port Macquarie.

5.5.32 Miscellaneous Substations

These include remedial works, and new items of work for inner city works.

5.5.33 Mulwala, Finley and Deniliquin Supply

The network supplying the south west of New South Wales includes a 132 kV ring (some 400 kilometres long) supplying Finley, Deniliquin and Coleambally, as well as Country Energy's 132 kV line from Albury to Mulwala.

The main network limitation is unacceptably low voltages at Finley and Deniliquin on outage of the Wagga – Finley, Darlington Point - Coleambally or Coleambally – Deniliquin lines. Of these, outage of Darlington Point – Coleambally is the most severe. In addition, the Mulwala load is reaching the stage where a second 132 kV supply is appropriate.

Planned developments to overcome these limitations are:

1. Provision of a 10 MVAr 132 kV capacitor at Deniliquin;
2. Expansion of Finley 132/66 kV substation to accommodate additional lines and a second transformer; and
3. Construction of a new Finley – Mulwala 132 kV line.

5.5.34 Narrabri Capacitor Bank and Reconstruction of the Tamworth – Gunnedah 66 kV Line

The 132 kV network supplying Gunnedah, Narrabri, Moree and Inverell 132 kV Substations is more than 500 km long. Its capability is limited by unacceptably low voltages at these substations on outage of critical 132 kV lines. To enable this limitation to be overcome in the short term it is planned to install an 8 MVAr 66 kV capacitor bank at Narrabri.

In the medium term it is planned to increase 132 kV line capacity by reconstruction of the existing 875 Tamworth – Gunnedah 66 kV line as a 132 kV line.

5.5.35 Narrandera and Lockhart Supply

Country Energy has indicated that the existing 66/11kV transformers at its Narrandera 66/11kV Substation and the 66kV supply to Lockhart area have reached the limit of their capacity and need reinforcement.

Options available to address the Narrandera 66/11kV transformer capacity limitations and 66kV supply to Lockhart include:

- Augmentation of the Narrandera 66/11kV transformers, establishment of a 66kV voltage regulator between Wagga and Lockhart combined with uprating of the Wagga-Narrandera 66kV line;
- Establishment of a 132/66 kV substation near Narrandera to supply Narrandera 66/11kV substation as well as Lockhart; or
- Demand management; and development of local generation.

5.5.36 Orange 132 kV Substation Augmentation

Orange 132/66 kV substation supplies approximately 140 MW of load. The substation has only a single section of 132 kV busbar. Two sections of 132 kV busbar are appropriate for a load of this magnitude. Consequently it is planned to install a 132 kV bus section switchbay.

The 30 MVA 132/66 kV transformers at Orange are over 50 years old are approaching the end of their serviceable lives. It is planned to replace them by two larger units.

At present one of the 132 kV lines supplying Orange is tee connected to a Mount Piper – Wellington line. On outage of that line at times of high Orange area load, low voltages at Orange are expected within the next few years. As part of the works at Orange, it is planned to remove the tee connection and to "loop" the line into Orange.

5.5.37 Panorama Capacitor Banks

Panorama 132/66 kV substation is supplied via two 132 kV lines from Wallerawang and Orange. On outage of the Wallerawang line at times of high demand unacceptably low voltages can occur at Panorama. To relieve this limitation, it is planned to install two 10 MVAr 66 kV capacitors at Panorama.

5.5.38 Parkes Transformer Capacity

Parkes 132/66 kV substation has a single transformer with backup provided by Country Energy's Forbes – Parkes 66 kV line. On outage of the transformer, the capacity of the supply to Parkes is limited by the rating of Country Energy's line. To overcome this limitation it is planned to install a second 132/66 kV transformer at Parkes.

5.5.39 Port Macquarie 132/33 kV Transformer Replacement

The load at Port Macquarie has grown rapidly over recent years due to developments in Port Macquarie and surrounding areas. This development and consequent load growth is expected to continue and it is expected that the firm transformer capacity will be exceeded by winter 2006. In addition, the transformers at Port Macquarie are nearing the end of their serviceable lives.

It is planned to replace the existing three 30 MVA 132/33 kV transformers by three 60 MVA units by winter 2006.

5.5.40 Southern Communications Upgrade

This project involves upgrading of PLCs and other obsolete communications equipment in the south of the state. Some expenditure is required this financial year to complete the works.

5.5.41 South West of Greater Sydney Supply

Forecasts of existing load growth, new housing developments and reduced generation in the South West of Greater Sydney area indicate that it needs major infrastructure works to sustain supply capacity and reliability.

TransGrid and Integral Energy have been carrying out joint planning to develop long term planning strategies to secure electricity supplies in the Macarthur/Campbelltown area and the southern portion of the South West Sector release area. Integral Energy have requested establishment of a 330/132/66 kV supply point at Mt Annan.

5.5.42 Supply Point Site Acquisitions

To cater for growing load within the state, it is intended to acquire sites at strategic locations on which supply points may be established in the future. The sites currently under investigation are:

- Catherine Field, south west of Liverpool near the intersection of the Kemps Creek – Avon and Wallerawang – Sydney South 330 kV lines.
- Cobbitty, west of Catherine Fields near the intersection of the Sydney West – Yass and Wallerawang – Sydney South 330 kV lines;
- Port Macquarie;
- Warrabrook, near Mayfield West in Newcastle;
- Richmond Vale, west of Newcastle;
- Oran Park;
- Mount Annan;
- Royalla, near the Canberra – Cooma 132 kV lines south east of Canberra;
- Bungendore, near the Canberra – Kangaroo Valley 330 kV line north east of Canberra.
- Bannaby, near the intersection of the Mt Piper – Marulan and Sydney West – Yass 330 kV lines
- Cooma.

5.5.43 Sydney North 330 kV Substation: Fault Level Rating Limitations

Switching of 132 kV lines is currently undertaken to control the fault level at Sydney North 132 kV busbar to within equipment ratings. The establishment of additional supply capacity to the inner metropolitan area and/or generation developments is expected to result in increased fault levels at this site and is expected to exceed the equipment short circuit ratings.

The preferred option to address this limitation is implementation of an equipment replacement program.

5.5.44 Sydney South 330 kV Substation: Replacement of 330/132 kV Transformers

Sydney South 330/132 kV substation has two 375 MVA and four 250 MVA transformers. With growing load in the southern and inner metropolitan area, it is expected that the capacity of the transformers will be exceeded. To increase the transformer capacity at Sydney South it is planned to replace at least two, and possibly all four, of the 250 MVA transformers by 375 MVA units over the next several years.

5.5.45 Sydney West 330 kV Substation: Equipment Fault Level Upgrade

Some 330 kV equipment at Sydney West has been replaced recently so that the 330 kV fault level is currently within equipment ratings. The establishment of additional supply capacity to the metropolitan area and/or generation developments is expected to result in increased fault levels with 330 kV fault level limitations expected to re-emerge within the next several years. The 132 kV busbar is operated “split” to maintain fault levels within equipment ratings.

The options available to address the emerging 330 kV fault level limitations include:

- A program of further equipment replacement; or
- “Splitting” the 330 kV busbar.

5.5.46 Sydney West SVC

A SVC at Sydney West has recently been commissioned. Some minor works are required in this financial year to complete this project.

5.5.47 Taree Transformer Capacity

The load supplied at 66 kV from Taree has grown rapidly over recent years. It is expected that high load growth will continue and that the firm transformer capacity will be exceeded by winter 2007.

The preferred development option involves transferring some 66 kV load to the 33 kV network.

5.5.48 Technical Services

A number of communications projects throughout the State are planned (refer also to Section 8) to:

- Enable the requirements of NEMMCO’s recently released Power System Data Communications Standard to be met;
- Provide enhanced communications for improved SCADA, corporate data, voice communications and substation monitoring and security at a number of 132 kV substations; and
- Rationalise some existing aging communications systems.

5.5.49 Tomago Supply Point

The load supplied from EnergyAustralia’s Tomago 132/33 kV substation has reached the stage where reinforcement of EnergyAustralia’s 132 kV network supplying Tomago is required. It is planned to install a 330/132 kV transformer at Tomago 330 kV switching station (which supplies the Tomago smelter) to supply a new EnergyAustralia 132 kV line to their Tomago substation. This development would avoid the need for additional lines to cross the Hunter River.

5.5.50 Tuggerah – Sterland Upgrade

A section of 330 kV single circuit 330 kV line between Tuggerah and Sterland has recently been reconstructed as a double circuit 330 kV line. The new section of double circuit line is in service. A small amount of expenditure is required this financial year to finalise this project.

5.5.51 Tuggerah Supply

By summer 2008/09, the load on the Central Coast is forecast to exceed the capacity of the 132 kV systems from Munmorah, Vales Point and Sydney east should either the 330/132 kV transformer or the 330 kV line supplying Tuggerah be out of service. Also, for this outage some of EnergyAustralia's transformers are expected to be at the limit of regulation.

Reconstruction of the section of single circuit 330 kV line between Tuggerah and the tee point at Somersby was completed recently. The double circuit line is presently operating as a "split phase" single circuit. In the future, the section of double circuit will facilitate "looping" 21 line into Tuggerah, which will relieve the limitation imposed by outage of the present single 330 kV supply to Tuggerah.

To relieve the limitations imposed by the single 330/132 kV transformer and single 330 kV supply to Tuggerah, it is planned to:

1. Complete the 330 kV mesh busbar at Tuggerah;
2. Install a second 375 MVA 330/132 kV transformer; and
3. Loop Tuggerah into 21 line.

Also EnergyAustralia has been progressively replacing sections of its existing 33 kV network with a 132 kV network. Conversion of Berkeley Vale substation to 132/11 kV is expected by 2006, which will require an additional 132 kV line switchbay and a 132 kV bus section switchbay at Tuggerah.

5.5.52 Vales Point and Munmorah Switchyard Uprating

Terminal equipment on the 23 Vales Point – Munmorah 330 kV line has been uprated. As part of these works, some rationalisation of switchgear configurations has also been undertaken. Minor expenditure is required this financial year to complete these works.

5.5.53 Wagga 132 kV Transmission Line Rearrangements

The firm 132 kV transmission line capacity from Wagga 330/132 kV Substation to Wagga 132/66 kV Substation has been exceeded over recent summers. Loading on these lines is expected to be further increased with the commissioning of a new gold mine at Lake Cowal. It is planned to rearrange 132 kV lines to between Wagga 330/132 kV Substation and Wagga 132/66 kV Substation, to make better use of the existing 132 kV line capacity, prior to the commissioning of the new gold mine

5.5.54 Wagga 132/66 kV Substation Transformer Capacity

Based on the current load forecast, the firm transformer capacity at Wagga 132/66 kV Substation is expected to be exceeded in the next few years.

In addition to the transformer capacity limitations, the two main incoming 132kV circuits from Wagga 330/132kV substation are both rated slightly above the existing firm 132/66kV transformer rating. Any increase in the 132/66kV transformer capacity at Wagga 132/66kV substation would also require augmentation of the 132 kV lines from Wagga 330/132kV substation.

Wagga 132/66kV Substation operates close to the substation equipment fault ratings and further augmentations to increase 132/66kV capacity and alleviate 132kV circuit thermal capacity will need to address the substation fault rating limitations.

Country Energy, as part of joint planning with TransGrid, has initiated an investigation into the 66kV reticulation system near Wagga and has identified that they may require an additional 66kV supply point as part of their system augmentations.

It is planned to establish Wagga North 132/66kV Substation to provide an additional supply point to Country Energy and to relieve the loading on the existing substation.

5.5.55 Waratah West

A 330/132 kV transformer at Waratah West is expected to be commissioned in late 2004. Some works are required this financial year at Newcastle, Tomago and Waratah West to complete this project.

5.5.56 Wollar - Wellington 330 kV Line and Wollar 330 kV Switching Station

The west and central west of the state is supplied from 330/132 kV substations at Wallerawang, Mount Piper, Yass and Wellington. The 72 Mount Piper – Wellington 330 kV line provides the only 330 kV supply to Wellington.

The network is approaching a number of limitations, of which the most significant is unacceptably low voltages at Wellington 132 kV busbar, and consequently many locations within Country Energy's subtransmission and distribution network, on outage of 72 line.

To relieve the limitations associated with outages of 72 line, it is planned to:

1. Establish a 330 kV switching station at Wollar (on the Bayswater – Mount Piper line); and
2. Construct a Wollar – Wellington 330 kV line.

These works are expected to be completed by late 2007.

5.5.57 Yass 330 3V Substation and Lines

Yass 330/132 kV substation is being refurbished, with much of the work having been completed. Some expenditure is required to complete the works.

SECTION 5

ATTACHMENTS

5A Extract from the 2004 Annual Planning Report (Appendix 1 to that document) "TransGrid's Network Planning Approach".

TransGrid's Submission to the

Australian Competition & Consumer Commission

Revised Transmission Capital

Investment Program 2004-2009

Section 6 of 10

Main System (Generation and Load Driven) Developments

November 2004

6. MAIN SYSTEM (GENERATION AND CUSTOMER DEMAND DRIVEN) DEVELOPMENTS

6.1 Introduction

The NSW main system comprises the 500 kV, 330 kV and 220 kV system that connects the major power stations to the major load centres and the interconnections with other states. This system extends from the Queensland border to the Victorian border and encompasses the Snowy transmission system. This system has been progressively developed over the last 50 years in response to load growth and power station development.

The load-driven network augmentations set out in Section 5 are the State wide network augmentations that are driven predominantly by localised load growth. The potential for interconnection development is very dependent on the capability of the sections of the NSW main system that support the interconnectors. Potential interconnection developments are described in Section 7.

This Section of TransGrid's Revenue Reset Application covers the main system developments that are required over the 2004/5 to 2008/9 period.

The following projects are covered:

- Upgrading of the Bayswater – Mt Piper – Marulan system to 500 kV
- Transmission line development – 500kV:
  - Hunter Valley to Eraring / Richmond Vale
  - Bannaby to Sydney
  - Connection of a Ulan / Rylstone power station
- Capacitor bank installations
- Tamworth 330 kV shunt reactor
- Kemps Creek transformer capacity
- Line uprating
- Rearrangement of Central Coast circuits
- Switching rearrangement – Sydney West – Liverpool 330 kV line
- Bus coupling of 330 kV busbars
- Armidale SVC – system oscillatory damping
- Weather monitoring – line ratings
- Disturbance monitoring
- Multiple contingencies – Special Protection Scheme
- Quality of supply monitoring

Some of these projects are "excluded" projects and these are discussed in Section 6.8.

6.2 Drivers for Main System Developments

The reliability and power transmission capability of the NSW system are critical to the continued reliability of supply to the NSW loads and to the overall operation of the NEM system. The main drivers for reinforcement of the main system are:

- the state-wide load growth;
- the growth of load in the Sydney, Wollongong, Newcastle and Canberra areas of the system, leading to increased power transfers across the main system;
- the need to connect new generation and transmit the generation to the major load centres; and
- the need to support the interconnections with adequate main system power transfer capability.

The NSW load has reached a winter peak load of about 13,000 MW and a summer peak load of about 12,400 MW. The load is forecast to grow and under medium economic load growth conditions is expected to reach about 17,000 MW by summer 2012/13[1] and about 20,000 MW in about 15 years[2].

The present annual load growths in the areas of the main system are shown in *Table 6.1* below (medium load growth with 10% probability of exceedance):

Table 6.1 – Indicative Area Load Growths

Area	Indicative Load Growth (MW) 2004/5 to 2005/6
North of the Hunter Valley	30
Central Coast	70
Greater Sydney area	250
South Coast	30
Canberra area	30
South west	20
West	20

The increasing load will require reinforcement of the main system. The greater Sydney area load amounts to about half of the state load and is expected to dominate the need for main system reinforcements.

Associated with the load growth will be a need for generation development, located within NSW or in other states supported by interconnection development. NEMMCO's Statement of Opportunities 2004 (SOO 2004) has indicated that under medium load growth conditions NSW supply reserves will fall below minimum requirements in summer 2008/09 and generation development to service NSW will be required from that summer onwards.

The generation development may be in the form of upgrading of the 660 MW units in NSW, black coal-fired power stations, OCGT's, CCGT's, brown coal-fired power stations and renewable energy developments. It is expected that the NEM-wide requirements for new generation will be in the order of 12,000 MW over 15 years[3].

New generation developments will require transmission works for connection of the power stations to the system and also deep network augmentations in NSW to enable the state loads to be reliably supplied whilst maintaining system security.

Power transfer over the interconnections with Queensland and Victoria also loads the NSW main system. The impact on the NSW main system of high power transfers and the impact of potential interconnection developments are addressed in Section 7.

Many of the potential transmission system augmentations referred to in this Section have been described in TransGrid's Annual Planning Report 2004 (APR 2004).

The augmentations requiring new line developments or upgrading of existing lines will be subject to the works having acceptable social and environmental impact.

[1] TransGrid Annual Planning Report 2004 medium growth forecast, 10% probability of exceedance
[2] Approximate extrapolation of the medium growth 10% probability of exceedance forecast.
[3] Attachment 6A

6.3 Main System Planning Criteria

TransGrid's Annual Planning Report 2004 describes TransGrid's planning approach for the NSW network.

Power flows on the main transmission network are subject to overall State load patterns and the dispatch of generation within the NEM, including interstate export and import of power. NEMMCO applies operational constraints on generator dispatch to maintain power flows within the capability of regional networks. These constraints are based on the ability of the networks to withstand credible contingency events that are defined in the National Electricity Code. These events mainly cover forced outages of single generation or transmission elements, but also provide for multiple outages to be redefined as credible from time to time.

The rationale for this approach is that, if operated beyond a defined power transfer level, credible contingency disturbances could potentially lead to system wide loss of load with severe social and economic impact.

Following any transmission outage, for example following a forced line outage for which line reclosure has not been possible, NEMMCO applies more severe constraints within a short adjustment period, in anticipation of the impact of a further contingency event.

NEMMCO may direct the shedding of customer load, rather than operate for a sustained period in a manner where overall security would be at risk for a further contingency. The risk is, however, accepted over a period of up to 30 minutes. In performing its planning analysis, TransGrid must consider NEMMCO's imperative to operate the network in a secure manner.

Overall supply in NSW is heavily dependent on the base-load coal-fired generation in the Hunter Valley, western area and Central Coast. These areas are interconnected with the load centres via numerous single and double circuit lines. In planning the NSW system, taking into account NEMMCO's operational approach to the system, there is a need to consider the risk and impact of overlapping outages of circuits under high probability patterns of load and generation.

The planning of the NSW main system is based on the need to cover the first contingency ("n-1") with recognition of the need to re-secure the system within 30 minutes. The analysis of network adequacy is based on the load forecasts published in TransGrid's Annual Planning Reports and NEMMCO's Statement of Opportunities. Attachment 6B sets out the details of the application of the main system planning criteria.

6.4 Development of Backgrounds

Generation development in the NEM is expected to take place in response to market forces i.e. in response to sustained increases in pool prices in the NEM and where profitable trading opportunities by the generators are perceived.

Apart from the presently committed generation developments the future generation development pattern in the NEM is unknown. Hence to ensure that the NSW system has adequate power transfer capability into the future it is necessary to assess the need for network developments against a set of future scenarios of load and generation development. The generation development may need to be complemented with increased interconnection capability. TransGrid uses the term "Background" in reference to the scenarios, in line with the practice of National Grid UK[4].

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[4] The National Grid approach is set out in a number of papers, see for example K. Bell, P. Roddy and C. Ward "The Impact of Generation Market Uncertainty on Transmission System Thermal Constraints and Plant Procurement Volumes", CIGRE – 2002 Session – Paris.

The Backgrounds for the NSW system could be developed by an integrated approach to generation and transmission planning. In this process the optimum combination of generation development, inter-regional interconnector development and intra-regional transmission development would be devised through modelling of the NEM applying detailed knowledge of all the factors that influence investment in new generation, taking into account future movements in fuel prices and the impact of environmental initiatives.

This detailed knowledge is not available and instead a set of five basic scenarios of generation development have been considered. These scenarios are as follows[5]:

- 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

With these scenarios again an integrated approach to generation and transmission planning could yield optimal plans for power station siting in association with interconnector and intra-state transmission developments. This was the traditional approach when supply utilities were integrated, such as the Electricity Commission of NSW or Pacific Power prior to 1995. However, in the disaggregated NEM environment it is necessary instead to assume a set of likely power station locations based on local knowledge and then design appropriate transmission developments.

The Commission has recently advocated a scenario-based approach for determining TransGrid's forward 5 year capex as part of an ex-ante regulatory regime. To meet the lead-times in this revenue reset process TransGrid has had to develop a very abbreviated approach to determining the future Backgrounds and assigning the expected probability of occurrence of the Backgrounds. The TransGrid processes are in embryonic form but have been pursued with as much rigour as the revenue reset timeframe has allowed in order to maximise the integrity of the outcomes. However, it should be noted that the process is imperfect at this stage and a number of regulatory reset cycles may be required to achieve an acceptable level of certainty. It is understood that this has been the case in the United Kingdom.

TransGrid's preliminary considerations in the development and application of the Backgrounds is set out in Attachment 6F. The present basis of the approach to developing the Backgrounds is described in Attachment 6C.

The approach taken has been to determine the NSW supply requirements 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 the future and in general all generating plant in other states is available for service, apart from known isolated retirements; and
- The regional reserve requirements are at the present levels determined by NEMMCO.

Table 6.2 below shows the approximate annual NSW supply side augmentations required to meet the NSW load growth, whilst satisfying NEMMCO's reserve plant margin standard:

[5] Attachment 6A

Table 6.2 - Supply Reserve Shortfall (MW) 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

Under the medium load growth forecast there is a need for additional power sources from 2008/09. The need is advanced by two years under high growth conditions and delayed by one year under low growth conditions. The 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 new power station developments will therefore be expected to affect the NSW transmission system from about 2008/09 onwards. As the generation planting will require transmission works to various degrees, and the transmission expenditure will occur over a number of years up to the time of commissioning of the works, the impact of generation development will be seen in the transmission capital expenditure for a number of years of the present revenue reset period.

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 2008/09 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 2008/09 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 2004/05 to 2008/09 period.

Within the 2004/05 to 2008/09 period it is possible to commence the preparatory work that would be required to commission major line developments in the following years.

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[6].

The above five scenarios of generation development each have certain probabilities. Whilst TransGrid's best judgement has been applied in prescribing the probability of a future power system development, the probability that is able to be assigned to any particular development is considered indicative and subject to judgement.

6.5 Background Details

The Backgrounds are based around the load growth scenarios set out in the APR (and reflected in the SOO 2004), namely medium economic load growth, low economic load growth and high economic load growth. In addition a fourth category covers medium economic load growth together with an additional 400 MW industrial load development by 2008/9. This additional load is assumed concentrated in the Newcastle area. A probability is assigned to each of these load growth categories.

The details of the Backgrounds are set out in Attachment 6C. This subsection of Section 6 summarises the following aspects of the Backgrounds:

- The set of generation developments appearing in various Backgrounds (6.5.1);
- The interconnection developments in the Backgrounds that impact on the NSW transmission system (6.5.2);
- The components of each Background (6.5.3);
- The overall process applied in determining the network augmentation requirements from each background, with a guide to the structure of the supporting documentation (6.5.4); and
- The probabilities assigned to each Background (6.5.5).

6.5.1 Generation Developments in NSW

The Backgrounds assume a number of potential coal-fired and gas turbine generation developments. Each of these affect the need for works in the revenue reset period.

<u>Coal-fired power stations</u>

Three potential coal-fired power stations developments have been considered:

- A Hunter Valley power station near Bayswater
- A power station development near Ulan / Rylstone in western NSW
- An extension of Mt Piper with units 3 and 4

A unit size of 700 MW has been assumed.

It is assumed that the Hunter Valley power station units could be connected directly to a Bayswater 500 kV bus adjacent to the existing 330 kV switchyard, therefore not requiring any transmission line development for connection of the power station.

The Ulan / Rylstone power station is assumed to be located approximately 30 km from the site of the proposed Wollar switching station. The Wollar switching station is located on the route of the Bayswater – Mt Piper line.

The extension of Mt Piper is assumed to be connected to a 500 kV bus adjacent to the existing 330 kV switchyard.

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

Gas turbine power stations

Eight possible gas turbine power station developments have been considered:

- Tomago area
- Eraring
- Munmorah
- Tallawarra
- Pt Kembla
- Tomerong area
- Marulan
- Wagga area or in Victoria associated with increased Victorian export

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.

The Tomago area power station is assumed connected to the Tomago 330 kV bus.

The Munmorah power station is assumed to be a development on the existing power station site and hence is assumed to connect to the existing 330 kV bus.

The Tallawarra power station is assumed to be located on the site of the original Tallawarra power station and hence requires only a short connection to Dapto 330/132 kV Substation.

The Pt Kembla development is assumed to be within the steelworks network.

The Tomerong area power station is assumed connected into the Kangaroo Valley – Dapto 330 kV line on a site near north Nowra.

The Marulan power station is assumed connected directly to the Marulan 330 kV bus.

The Wagga area power station is based on the Wambo proposal for a development near Uranquinty.

There is potential for gas turbine development in Victoria or South Australia. With respect to the NSW main system such developments can be represented broadly by the gas turbine at Wagga.

Wind parks

There is potential for wind generation development at a number of sites in NSW. TransGrid has already processed or is processing a number of connection applications. 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.

6.5.2 Interconnection Developments Affecting NSW

Table 6.3 outlines the potential interconnection developments that have been considered in the period 2004/5 to 2008/9 in various backgrounds.

Table 6.3 - Interconnection Developments Considered in Backgrounds

Interconnection	Potential development
NSW – Snowy: NSW import	• Line uprating • Reactive power support These works are intended to maintain the present import capability
NSW – Snowy / Victoria: NSW import	• Development of a Yass – Wagga 330 kV line • Uprating of lines These works are intended to increase NSW import capability
NSW – Queensland: NSW import	• Power flow control on the NSW 132 kV system (to maintain present capability) • Upgrading of QNI with line series compensation (to increase import capability)

Further details of the interconnector developments are set out in Section 7.

6.5.3 Components of Backgrounds

There are forty three Backgrounds, made up of:
- Medium load growth – 24 Backgrounds, labelled M1 to M24
- Low load growth – 1 Background, labelled L1
- High load growth – 9 Backgrounds, labelled H1 to H9
- Medium load with 400 MW of industrial development – 9 Backgrounds, labelled F1 to F9.

The developments of additional sources of power for NSW for each Background are set out in the Table of Appendix 6(i).

6.5.4 Determination of Network Augmentation Requirements from the Backgrounds

The process for determining the network augmentation requirements of each of the Backgrounds is set out in Attachment 6F.

The flow chart in *Figure 6.1* below shows the main steps.

There is considerable commonality between many of the Backgrounds and the analysis has been abbreviated where possible to meet the timeframe of the Revenue Reset project.

Each of the Backgrounds has been analysed from a planning perspective to identify shortcomings (step 4). These are set out in reports, such as for Background M1:

> *"Background M1 – Main System Capability – Revenue Reset", dated 28/9/2004, File 2003/3466.*

From the list of system shortcomings a set of network development options are derived (step 5) and these are set out in reports such as (again for Background M1):

> *"Background M1 – Main System Reinforcement Options", dated 30/9/2004, file 2003/3466.*

Appendix 6(ii) lists the set of Background documents.

The outcome of this process is a set of necessary network augmentations for each Background and an associated timing. These augmentations have then been scoped out and costed.

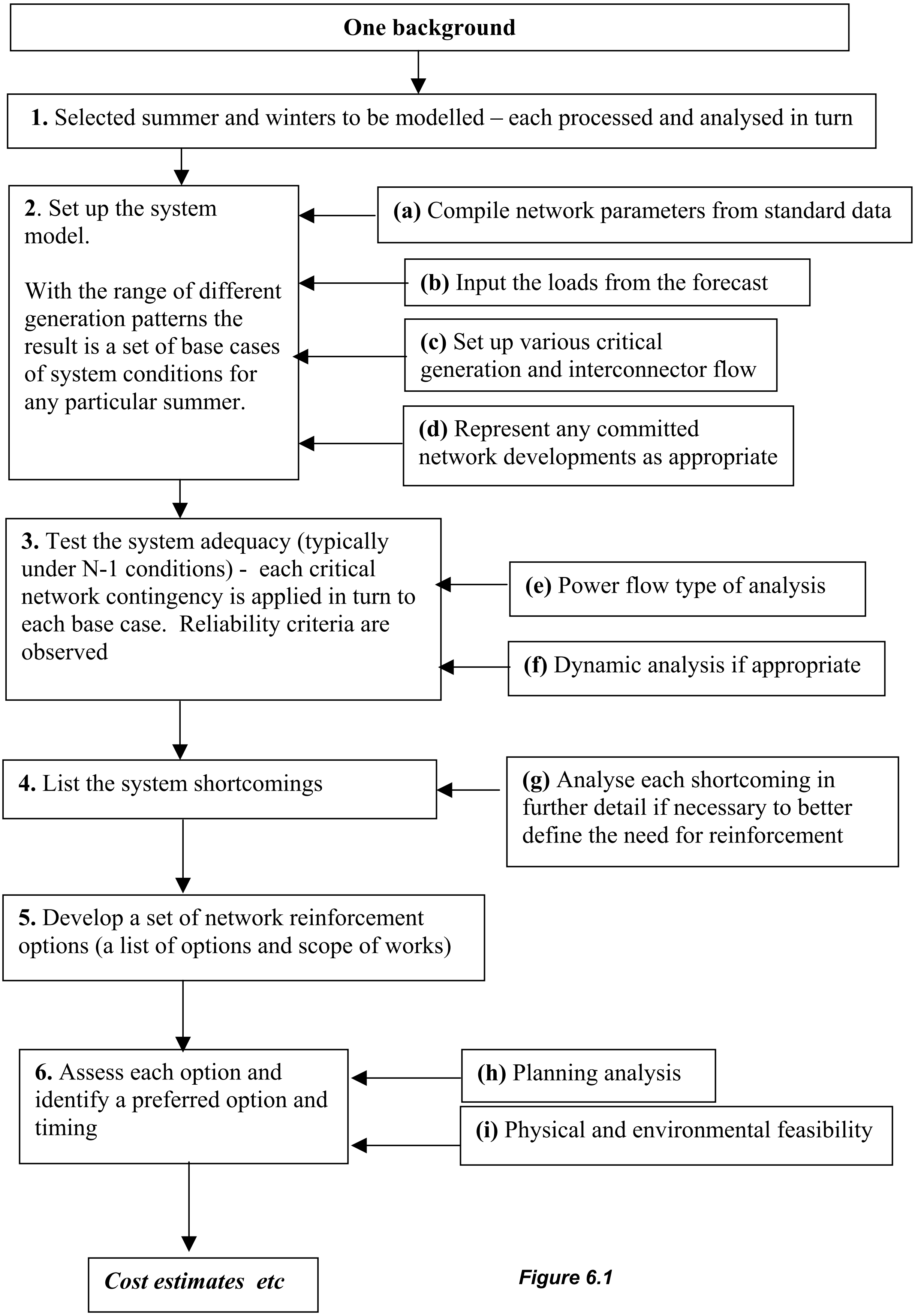
One background
1. Selected summer and winters to be modelled – each processed and analysed in turn
2. Set up the system model.
With the range of different generation patterns the result is a set of base cases of system conditions for any particular summer.
(a) Compile network parameters from standard data
(b) Input the loads from the forecast
(c) Set up various critical generation and interconnector flow
(d) Represent any committed network developments as appropriate
3. Test the system adequacy (typically under N-1 conditions) - each critical network contingency is applied in turn to each base case. Reliability criteria are observed
(e) Power flow type of analysis
(f) Dynamic analysis if appropriate
4. List the system shortcomings
(g) Analyse each shortcoming in further detail if necessary to better define the need for reinforcement
5. Develop a set of network reinforcement options (a list of options and scope of works)
6. Assess each option and identify a preferred option and timing
(h) Planning analysis
(i) Physical and environmental feasibility
Cost estimates etc

Figure 6.1

6.5.5 Background Probabilities

Probabilities can theoretically be attached to each Background. This, in principle, enables a weighted average expenditure for network augmentations in each year to be derived.

There is a need for considerable judgement in assigning probabilities for these future events. The probabilities cannot necessarily be based on quantifiable factors. It is therefore expected that the probabilities would be only indicative. Attachment 6C describes the approach to assigning probabilities.

It is TransGrid's view that the load growth scenarios have the probabilities set out below in *Table 6.4*:

Table 6.4 - Load Growth 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:

Table 6.5 - Assumed Probabilities

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 work of ROAM (Attachment 6A) indicates a 20% probability of coal-fired power station development and 80% probability of gas-fired development by 2009/10. These probabilities have been applied to the Backgrounds.

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

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

The GT stations have generally been limited to 300 MW per site. Hence to achieve larger increments in supply it has to be assumed that groups of sites would be developed. The number of possible combinations of sites is large and it has been necessary to cover a restricted set of combinations as set out below. The following probabilities that have been assumed for the gas turbine developments to meet 600 MW supply increments.

Table 6.6 - Gas Turbine Power Station - Probabilities

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

The overall probabilities for each Background are set out in Appendix 6(i).

6.6 Main System Transmission Developments

The following are the main system transmission developments that will be required, based on the analysis of the range of Backgrounds:

- Upgrading of the Bayswater – Mt Piper – Marulan system to 500 kV
- Transmission line development – 500kV:
  - Hunter Valley to Eraring / Richmond Vale
  - Bannaby to Sydney
  - Connection of a Ulan / Rylstone power station
- Capacitor bank installations
- Kemps Creek transformer capacity
- Line uprating
- Rearrangement of Central Coast circuits

A number of other developments will be required, largely independent of the Backgrounds, and these have been set out in Section 6.7:

- Tamworth 330 kV shunt reactor
- Switching rearrangement – Sydney West – Liverpool 330 kV line
- Bus coupling of 330 kV busbars
- Armidale SVC – system oscillatory damping
- Weather monitoring – line ratings
- Disturbance monitoring
- Multiple contingencies – Special Protection Scheme
- Quality of supply monitoring

These developments are summarised below. Further details are presented in the supporting documentation associated with each Background.

6.6.1 Upgrading of the Bayswater – Mt Piper – Marulan System to 500 kV Operation

Need and Timing

The Bayswater to Mt Piper and Mt Piper to Marulan lines were constructed at 500 kV but presently operate at 330 kV. The analysis of a range of system conditions that has been carried out has shown the need for upgrading to 500 kV operation. The upgrading is required to overcome line loading limitations and limitations in voltage control on the NSW system.

The line loading issue arises in the network between Liddell and Newcastle / Tomago. There is potential for overloading of lines at times of very high generation in the Hunter Valley coupled with high NSW import from Queensland. The line loading is exacerbated if the central coast generation is reduced below maximum. The line loading issue could be relieved by restricting northern generation or import but only if there is sufficient alternative generation in the State.

The line loading issue also arises with increasing load in the Newcastle area. A significant increase in load would occur with expansion of the aluminium smelters.

The voltage control issue occurs at times of very high load in summer when there is high power flow from the north of the state towards Sydney and also when there is high power flow from the south towards Sydney.

Due to the tightening of the supply / demand balance in NSW it is considered that intra-regional constraints on generation will not be tolerable.

Relief of these system limitations is required in all of the Backgrounds. Upgrading of the Bayswater – Mt Piper – Marulan system to 500 kV operation has been shown to relieve the system limitations and is the preferred development. Some alternative development options are set out below and will be analysed in the application of the Regulatory Test.

The 500 kV upgrade is required by 2008/9 in all the medium load growth Backgrounds and the high load growth Backgrounds. In the low load growth Background the need is deferred by one year to 2009/10.

Scope of Work

The upgrading of the western system involves the following developments:

- Establishment of 500 kV switchyards and 500/330 kV transformation at Bayswater, Wollar, Mt Piper and Marulan.
- Two Bayswater generators will also need to be transferred to a 500 kV connection.
- Uprating of plant in the Wallerawang 330 kV Switchyard due to fault level issues.
- System-wide capacitive support.

TransGrid is considering a site at Bannaby as an alternative to the Marulan site for development of a 500 kV switchyard[7].

The advantage of this 500 kV upgrade is that no significant new line development is required. This has significant environmental and cost benefits over time as line routes become increasingly difficult to procure.

Options

Theoretically the other options for relieving the situation are:

- Demand side management in the greater Sydney area accompanied by constraints on the total northern generation and import from Queensland;

[7] NSW Main System Outline Plan – Attachment 6D

- Large-scale line series compensation; or
- Generation development in the greater Sydney area or immediately south of Sydney such as in the Wollongong area.

Each of these options would also require the installation of capacitive support.

The only alternative network development that may partially relieve the system limitations is an extensive installation of series compensation, covering numerous lines. This is not presently considered feasible due to short circuit rating constraints and uncertainty with respect to managing sub-synchronous resonance issues.

A new line development or reconstruction of existing 330 kV lines to 500 kV have not been considered as practical options due to the limited lead-time and environmental impact compared to upgrading of the western 500 kV lines, which involves predominantly substation work.

Regulatory Status

This project has been identified in TransGrid's APR 2004.

The Regulatory Test process for this development will be initiated in the near future.

The cost of the switchyard work makes up more than 10% of the total projected capital expenditure of all of TransGrid's projects over the five year reset period. The cost of the work does not include the cost of new generator transformers at Bayswater. There is some uncertainty in the cost pending detailed site investigations. However the work must start soon in order to meet the 2008/09 timing and the cost uncertainties are reduced because of the minimal need for new line routes. The project is therefore included in TransGrid's capital budget.

Community and Environmental Issues

No significant new line work is required for this project and hence there are not expected to be any community or environmental issues. The elevation of the backbone main transmission network to 500kV operation provides material long term environmental and land use benefits due to the substantial reduction in the need for future transmission line routes.

6.6.2 New Transmission Line Development – 500 kV

The new 500 kV transmission line developments required in the Backgrounds are:

- Hunter Valley to Eraring / Richmond Vale
- Bannaby to Sydney
- Connection of a Ulan / Rylstone power station

Need and Timing

Some of the Backgrounds show the need for reinforcement of the system from the Hunter Valley to the coast at Eraring. This is largely to accommodate new generation development in the north or increased import from Queensland. New line development is required to overcome 330 kV line loading limitations between the Hunter Valley and the coast and also to relieve voltage control limitations on the main system.

Other Backgrounds indicate the need for transmission reinforcement from the south to Sydney. The need for this development is partly related to the potential for an overload of the Hunter Valley to coast system and partly to overcome voltage control limitations, depending on the characteristics of the Background.

Both of these developments form links in the 500 kV ring system that is seen as a long-term development for NSW. This is set out in the main system outline plan – Attachment 6D.

The development of generation in the north or increased import from Queensland exacerbates the potential for overloading of the Hunter Valley to coast 330 kV network. This system constraint could be relieved by development of a new line from Bayswater to Eraring.

The development of generation in the west also exacerbates the potential for overloading the Hunter Valley to coast 330 kV network. Whilst a Hunter Valley to coast reinforcement would overcome this limitation it is presently preferred instead to reinforce the network from the south (Bannaby or Marulan) to Sydney.

Independent of the line overload issue the development of generation in the west or north, or increased power transfer into NSW from Queensland, requires line development to overcome voltage control limitations. The Hunter Valley to coast reinforcement is less effective than the southern reinforcement under some conditions.

The development of GT power stations at the range of sites considered in the Backgrounds does not exacerbate the potential for line overloading in the Hunter Valley to coast 330 kV network. Certainly GT generation on the central coast could partly relieve the limitation.

Modelling of the majority of Backgrounds in 2009/10 indicates that there will be a significant voltage control limitation on the main system by about that time. This is as a result of the overall state load and the loading on the network imposed by the new generation or interconnector flows. The new power sources included in the Backgrounds are the minimum necessary to preserve adequate reserve plant margins and hence it will not be tolerable to have intra-regional constraints on generation dispatch. It is expected that new line development, such as the above northern reinforcement or southern reinforcement, will be the only available options to provide adequate power transmission capability across the main system. Hence the majority of Backgrounds include either a Hunter Valley to coast reinforcement or a Marulan / Bannaby to Sydney reinforcement by 2009/10.

The development of such major network reinforcements would usually require longer lead-times under normal conditions.

If a major load is developed in the Newcastle area the transmission reinforcement will need to include the northern reinforcement with the establishment of a substation near Newcastle, known as Richmond Vale.

To avoid a proliferation of lines throughout NSW it will be aimed to utilise existing line easements where possible. The above network reinforcements will involve construction of double circuit 500 kV lines. This is required for a number of reasons:

- to maximise the utilisation of easements;
- to provide a long-term solution giving adequate transmission capacity for the long-term, and
- to manage 330 kV system fault level constraints.

Whilst the first of the 500 kV line developments is expected to be required this decade it is expected that within 10 to 15 years reinforcement of the system from the Hunter Valley to the coast and from the south to Sydney will both be required. The order of development of the lines will be governed by the order of generation development. When these lines are developed the 500 kV ring in NSW will effectively be closed providing a high capacity for power transfer around the ring.

In addition to the 500 kV line developments that close sections of the 500 kV ring there will be a need to develop new lines to connect new power stations. It is assumed for example that the Ulan / Rylstone power station would be connected to the proposed Wollar switchyard which is along the route of the Bayswater – Mt Piper line. Other power station developments have been assumed to be connectable directly to existing switchyards or have required only minor line works for connection.

Scope of Work

The reinforcement of the Hunter Valley – coast system will involve the development of a 500 kV double circuit line from Bayswater to Eraring. Rather than reinforce the system fully between the two 500 kV switchyards it may be feasible to terminate the line from Bayswater at a Richmond Vale 500 /330 kV substation. The Richmond Vale – Eraring line section may then be developed at a later time.

The Richmond Vale substation development would be expected to require 500 kV and 330 kV switchyards and at least two 500/330 kV transformers.

There is potential to rebuild existing 330 kV lines from the Hunter Valley toward Newcastle.

The development of a 500 kV line from the south to Sydney may be able to be achieved by reconstructing the Yass – Sydney West 330 kV line between Bannaby and Sydney West.

Detailed planning and feasibility assessment will be required to define the works.

Extensive community consultation and environmental assessment would also be required to develop the project.

Options

The closure of links in the 500 kV ring will require new line development. Some of these developments may be able to be achieved through reconstruction of 330 kV lines.

No other options, consistent with the long-term requirements of the system, are considered feasible.

Regulatory Status

It is not feasible to commence development of either of the northern or southern 500 kV lines until the future sequence of generation development becomes more firm. Instead TransGrid will undertake preparatory work to minimise the line development lead-time.

The projects are considered “excluded” projects as discussed in Section 6.8.

Community and Environmental Issues

Such major new line development will require extensive consultation with the community and management of environmental issues.

6.6.3 Capacitor Bank Installation

The main system will require an ongoing installation of shunt switched capacitor banks and possible SVC’s. Approximately 400 Mvar of new plant is required per annum up to the time of upgrading of the western system to 500 kV operation. This is broadly common to all Backgrounds.

Further 500 kV line developments, such as those described in 6.6.2, are expected to reduce the need for additional reactive plant.

Some of the future capacitor support is required to offset the reduction in the generator var capability of the 660 MW units as they are upgraded to higher MW output.

The following main system capacitor banks which are scheduled for installation in 2005/06 have been identified in TransGrid's APRs and are deemed to have passed the Regulatory Test:

Canberra: 132 kV – 120 Mvar
Sydney West: 330 kV – 200 Mvar
Vales Pt: 330 kV – 2 x 200 Mvar

6.6.4 Kemps Creek Transformer Capacity

Need and Timing

There are two 1200 MVA 500/330 kV transformers in service at Kemps Creek. The transformer capacity will need to be augmented to meet the high north to south power transfers that occur in some of the Backgrounds. These are Backgrounds that include additional northern generation and reinforcement of the Hunter Valley to coast system.

The timing is 2009/10 except under three high load growth Backgrounds where the additional capacity would be required in 2008/9.

Scope of Work

In a number of Backgrounds high north to south power transfers result in a marginally higher loading than the present firm rating of the transformers. An augmentation to the cooling systems is expected to adequately cover these conditions and this has not been explicitly covered in the capital works costing. It would be considered part of the contingency allowance.

The installation of a third transformer (three single-phase units) will require 500 kV and 330 kV switchbays.

Regulated Status

This project has been identified in TransGrid's APR 2004. It would be associated with a northern generation development and hence has not yet been subjected to the Regulatory Test.

6.6.5 Line Uprating

The uprating of a number of 330 kV lines will be progressively required by 2008/09. In some cases the uprating may require only uprating of the terminal plant. In other cases a physical uprating of the line conductors will be required.

The need to uprate 330 kV lines was covered in APR 2004.

6.6.6 Rearrangement of Central Coast Circuits

This work is required to improve the level of reactive power support to the growing Newcastle area load from Eraring Power Station. It is also required to relieve potential line overloading issues. An additional benefit will be a saving in transmission losses.

The project has been covered in recent APR's.

6.7 Additional Transmission Works

To provide a reliable and secure power supply on the main system the following additional transmission works are required in the 2004/5 to 2008/9 period. They are relatively small projects and are independent of the Backgrounds. In some cases the cost of the works is relatively small and there is no explicit provision of a cost in capital estimates. It is expected that the smaller projects would be treated as part of the contingency sum.

The following works are summarised:

- Tamworth 330 kV shunt reactor
- Switching rearrangement – Sydney West – Liverpool 330 kV line
- Bus coupling of 330 kV busbars
- Armidale SVC – system oscillatory damping
- Weather monitoring – line ratings
- Disturbance monitoring
- Multiple contingencies – Special Protection Scheme
- Quality of supply monitoring

6.7.1 Tamworth 330 kV Shunt Reactor

There are two 330 kV shunt reactors located at Tamworth. One of these is not serviceable and has been disconnected for some time.

It is necessary to replace this reactor with a new reactor in order to manage voltage control under conditions where the system is to be restarted from Queensland following a widespread interruption to the NSW system.

6.7.2 Switching Rearrangement – Sydney West – Liverpool 330 kV Line

The Sydney West – Liverpool 330 kV line is single circuit breaker switched at Sydney West. To improve the reliability of supply to the growing Liverpool load a second 330 kV switchbay is required at Sydney West to provide a dual switching arrangement.

6.7.3 Bus Coupling of 330 kV Busbars

The coupling of the 330 kV busbars at many 330 kV switchyards having a double bus arrangement has been achieved by dual switching of some of the 330 kV lines terminated at the substation. Bushfires in the Sydney area have caused the outage of multiple lines which has resulted in the loss of bus coupling at Sydney South 330kV switchyard. This potentially has severe implications for the integrity of the 330 kV system and the continuity of supply over a large area.

It is proposed to increase the level of 330 kV bus coupling at the major substations supplying the larger urban loads, namely: Sydney South, Sydney North, Sydney West, Sydney East and Newcastle. The works involves the installation of one additional 330 kV switchbay at each site.

6.7.4 Armidale SVC - System Oscillatory Damping

To improve the damping of system oscillations involving QNI a damping control (Power Oscillation Damper) is to be installed on the Armidale SVC.

6.7.5 Weather Monitoring – Line Ratings

TransGrid is aiming to maximise the rating available from its lines for the use of the market. An extensive program of installation of weather monitors is required to facilitate the application of real-time line ratings.

6.7.6 Disturbance Monitoring

TransGrid has an extensive program for installation of disturbance monitors on the system. The monitors provide information on the response of the system, the generators and loads to system faults and power flow disturbances. This information enables a rigorous review of system incidents and also provides modelling data required for ensuring the ongoing security of the system through the accurate representation of system components.

6.7.7 Multiple Contingencies – Special Protection Scheme

Planning and operation of the system generally provides for the impact of single contingencies. There is a low risk of multiple contingencies but the potential impact of such events includes significant interruptions to supply and widespread disturbances to the NEM.

As the State load grows the system will be expected to operate closer to power transfer limits over longer periods of time.

TransGrid has already implemented a number of Special Protection Schemes (SPS). These have been used to extend the capability of the system under system normal conditions and to enable the control of voltage following large frequency excursion events.

The design requirements of a SPS to cover multiple contingencies in the system supplying the greater Sydney system are being analysed. The SPS would shed load under certain conditions following events that are projected to lead to system instability or line overloading. Installation of the scheme is proposed within the five year reset period.

6.7.8 Quality of Supply Monitoring

To meet TransGrid's National Electricity Code obligations quality of supply monitoring will be installed at a number of sites.

6.8 Excluded Projects

Some projects have been classified as "excluded". The reasons for their exclusion and the likely triggers that may require development of the project are summarised below. Whilst the likely triggers have been listed below other triggers may however arise that require development of the projects.

6.8.1 Hunter Valley – Coast 500 kV Development

This development includes a new 500 kV line and possibly development of a Richmond Vale 500/330 kV Substation.

Although it is an excluded project it is considered necessary to make progress towards acquiring a site for the Richmond Vale substation before urban encroachment precludes its development. It is also considered necessary to commence investigations into the potential route of the line and establish the feasibility of its construction to minimise lead-times in the future.

<u>Reasons for Exclusion</u>

- This project is expected to have a high cost.
- There are a range of possible line routes including the possibility of reconstruction along existing easements in some area. The 500 kV line may or may not require termination at a Richmond Vale substation depending on the extent of future

industrial development in the Newcastle area. This introduces uncertainty in the project cost.

- The cost of easements is expected to be high.
- Refinement of the options will involve extensive community consultation.
- The development is subject to environmental acceptability.
- The project is largely contingent on development of a western or northern power station. If a power station is developed in the Mt Piper area it is likely that the alternative 500 kV development from the south into Sydney would be the preferred development. There is a long-term need for development of the Bayswater to coastline but its timing is dependent on future generation developments.

Likely Triggers for Development

- Development of a major power station near Bayswater or further north towards Gunnedah / Narrabri
- Development of a major power station in the Ulan / Rylstone area.
- Major interconnection development with Queensland
- Major load development in the Newcastle area.

6.8.2 Bannaby Area – Sydney 500 kV Development

This development includes a new 500 kV line form the Marulan / Bannaby area to Sydney. It may require development of 500/330 kV transformation at Sydney West Substation.

Although it is an excluded project it is considered necessary to commence investigations into the potential route of the line and establish the feasibility of its construction to minimise lead-times in the future. It may also be necessary to acquire a site for a 500/330 kV substation in the Cobbitty area, depending on the feasibility of constructing a 500 kV line to Sydney West.

Reasons for Exclusion

- This project is expected to have a high cost.
- There are a range of possible line routes including the possibility of reconstruction along existing easements in some area.
- There are a range of options for termination of the line including a new Sydney West 500/330 kV Substation or a termination at a 500/330 kV site on the southern outskirts of Sydney near Cobbitty.
- The cost of easements is expected to be high.
- Refinement of the options will involve extensive community consultation.
- The development is subject to environmental acceptability.
- The project is contingent on development of a western station. If a power station is developed in the north it is likely that the alternative 500 kV development from the Hunter Valley to the coast would be the preferred development. There is a long-term need for development of the Bannaby – Sydney line but its timing is dependent on future generation developments.

Likely Triggers for Development

- Development of a major power station near Mt Piper and possibly Ulan / Rylstone
- Major interconnection development with Snowy / Victoria.
- Increased system reactive power deficiencies.

APPENDIX 6(i) – COMPONENTS OF THE BACKGROUNDS

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

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	1.12

APPENDIX 6(i) – COMPONENTS OF THE BACKGROUNDS

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

Background	Load forecast	Interconnection development	NSW unit upgrading	Coal-fired power station development	Gas-fired power station development	Probability % (approx)
					Tomago + Eraring	
M14	Medium	As above	As above		2009/10 Tomago + Munmorah	1.12
M15	Medium	As above	As above		2009/10 Eraring + Munmorah	1.12
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				10

APPENDIX 6(i) – COMPONENTS OF THE BACKGROUNDS

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

Background	Load forecast	Interconnection development	NSW unit upgrading	Coal-fired power station development	Gas-fired power station development	Probability % (approx)
		2009/10: NSW import capability from Qld increased by 150 MW				
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

APPENDIX 6(i) – COMPONENTS OF THE BACKGROUNDS

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

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

APPENDIX 6(ii) – LIST OF BACKGROUND DOCUMENTS

The following is the list of Background documents that have been provided to the ACCC:

Background M1

“Background M1 – Main System Capability – Revenue Reset”, dated 28/9/2004, File 2003/3466.
“Background M1 – Main System Reinforcement Options”, dated 30/9/2004, file 2003/3466.

Background M2

“Background M2 – Main System Capability – Revenue Reset”, dated 1/10/2004, File 2003/3466.
“Background M2 – Main System Reinforcement Options”, dated 1/10/2004, file 2003/3466.

Background M3

“Background M3 – Main System Capability – Revenue Reset”, dated 2/10/2004, File 2003/3466.
“Background M3 – Main System Reinforcement Options”, dated 2/10/2004, file 2003/3466.

Background M4

“Background M4 – Main System Capability – Revenue Reset”, dated 13/10/2004, File 2003/3466.
“Background M4 – Main System Reinforcement Options”, dated 14/10/2004, file 2003/3466.

Background M5

“Background M5 – Main System Capability – Revenue Reset”, dated 13/10/2004, File 2003/3466.
“Background M5 – Main System Reinforcement Options”, dated 14/10/2004, file 2003/3466.

Background M6

“Background M6 – Main System Capability – Revenue Reset”, dated 13/10/2004, File 2003/3466.
“Background M6 – Main System Reinforcement Options”, dated 14/10/2004, file 2003/3466.

Background M7

“Background M7 – Main System Capability – Revenue Reset”, dated 14/10/2004, File 2003/3466.
“Background M7 – Main System Reinforcement Options”, dated 19/10/2004, file 2003/3466.

Background M8

“Background M8 – Main System Capability – Revenue Reset”, dated 21/10/2004, File 2003/3466.
“Background M8 – Main System Reinforcement Options”, dated 1/10/2004, file 2003/3466.

<u>Background M9</u>

"Background M9 – Main System Capability – Revenue Reset", dated 21/10/2004, File 2003/3466.
"Background M9 – Main System Reinforcement Options", dated 21/10/2004, file 2003/3466.

<u>Background M10 – M18</u>

"Background M10 – M18 – Main System Capability – Revenue Reset", dated 21/10/2004, File 2003/3466.
"Background M10 – M18 – Main System Reinforcement Options", dated 21/109/2004, file 2003/3466.

<u>Background M19 – M24</u>

"Background M19 – M24 – Main System Capability – Revenue Reset", dated 25/10/2004, File 2003/3466.

<u>Background L1</u>

"Background L1 – Main System Capability – Revenue Reset", dated 22/10/2004, File 2003/3466.
"Background L1 – Main System Reinforcement Options", dated 22/10/2004, file 2003/3466.

<u>Background H1</u>

"Background H1 – Main System Capability – Revenue Reset", dated 25/10/2004, File 2003/3466.
"Background H1 – Main System Reinforcement Options", dated 25/10/2004, file 2003/3466.

<u>Background H2 – H3</u>

"Background H2 – H3 – Main System Capability – Revenue Reset", dated 25/10/2004, File 2003/3466.
"Background H2 – H3 – Main System Reinforcement Options", dated 25/10/2004, file 2003/3466.

<u>Background H4 – H9</u>

"Background H4 – H9 – Main System Capability – Revenue Reset", dated 25/10/2004, File 2003/3466.
"Background H4 – H9 – Main System Reinforcement Options", dated 25/10/2004, file 2003/3466.

<u>Background F1 – F9</u>

"Background F1 – F9 – Main System Capability – Revenue Reset", dated 25/10/2004, File 2003/3466.
"Background F1 – F9- Main System Reinforcement Options", dated 25/10/2004, file 2003/3466.

SECTION 6

ATTACHMENTS

6A ROAM Report – "Probabilistic Assessment of Generation Developments for NSW", 16th November 2004.

6B "Main System Planning Criteria – Application", Transmission Development report dated 1/4/2004, File 2003/5997.

6C Backgrounds Affecting Main System and Interconnection Developments", discussion paper dated 12/11/2004.

6D NSW Main System Outline Plan, dated 9/9/2004, File 2004/1680.

6E "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

6F "Background Related Planning Process for Major Network Developments", discussion paper dated 27/9/2004, File 2003/3466.

TransGrid's Submission to the

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Interconnection Capital Expenditure

November 2004

7 INTERCONNECTION DEVELOPMENTS

7.1 Introduction

The south-east Australian interconnected system now comprises the power systems of Queensland, New South Wales, Victoria and South Australia. It is expected that Tasmania will be connected via Basslink in 2005.

The NSW main system is interconnected with the Queensland and Victorian systems. The interconnections have been progressively developed since the inception of the Snowy Scheme.

In the late 1950's the NSW and Victorian systems were interconnected using 330 kV transmission in association with the development of the Snowy Mountains Hydro-Electric Scheme. The output of the Snowy scheme was then shared between NSW and Victoria.

The interconnection was reinforced in 1979 via a Wagga – Jindera – Wodonga – Dederang 330 kV connection. This latter interconnection also provided support to the developing loads at Albury and Wodonga, astride the border between the two States.

The development of the Broken Hill load was the catalyst for interconnection at 220 kV between Darlington Pt, Buronga and Red Cliffs in 1988.

The NSW – Victoria interconnection has provided benefits to both States through the sharing of Snowy generation, the sharing of surplus generation, supply to intermediate loads and the close control of frequency typical of large interconnected systems.

Interconnection to South Australia was developed in 1989 via a 500 kV and 275 kV transmission system between Heywood in western Victoria and the Mt Gambier area in south eastern South Australia. The overall route length from Port Augusta in South Australia to northern New South Wales was then about 2800km.

In 1999 the entrepreneurial Directlink HVDC project was completed linking the far north coast of NSW to the Queensland Gold Coast System.

In 2000 Queensland was connected to NSW via a 330 kV and 275 kV HVAC system that extended from the Hunter Valley in NSW to the Tarong Power Station in Queensland. The overall route length of the interconnected system from South Australia to northern Queensland was then extended to about 4400km.

QNI has provided benefits in sharing of generation between Queensland and the southern States, the connection of the Millmerran Power Station and close control of system frequency.

In 2002 the entrepreneurial Murraylink HVDC project was completed linking the far north west of Victoria to the Riverland of South Australia.

Section 6 of TransGrid's Revenue Reset Application covered the main system developments that are required over the 2004/05 to 2008/09 period.

This section addresses the potential interconnection developments over the 2004/05 to 2008/09 period.

The focus is on maintaining and later improving the NSW import capability and the following projects are covered:

Maintaining NSW import capability

- Refurbishing work on the Murray – Lower Tumut and Murray – Upper Tumut 330 kV lines.
- Uprating the Marulan – Dapto 330 kV lines.
- Reactive support at Canberra.
- Installation of power flow control on the Armidale – Kempsey 132 kV line.

Upgrading NSW import capability

- Yass – Wagga 330 kV line.
- Series compensation of the QNI lines.

Some of these projects are “excluded” projects and these are discussed in Section 7.11.

7.2 Drivers for Interconnection Development

Section 6 discussed the impact of load growth in NSW and the emerging need for additional power sources and main system reinforcements. The interconnectors between NSW and the other States provide NSW with access to the generation in other States at times of surplus generation over demand in those States. The import of additional power over the interconnectors is an alternative future option to the development of power stations in NSW.

Similarly the other States rely at times on NSW generation surplus. In meeting the load demand of each State the interconnectors allow advantage to be taken of the diversity of load between the States.

The interconnectors also allow trading activity across the NEM for profit.

NSW is heavily interconnected with Victoria and Queensland and also with the Snowy region. The interconnector capabilities are functions of load levels and generation dispatch. Most of the interconnector capabilities will decline over time and one with increase over time in response to load growth in NSW.

The main drivers for maintaining the present interconnection capability and for interconnection reinforcement are:

- To meet the growing demand in NSW, relying in part on interstate generation;
- To support the other States by sharing NSW surplus generation at time of reduced NSW demand; and
- To facilitate the trading of power across the NEM.

The maintenance of the existing interconnection capability has been included in the Backgrounds described in Section 6. The upgrading of the interconnections has been factored into a number of the Backgrounds.

7.3 Planning Criteria

The power transfer capability of the interconnectors is determined by four factors:

- Line thermal ratings;
- Voltage control capability;
- System oscillatory damping; and
- Transient stability

Any one or all four of these factors may limit the power transfer over any interconnector at any time, the power transfer capability being determined by the most restrictive of the capabilities. The limitations are generally expressed as constraint equations, which define a technical envelope for the system. The constraint equations may include variables that cover system load levels, voltage profile, generation inertia etc.

The power transfer capability is based on the ability of the networks to withstand credible contingency events that are defined in the National Electricity Code. These events mainly cover forced outages of single generation or transmission elements, but also provide for multiple outages to be redefined as credible from time to time.

Power flows over the interconnectors are subject to overall State load patterns and the dispatch of generation within the NEM. NEMMCO applies the constraint equations to maintain the power flows within the capability of the interconnectors.

Following any transmission outage NEMMCO applies more severe constraints within a short adjustment period, in anticipation of the impact of a further contingency event. The risk of a further contingency is accepted over a period of up to 30 minutes. In performing its planning analysis, TransGrid must consider NEMMCO's imperative to operate the network in a secure manner.

Therefore TransGrid's planning for interconnector reinforcement is based on a detailed knowledge of the present capability of the interconnectors and the analysis of the impact of single contingencies.

7.4 Components of the NSW Interconnections

In this document the interconnections are viewed as forming the electrical connections between the States and between the NSW main system and the Snowy generators. Also included are the critical intra-regional parts of the network that may determine the interconnector capability. Hence the interconnectors in this document don't directly align with the interconnectors between the Regions of the NEM.

7.4.1 NSW – Queensland

The connection between NSW and Queensland is comprised of QNI and Directlink.

<u>Directlink</u>

> The HVDC Directlink scheme is connected within the far north NSW 132 kV system supplied from Lismore 330/132 kV Substation.
>
> For export from NSW the power transfer capability is determined by the capability of the 330 kV and 132 kV system supplying the Lismore area and the three 132 kV lines from Lismore 330/132 kV Substation to Lismore 132/66 kV Substation.
>
> For export from Queensland the power transfer capability is determined by the capability of the Gold Coast system.

<u>QNI</u>

> The HVAC lines that comprise QNI connect Armidale and Dumaresq 330 kV switchyards in NSW to Bulli Ck in Queensland. This interconnection is supported by the 330 kV system extending from Liddell in NSW and the 330/275 kV system extending from Bulli Ck to Tarong in Queensland. The NSW mid north coast 132 kV system also operates in parallel with the northern NSW 330 kV system. The power transfer capability of QNI is partly determined by the capability of these supporting systems and loads connected in these systems.

A 330 kV line is being constructed from Millmerran to Middle Ridge in Queensland and this augmentation will also affect the power transfer capability of QNI.

7.4.2 NSW - Snowy

The Snowy region to NSW system comprises the system between switching stations in the Snowy NEM region and the Yass / Canberra area and thence to the south coast of NSW. The south west area of NSW, comprising the load centres of Wagga, Jindera, Darlington Pt and Broken Hill is also connected to the Snowy area and the Victorian system.
The interconnection between Snowy and NSW comprises the following 330 kV lines:

- Upper Tumut Switching Station to Yass
- Upper Tumut Switching Station to Canberra
- Lower Tumut Switching Station to Wagga
- Lower Tumut Switching Station to Yass
- Lower Tumut Switching Station to Canberra
- Yass to Canberra
- Yass to Marulan (two lines)
- Yass to Sydney
- Canberra to Dapto via Kangaroo Valley
- Lower Tumut to Wagga
- Marulan to Avon and Dapto

7.4.3 NSW – Victoria

The interconnection is formed by the following lines:

- Murray – Dederang 330 kV (2 lines)
- Jindera – Wodonga 330 kV
- Buronga – Red Cliffs 220 kV.

The capability of the Murray – Dederang and Jindera – Wodonga system is governed by the generation conditions at Snowy and the loading in the NSW south west area. The capability of the 220 kV interconnection is dependent on the integrity of the supporting Wagga – Darlington Pt 330 kV and 132 kV systems and the 220 kV line from Darlington Pt to Buronga.

The capability for power transfer between NSW and Victoria is also governed by overall stability considerations.

7.5 NSW Interconnection Capability

The capabilities of the interconnectors are summarised in Attachment 7A.

The capabilities of the interconnectors are generally described by multi-term limit equations with variables that include load levels, generation dispatch and voltage profiles. The power transfer capability is not a fixed quantity but varies as conditions in the supporting systems vary. The capabilities presented in this document are indicative capabilities for the purpose of illustration.

The capabilities are given for system normal conditions, i.e. with the network intact. The capability is the secure power transfer capability in anticipation of the next credible contingency. The capabilities presented in the document also exclude any necessary safety margins that may be implemented by NEMMCO as part of the NEM dispatch process.

The trend in the interconnector capabilities, in response to load growth and other factors, is summarised in the following sections.

7.5.1 NSW – Queensland – Capability Over Time

The interconnection with Queensland (QNI and Directlink) allows up to about 1200 MW NSW import and up to 700 MW NSW export.

The NSW import capability from Queensland is partly determined by the rating of the Armidale – Kempsey 132 kV line. The NSW import capability is expected to decline over time as the load on the NSW mid north coast grows. TransGrid has plans for reinforcing the 132 kV system on the mid north coast and this will affect the capability for NSW import.

The NSW import capability is also determined by the transient stability response of the system to the outage of a major load in Queensland, as a single credible contingency. A further consideration is the transient stability response of the system to a fault in the NSW system.

The capability for NSW export to Queensland is determined by 330 kV line ratings, considerations of voltage control and transient stability. The impact of a trip of a Queensland generator is a significant factor in determining the capability.

The capability for NSW export will decline over time as the northern load grows, exacerbating line rating limitations.

The development of the Kogan Ck Power Station (750 MW unit), being significantly larger than the present Queensland units, will significantly reduce NSW export capability with respect to transient stability.

7.5.2 NSW – Snowy – Capability Over Time

NSW is able to import up to about 3400 MW from Snowy/ Victoria in total. The limitation is due to the ratings of the lines within the Snowy region north of Murray and the ratings of the lines immediately north of Snowy. The lines between Marulan and the coast may also limit NSW import at times of high western generation.

As the NSW load grows the south western load is expected to grow accordingly and this tends to reduce the amount of power that needs to be transmitted north of Snowy. Hence it is expected that the NSW import capability will increase gradually over time.

7.5.3 NSW – Victoria – Capability Over Time

The interconnection with Victoria has a capability for power transfer of up to about 1900 MW to Victoria and about 1100 MW from Victoria.

The Victorian import capability is determined by the ratings of lines south of Murray and voltage control limitations. The capability is declining over time with the growth in the NSW south west area load.

The Victorian export capability to NSW is partly determined by transient stability considerations.

7.6 Outcomes of Joint Planning Work With Powerlink

TransGrid has undertaken joint planning work with Powerlink to design interconnector augmentations that would enable an increase in the power transfer between NSW and Queensland and to establish in broad terms whether projects could be economically justified. A report on this work is included as Attachment 7B.

A number of conceptual interconnector reinforcement works have been defined. These cover projects that do not involve major line works, and hence may be able to be achieved in the short-term, and some schemes that require major new lines to be developed and therefore could only be achieved in the long term.

The short-term schemes could provide a relatively small improvement to the QNI capability. The longer-term schemes aim to provide a substantial increase in power transfer capability between the States.

A preliminary cost/benefit study concluded that only the low cost schemes that provided an improvement in the NSW import capability may be able to be justifiable under the Regulatory Test. Since that study was completed the Kogan Ck Power Station became a committed project and the joint study is now being repeated. The competition benefits from interconnector development will need to be examined in the study.

The technical requirements of the long-term schemes will be further developed so that they may be available for development in the future.

7.7 Outcomes of Joint Planning Work with VENCorp

TransGrid has also undertaken joint planning work with VENCorp to design interconnector augmentations that would increase the power transfer capability into Victoria and to establish whether the works may be justifiable.

Again both short-term and long-term reinforcement options have been considered.

The joint planning with VENCorp defined a network augmentation that could be mainly achieved through substation work and provide an increase in Victorian import capability by the order of 180 MW. The work involved predominantly power flow control in the Wagga area and transformer installation in Victoria. The scheme would however require additional NCAS in Victoria and this could not be acquired at a reasonable cost. It was judged that this interconnector augmentation could not be justified.

Significant upgrade of the interconnection is feasible but it would require new line works, which could not be completed in the five year Revenue Reset period. The development of a Yass – Wagga 330 kV line is one option for improving the Victorian import capability[1].

The development of a new interconnector with Victoria may be associated with the reinforcement of supply to the growing loads along the Murray River in NSW and Victoria.

Joint planning work will continue with VENCorp to regularly review these findings and to resolve the supply requirements of the Murray River area loads.

7.8 Interconnector Developments Included in the Backgrounds

Attachment 7A sets out potential interconnector reinforcement projects between NSW and the other States.

The interconnector developments included in the Backgrounds[2] provide for the works needed to maintain the existing interconnector capability and a very limited set of works that may be used to increase the capability for NSW import. These works are those that could be undertaken in the 2004/05 to 2008/09 period. Due to the tightening of the supply/demand balance in NSW during this period the focus is on NSW import only.

[1] It should be noted that the line may also improve NSW import capability from the south as well as improving Victorian import capability. The benefits for NSW import are addressed in section 7.10.1.
[2] The Backgrounds are described in Section 6.

It is not considered feasible to complete a major new interconnector in the 2004/05 to 2008/09 period as a significant upgrade of the interconnectors would be expected to require major new line works

The development of new generation in NSW is included in the Backgrounds. This new generation may justify the reinforcement of the interconnectors to allow increased NSW export or increased import by the other States. Such reinforcements would be expected to involve major new line works and hence have not been addressed in the Backgrounds, in general. It remains necessary however to undertake preliminary work on all the potential interconnector developments to minimise future lead-times.

One line development included in the Backgrounds is the development of a Yass – Wagga 330 kV line. Though not strictly an interconnector it would support the NSW – Snowy/Victoria interconnection. It is addressed in section 7.10.1.

The interconnector developments relating to works to maintain the interconnector capability are covered in section 7.9 whilst section 7.10 covers the works relating to upgrading of the interconnectors.

7.9 Maintaining Interconnector Capability

As the NSW margin of supply over demand deteriorates with load growth there is an incentive to at least maintain the capability of the interconnections.

The Backgrounds covering 2004/05 to 2008/09 have allowed for the works that maintain present capabilities with respect to the following:

- NSW import from the south.
- NSW import capability from Queensland.

7.9.1 NSW Import from the South

The works required to maintain the present NSW import capability from the south are:

- Refurbishing work on the Murray – Lower Tumut and Murray – Upper Tumut 330 kV lines.
- Uprating the Marulan – Dapto 330 kV lines.
- Reactive power support at Canberra.

The line refurbishing work on the Murray – Lower Tumut and Murray – Upper Tumut 330 kV lines entails the management of line conductor clearances under high loading conditions at times of summer temperatures. This work was referred to in the APR 2004.

The uprating of the Marulan – Dapto 330 kV line is required to accommodate high import from the south at times of high western generation. The need to uprate the line arose in many of the Backgrounds. This issue has been addressed in the APR 2004.

Environmental constraints on both the line refurbishment and line uprating works will need to be carefully managed.

There is a need to also offset the growth in the Canberra load by installing additional capacitor support at Canberra. This will remove a voltage control constraint that may otherwise limit import from the south. The installation of a 120 Mvar 132 kV capacitor bank has been addressed in the APR 2004 and is scheduled for 2005/6.

7.9.2 NSW Import from Queensland

The NSW import capability from Queensland is partly determined by the rating of the Armidale – Kempsey 132 kV line. The installation of power flow control on this line is proposed be completed in the later part of the Revenue Reset period. This would serve to disassociate the power flow on the 132 kV line from the power flow from Queensland and hence remove this limitation on NSW import from Queensland.

TransGrid also has plans for reinforcing the 132 kV system on the mid north coast between Coffs Harbour and Port Macquarie due to the local load growth. The interaction of these works with the power flow control work will determine the economic benefits of the latter project.

The power flow control works involve the installation of a phase angle regulating transformer and associated switchgear at Armidale on the Armidale – Kempsey 132 kV line.

The Regulatory Test will be carried out on the power flow control project.

7.10 Upgrading of the Interconnections

The projects that are expected to involve expenditure in the 2004/05 to 2008/08 period are:

- Development of a Yass – Wagga 330 kV line.
- Series compensation of the QNI lines.

These projects are “excluded” projects and this is further discussed in Section 7.11.

7.10.1 NSW Import from the South

It is not feasible to significantly upgrade the NSW import capability from the south without new line works.

Without an increase in NSW import capability any gas turbine power station developments in the Wagga area or Victoria (where this leads to increased Victorian export capability) would be effectively insulated from the bulk of the NSW load by the network limitation immediately north of Snowy. This limitation effectively constrains the total NSW import from Snowy and Victoria.

An increase in NSW import capability has been factored into the Backgrounds that include the development of gas turbine power stations in the Wagga area or Victoria.

A Yass – Wagga 330 kV line could be developed for commissioning in the period following the immediate Revenue Reset period. The project will be assessed under the Regulatory Test.

It is intended that this line be developed on the route of the Yass – Wagga 132 kV line. The 132 kV line now requires extensive refurbishment due to its age and it is logical to replace it with the 330 kV line to meet longer-term needs.

This line development would provide the following benefits:

- Increased NSW import capability from Snowy / Victoria.
- The capability to access any new generation in the Wagga area.
- The capability to access any increased capability for Victorian export, as a result of generation development in Victoria, at times where the Victorian export transient stability constraint is not otherwise limiting; and
- Capability for increased Victorian import.

It should be noted that a Yass – Wagga 330 kV line development would also increase the Victorian import capability.

The scope of works includes a single circuit 330 kV line as a minimum with switchgear at Yass and Wagga.

The Special Protection Scheme that presently operates to open the Yass – Wagga 132 kV system when the Lower Tumut – Wagga 330 kV line is out of service could be removed.

7.10.2 NSW Import from Queensland – Short Term

Series compensation of some of the QNI lines will provide an increased capability for NSW import. This work could be achieved in the Revenue Reset period.

This work would also largely offset the decrease in NSW export capability that is expected to result from operation of the Kogan Creek Power Station development.

The scope of work includes switchable series compensation of the Armidale – Dumaresq and Dumaresq – Bulli Ck double circuit 330 kV lines. Protection and control augmentations would be required. Reactive support in NSW is required and additional support of the Queensland system may also be required.

This project will be assessed under the Regulatory Test.

7.10.3 NSW – Victoria / Snowy – Long Term

A significant upgrade of this interconnection will involve major new line work and a number of conceptual schemes have been considered. Some of these schemes include reinforcement of supply to the growing loads in Victoria and NSW near to the Murray River.

Joint planning with VENCorp will be required to develop the concept to a workable scheme. This joint planning work will be continued to assess the viability of the development.

There has been no provision for such projects in the Backgrounds within the Regulatory Reset period or in the early part of the following five years that may affect TransGrid’s capital expenditure during the Revenue Reset period.

7.10.4 NSW – Queensland – Longer Term

A significant upgrade (for import and export) of the interconnection between NSW and Queensland will require major new line works. A number of schemes have been considered. It is expected that some HVDC network would also be required in such a project.

Joint planning with Powerlink will be required to develop the present concepts to workable schemes. This joint planning work will be continued to assess the viability of the developments.

There has been no provision for such projects in the Backgrounds within the Regulatory Reset period or in the early part of the following five years that may affect TransGrid’s capital expenditure during the Revenue Reset period.

7.11 Excluded Projects

Some projects have been classified as “excluded”. The reasons for their exclusion and the likely triggers that may require development of the project are summarised below. Whilst the likely triggers have been listed below other triggers may nevertheless arise that require development of the projects.

7.11.1 Reinforcement of QNI with Series Capacitors

This development includes series compensation of the QNI lines from Dumaresq to Bulli Ck and from Dumaresq to Armidale.

Although it is an excluded project it is considered necessary to further develop the design of the project to minimise lead-times in the future.

Reasons for Exclusion

- This project is expected to have a high cost.
- The project requires joint planning and technical investigation with Powerlink and other TNSPs.
- There is a range of possible configurations for the series compensation and this will govern the project cost.
- Technical issues such as sub-synchronous resonance will need to be resolved.

Likely Triggers for Development

- Interconnection development with Queensland as a result of joint planning and application of the Regulatory Test.
- Continued development of base load generation in Queensland rather than NSW.

7.11.2 Yass – Wagga 330 kV Line

This development includes a new 330 kV line from Yass to Wagga.

Although it is an excluded project it is considered necessary to commence investigations into the potential route of the line and establish the feasibility of its construction to minimise lead-times in the future.

The cost of undertaking this project will be weighed against the cost of refurbishing the Yass – Wagga 132 kV line, with the object of achieving the least cost to the community in the long term.

Reasons for Exclusion

- This project is expected to have a high cost.
- There are a range of possible line routes including the possibility of reconstruction along an existing 132 kV easement in parts.
- There are options of single circuit or double circuit 330 kV construction, depending on long-term requirements. It is also possible to develop a hybrid HVAC/HVDC line.
- Refinement of the options will involve extensive community consultation.
- The development is subject to environmental acceptability.

Likely Triggers for Development

- Development of a major power station in the Wagga area or in Victoria that could support NSW demand.
- Major interconnection development with Victoria as a result of joint planning and application of the Regulatory Test.

7.11.3 Major Interconnection Development

Major interconnection development with Queensland or with Victoria, which will involve the development of new transmission lines, will require ongoing joint planning with other TNSPs. The future patterns of generation development and increases in State loads will define the scope of the interconnection developments.

SECTION 7

Attachments

7A “Interconnector Capability and Development Options – Revenue Reset” dated 14/10/2004, File 2002/0757.

7B “Benefits of Upgrading the Capacity of QNI – A Preliminary Assessment”, Report by TransGrid and Powerlink, 19/3/2004.

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Technical Services Capital Expenditure

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8 TELECOMMUNICATIONS WORKS

8.1 Introduction

To support its transmission network, TransGrid operates an extensive telecommunications network. Development of this network is primarily driven by transmission network augmentations. However, it is also heavily influenced by rapid changes in communication technology, standards and regulation as well as the relatively short asset life of communication equipment.

The “backbone” of TransGrid’s telecommunications system is an Optical Fibre Powerline Ground Wire (OPGW) link on 330 kV lines that extends from Jindera (near Albury) to Dumaresq and on to the Queensland border. There is also an OPGW link from Sydney to the Western power stations. In transit the OPGW link connects to the majority of key main system power stations and substations.

The introduction of the power system data requirements of the National Electricity Code (NEC) means that improved communication system security will need to be developed over about the next four years. Consistent with other NEM transmission providers, TransGrid will progressively develop alternative communication paths to most key sites by about 2008. In general these alternative communication paths will be predominantly via microwave radio links with some sections of new OPGW links. It is intended that a number of strategically formed “broad loops” (as shown in the diagram in this Section) will be developed to provide the increased communication security as required by the NEC.

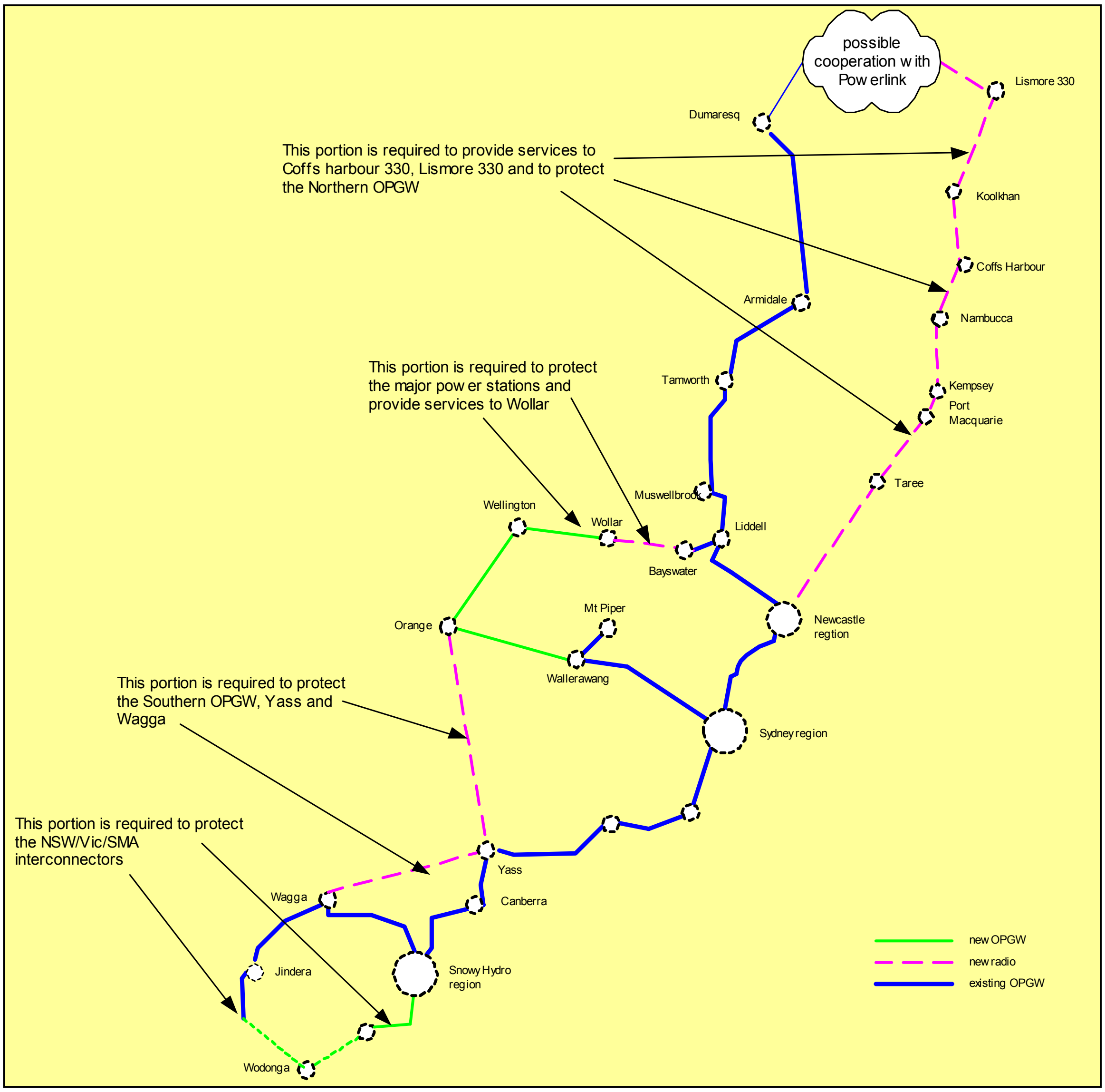
Associated with each of the network reinforcements set out in Sections 5, 6 and 7 are communication system works relating to the provision of control of the power system and substation elements, network protection, data acquisition, plant monitoring and physical security requirements. This Section does not detail these works as they are driven by the associated augmentation projects and cost estimates for these technical services are linked to these projects.

In addition to these works there are requirements for the provision of communications systems for corporate data and operational systems and these are summarised in this Section.

The projects covered in this Section are:

- North coast microwave system
- Darlington Pt – Wagga microwave radio
- Snowy area OPGW augmentation
- South western system SCADA
- New England area SCADA
- SCADA disaster recovery facility
- Western system redundancy augmentation
- Southern system redundancy augmentation
- Metropolitan system redundancy augmentation

These works are components in TransGrid’s Telecommunications Development Outline Plan (Attachment 8A). The projects have been referred to in TransGrid’s Annual Planning Report 2004.



8.2 Drivers for Development

The main drivers for the development of the additional links in the telecommunication system are

- Provision of SCADA facilities to 132 kV substations
- Communication of corporate data to staff at all sites
- Operational communications
- Monitoring of plant
- Physical security
- NEMMCO Power Systems Data Communications Standard (PSCDS).

8.3 Telecommunications Developments

8.3.1 North Coast Microwave Radio Services

Lismore 330kV substation is isolated from the main TransGrid communications network and the protection signalling schemes require reinforcement to be compliant with the Code after completion of the Coffs Harbour 330/132 kV Substation. The SCADA facilities are also not presently compliant with the PSDCS.

A number of 132kV substations on the north coast have high system significance due to high load growth in the area, and the provision of communications facilities suitable for SCADA is necessary for the secure operation of the network.

The provision of route diversity for the OPGW network north of Liddell is also required to comply with the PSCDS.

A microwave radio system, based on the Macrocom system is to be established to service the area and meet the requirements of the PSDCS.

Cooperation with Powerlink may facilitate the closing of the northern communications loop, otherwise it will be necessary to complete the loop between Lismore and Dumaresq.

8.3.2 Darlington Point – Wagga Microwave Radio

The current protection schemes associated with the Wagga – Darlington Point 330 kV transmission line must be upgraded to meet Code requirements. The PLC-based SCADA services for Darlington Point also do not comply with the PSDCS. The provision of duplicated protection grade communications for Darlington Point substation, suitable for protection signalling and SCADA systems at Darlington Point, is required.

8.3.3 OPGW Augmentation in the Snowy Area

The acquisition of the 330kV transmission network in the Snowy Mountains area did not include access to the existing Snowy Hydro Limited microwave radio network. This network is being retained by Snowy Hydro Limited for communications between the various hydro-electric generators in the area.

OPGW augmentation is required in the area to provide adequate network protection capability and to meet TransGrid's network operating and Code obligations.

8.3.4 South Western Area SCADA

Telecommunications facilities are required in the Darlington Point area to meet the SCADA requirements of the substations at Albury, ANM, Hume, Finley, Deniliquin and Yanco. A microwave radio system is to be installed.

8.3.4 New England Area SCADA

Telecommunications development is required to provide SCADA for the 132 kV substations at Glen Innes, Inverell, Moree, Narrabri and Gunnedah. A combination of power line carrier and microwave radio communication systems will be established.

8.3.5 SCADA Disaster Recovery

TransGrid's SCADA system has two independent control systems, one at Sydney West Regional Centre and one at Newcastle Regional Centre. Each is capable of operating TransGrid's High Voltage network.

The nature of the telecommunications network requires that communications channels between the SCADA control systems and the individual SCADA outstations be terminated at a Remote Terminal Gateway (RTG) before being transmitted to each of the two control systems.

A catastrophic event such as a fire in the Communications Apparatus Room housing the RTG and the local control system will also destroy the ability of that part of the network to communicate with the surviving control system. Hence a disaster recovery site is to be established at Sydney South 330/132 kV Substation.

8.3.6 Western System Redundancy

A failure of the western OPGW would isolate SCADA facilities associated with Wallerawang and Mt Piper power stations, subsequently interrupting the dispatch control data to these power stations. A failure would also affect protection signalling associated with the transmission lines between the Hunter Valley and Western power stations.

A failure of the northern OPGW south of Liddell would isolate SCADA facilities associated with one or more of the Hunter Valley and Central Coast power stations, and is also likely to affect a large number of protection signalling systems and the SCADA facilities at Newcastle Regional Centre.

By providing a link between Wellington and Orange, and suitably augmenting the existing Orange – Wallerawang microwave radio, a ring may be formed that includes all major power stations in NSW, as well as the Sydney West and Newcastle Regional Centres.

This ring will provide two telecommunications paths into all power stations, Newcastle and Sydney West Regional Centres, and many major 330kV substations.

8.3.7 Southern System Redundancy

A failure of the southern OPGW network will isolate the Yass control facilities and affect the ability to control the interconnectors at Murray, Jindera and Buronga.

Development of a microwave network between Wagga and Orange is one option for communication augmentation that is under consideration.

8.3.8 Metropolitan System Redundancy

A failure of the OPGW between Sydney West and the Newcastle Regional Centre will isolate the two SCADA application servers. Depending on where the failure occurs, some of all of the Central Coast power stations may be unable to receive dispatch data.

Route diverse communications around the Metropolitan area are required.

8.4 Summary

These projects, together with the technical services costs associated with transmission network augmentation projects, involve a total expected expenditure of about $23 million over the regulatory period from 2004/05 to 2008/09.

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Support the Business Capital Expenditure

November 2004

9 SUPPORT THE BUSINESS CAPITAL EXPENDITURE

9.1 Information Technology Capital Expenditure

Information Technology (IT) applications and infrastructure support all of TransGrid's business processes and are accessed from a large number of TransGrid sites across NSW. The major systems include:

- Maintenance Management
- Real Time System Control
- Outage Management Systems
- Human Resources and Payroll
- Supply Management
- Financial Management
- Messaging and Document Management
- Electronic Drawing and Drawing Management
- Geographical Information System
- Network Analysis and Planning Systems
- Environmental Management Systems
- Intranet and Internet
- Customer Billing Systems

IT investments in the organisation are managed in accordance with TransGrid's IT governance procedure (described in *Attachment 9A*). The key components of this procedure that govern the capital projects are:

- IT Strategic Plan which sets the overall objectives of IT strategies;
- Annual IT planning process which requires prioritisation and ranking of all IT capital projects; and
- Business cases for each project that quantify the costs and benefits.

The preparation of five year estimates for Information Technology needs to be able to anticipate:

- changes in technology; and
- volatility of the IT market place.

Technology trends can change very rapidly as new technology is introduced. Over the last five years there were rapid changes in applications, server and communications technology that resulted in investments that couldn't have been predicted when the last five year estimates were prepared. An example of this change is the worldwide adoption by business of the internet and email and the subsequent rise of virus and other security issues. It is almost certain that TransGrid will implement technologies that have not yet been developed during this next regulatory period.

TransGrid's IT strategy is prepared with a three year horizon as this is a period over which the organisation can plan and implement with some certainty. Technology changes over a five year period will be so large that it is not considered possible to prepare a plan that would be useful beyond three years. It is expected, for example, that over the next five years mobile communications technology will mature to a point where it becomes cost effective for all staff to have a mobile device that is always connected for email and access to enterprise systems. Currently this promises benefits to the organisation. However, it is almost impossible to predict if or when this type of technology will mature to the point that these benefits would be worthwhile.

Another source of uncertainty for preparing estimated IT investment is the volatility of the IT market place. There are massive changes and consolidation in the ownership of IT companies occurring which increases uncertainty for IT planning. During the last five years the acquisition by Compaq of Digital Equipment Corporation and the subsequent acquisition of Compaq by HP necessitated millions of dollars of expenditure. Currently there is considerable uncertainty in the market place as a result of the acquisition by Oracle of Peoplesoft following Peoplesoft's acquisition of JD Edwards.

TransGrid's plans around the upgrade and improvement of its Enterprise Resource Planning (ERP) solution in Oracle and Mincom systems cannot be certain as these companies' products may not be supported in five years time.

The capital estimates provided to the ACCC in TransGrid's last Application were based on the assumption that expenditure from events that could not have been reasonably anticipated can be reviewed as part of the next regulatory reset process. TransGrid had accepted that having to demonstrate the prudent nature of these type of investments at this stage was workable.

Under the new framework there is considerable uncertainty in the area of IT to take into account when preparing these estimates. TransGrid could be left in a position where it has no provision under the capex cap for expenditure required to replace or upgrade a system due to a software or hardware vendor unexpectedly de-supporting a system. TransGrid could also have insufficient provision for investment in new technology that will provide opportunities for improved business performance.

To try and address the changes in the regulatory framework the estimates for IT have been restructured so that the estimates are broken into three broad categories:

- cyclical upgrades and replacements;
- business performance improvement projects; and
- a factor to mitigate uncertainty.

9.2 Cyclical Upgrades and Replacements

The projects in this category are ones that are required to keep the IT systems and infrastructure running. Projects in this category are required to preserve the benefits of automation of the organisation's business processes. The upgrade of the payroll system for example keeps the systems running that automates this particular business process.

All the components of the IT systems have a support life of between three and five years. Software suppliers worldwide will only support a small number of versions of their products and on release of new systems de-support older releases. IT equipment manufacturers are also aggressive in de-supporting older equipment with either hard de-support dates, by ceasing to make available spare parts, or by rapidly increasing support costs. In many cases the equipment has a similar technical obsolesce life with new models of equipment having significantly improved features or performance. A four year old laptop for example won't run recently released Microsoft products, designed to take advantage of the performance of new computer models, at an acceptable speed. It is not surprising then that the current depreciable life of systems is between three and five years.

The major categories of cyclical system upgrades and replacement for the five years are show below in *Figure 9.1* with detailed estimates of each category in *Attachment 9B*.

Figure 9.1 - Cyclical Upgrades and Replacements

Applications	$15.7m
Infrastructure	$18.7m
Corporate Data Network	$5.9m
Desktop Hardware and Software	$12.9m
SCADA	$5.2m
Total	**$58.4m**

9.2.1 Applications

TransGrid has adopted business guidelines for the development and support of its IT systems, which include:

- A preference for acquisition of third party packages rather than internal development of systems;
- Limited customisation of packaged systems; and
- Application support by the third party software suppliers.

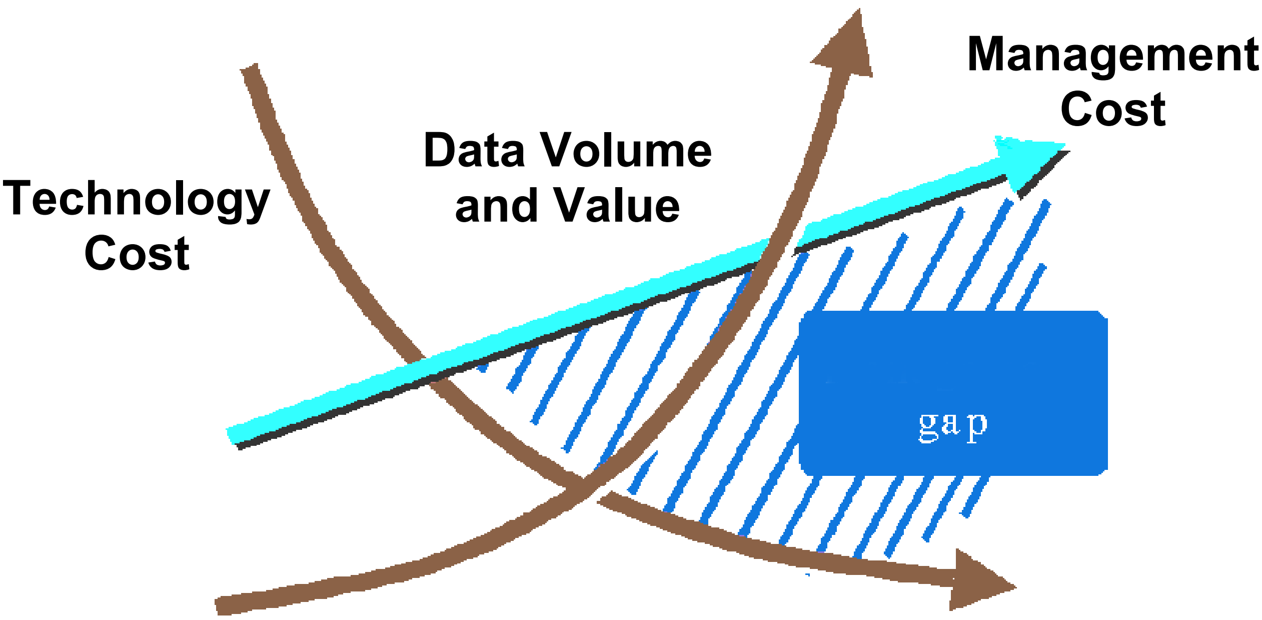
These guidelines provide the most cost effective solutions to meet the TransGrid business requirements but do commit TransGrid to cyclical upgrades as the software suppliers de-support older releases. All of TransGrid's systems will require an upgrade in the five year regulatory period. Some systems based on the support cycles of their vendors will require two upgrades.

The estimates in this category provide for the upgrades of software including external services, staff costs and testing for implementation. There is no provision in this category for the development and implementation of improvements in functionality often provided by software vendors in the upgraded packages. A provision for the implementation of changes that would result in business performance improvement is covered in the next section.

9.2.2 Infrastructure

This section covers the cost of replacement of the infrastructure that supports the TransGrid IT systems. Included in this category are servers, firewalls and remote access systems. This infrastructure involves effective lives limited either by superior performance and features of new models required by the newer systems that run on them, or de-support by vendors.

Figure 9.2: Increasing Cost of Managing Data



In some cases the cost of this infrastructure is reducing over time as technology improvements come into the market place. However these cost reductions are swamped by the growth in data and processing requirements of the new systems and the organisation. *Figure 9.2* above indicates that as the unit costs of the technology reduce it becomes more affordable to deploy more functionality and the amount of data being stored is rising dramatically. This trend is occurring in organisations worldwide. The management cost of this change is often overlooked and this is being currently absorbed in the IT operating costs of TransGrid.

9.2.3 Corporate Data Network

The Corporate Data Network provides connectivity from the TransGrid data centres to over 60 TransGrid sites across NSW. The equipment will require replacement in the next regulatory period.

9.2.4 Desktop Hardware and Software

This category covers all of the hardware and software that supports TransGrid's staff and contractors on the desktop. It includes the cyclical replacement of desktop and laptop personal computers and printers.

The costs include upgrade of the Microsoft windows operating systems and all desktop productivity tools such as Office, Project and Visio.

9.2.5 SCADA

TransGrid's real time control system was purchased during the last regulatory period under a turnkey contract. The SCADA applications will be upgraded and hardware replaced in the next regulatory period.

9.2.6 Cost Estimates

The cost estimates in this Section are based on TransGrid's historical experience of the upgrades and replacements. The estimates are built up from the current number of systems, servers, routers etc with the estimated number of replacements in the regulatory period. Each estimates is based on:

- The current prices of software or equipment; and
- Historical unit cost services and labour in managing, configuring and implementing the component.

9.3 Business Performance Improvement Projects

In addition to the cyclical replacement of and upgrade of IT systems there are opportunities to improve business performance though the utilisation of IT. The projects to be implemented in TransGrid will be controlled through the IT governance processes including:

- IT Strategic Plan
- Annual Project Planning cycle, and
- Approval of projects based on business cases.

Projects of this nature implemented during the last regulatory period include:

- Intranet site for electronic presentation of polices, procedures and manuals
- Electronic Document Management System
- Geographical Information System, and
- Microsoft Exchange and outlook.

The processes put in place to manage theses business performance improvement projects are the result of a comprehensive external review conducted in 2003. They are considered to be best practice but due to uncertainty in IT only cover a three year period.

The key areas where TransGrid expect to invest in business performance improvement are:

IT Enabled Process Improvement

- **Adopt a process view across TransGrid supported by appropriate tools.** Deliver standard tools to support and give visibility to the project life cycle, outage management and Human Resources processes.
- **Provide mechanisms to extend the access to systems**. Identify collaboration requirements and provide an appropriate platform and tools to extend the use of TransGrid's systems to external partners and remote staff.
- **Enable greater staff effectiveness.** Deliver simplified and consistent user interface and provide just-in-time training and adequate change management.

Management of Corporate Data

- **Provide one accurate and accessible data source.** Define data requirements for key processes and assign responsibility for ongoing management
- **Provide simplified and standard corporate reporting.** Provide tools to streamline corporate reporting and analysis from multiple sources.

System rationalisation

- **Adopt a single Enterprise Resource Planning (ERP) solution**. Review ERP options and select a preferred platform.
- **Adopt a single Project Management solution**. Review Project Management tools and select a preferred platform.
- **Reduce the complexity of the Application Architecture.** Identify functionality supported by minor corporate systems and where appropriate consolidate in major corporate applications.

Standard tools & systems

- **Implement application development standard tools**. Identify a standard application development toolkit.
- **Ensure corporate data resides in corporate systems**. Identify and plan the migration of corporate data in non-corporate systems.

As detailed business cases for these projects are prepared on an annual basis it is not possible to provide detailed justifications at this time for projects over the next five years. In order to provide a realistic provision for utilising IT to make improvement to the performance of TransGrid, a factor on top of the cyclical replacement expenditure is proposed. Discussions with the IT research company Gartner have indicated that companies should provide for at least 20% of their IT spending on new developments and application overhaul to keep themselves healthy and competitive. This amounts to $14.6 million ($2004).

As noted in Section 3 of this Application, TransGrid faces a number of significant challenges in delivering the required network capability enhancement over the next two regulatory periods. For the first time since TransGrid's establishment in 1995 new transmission capability is simultaneously required to meet local reliability needs, reinforce the main interconnected system, and to accommodate new generation developments. It is also the first time that this confluence of events has occurred in NSW since the establishment of competitive market arrangements in the electricity sector.

TransGrid has adopted the generic estimate by Gartner because of uncertainty, at the time this Application was being prepared, as to which improvement projects would have the strongest business cases. However, it is clear is that a significant proportion of this type of expenditure is likely to be associated with supporting capital project delivery processes. That is, in light of the challenges now facing TransGrid in developing the capability of the NSW transmission network, it is likely that the generic estimate attributed to Gartner is conservative.

9.4 Factor to Mitigate Uncertainty

The uncertainty in the area of IT is of concern to TransGrid in submitting its estimates under the new framework. TransGrid requires this risk to be mitigated with a mechanism such as:

- inclusion of a specific provision to address the large amount of uncertainty in this area;
- off-ramps for large unexpected events; or
- excluded projects be included in the IT area.

TransGrid would like to work with the ACCC staff to design the parameters for these measures.

9.5 Other Support the Business Capital Expenditure Requirements

<u>Motor Vehicles and Mobile Plant</u>

TransGrid manages assets that are geographically dispersed across NSW. To service these assets a range of motor vehicles is required. TransGrid has adopted a strategy of purchasing and reselling these assets. Specialised mobile plant such as cranes and bucket trucks are also required. Where plant is specialised in nature and/or is not readily available from plant hire companies then purchasing of plant is undertaken.

The gross cost of motor vehicles and mobile plant over the regulatory period is $ 39.5 million ($2004). While this has been included in the capital expenditure forecast, an adjustment in the Commission's Post Tax Revenue Model is required to properly reflect the expected disposal value of these assets during the regulatory period. This is currently estimated at about $ 25 million.

<u>Miscellaneous Assets, Office Equipment, and State Records Security Upgrade</u>

An allowance of $ 9.2 million ($2004) has been included over the regulatory period for these assets associated with servicing TransGrid's sites across NSW.

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Consolidated Capital Expenditure Requirements

November 2004

10 Consolidated Capital Expenditure Requirements

10.1 Introduction

This Section outlines the 'build-up' of capital expenditure requirements for the period 2004/05 to 2008/09. It provides a guide to the linkages between this 'build-up' and the following key 'build-up' elements:

- capital expenditure drivers
- capital expenditure projects
- capital expenditure build-up structure
- cost estimates and scope definition of the projects
- the pooled contingency
- planning backgrounds
- the effect of excluded projects and the excluded projects capital expenditure summary
- capital expenditure projection summary

10.2 Capital Expenditure Project Drivers

The main drivers for the capital expenditure projects are summarised in Table 10.1 below.

Table 10.1

	Capex Project Drivers	**Reference Section**
1	Plant Replacement Projects	4
2	Customer Demand (Load) Driven Augmentation Projects	5
3	Main System (Generation and Customer Demand Driven) Projects	6
4	Interconnection Projects	7
5	Communications System Projects	8
6	Support the Business Projects	9

The Sections 5 to 8 provide an outline of the related augmentation projects and Section 4 provides the strategies and approach to developing the Plant Replacement projects.

10.3 Capital Expenditure Projects

The details of the projects included within the aggregate capital expenditure build-up have been provided within the relevant sections of the Application and include:

- **Augmentation Projects** – the Master Project List (Section 1 – Attachment 1B) contains a listing of all Augmentation Projects. This List also includes combined Replacement Augmentation projects, and the more significant Replacement projects that require involvement of TransGrid's Engineering Group to provide cost estimates and manage the design and delivery process.

- **Asset Replacement Projects**: - Individual Plant Replacement projects may involve large numbers of specific items of plant. Details have been provided in Section 4 on TransGrid's overall asset management processes and procedures. There are also a number of combined Replacement Augmentation projects.

- **Support the Business Projects**: The details of the Support the Business capital expenditure requirements are provided in Section 9 and associated Attachments.

10.4 Aggregate Capital Expenditure Build-up Structure

The aggregate capital expenditure build-up has been structured into the Categories and Sub-categories set out in Table 10.2 below.

Table 10.2

Asset Replacement
Individual Plant Replacement Projects These projects are based on Strategies and are based on replacing individual items of equipment by type rather than location.
Substation Projects Replacement of individual items of substation equipment.
Mains Projects Replacement of transmission line equipment – poles, insulators etc
Protection & Metering Projects Replacement of service life expired protection and metering equipment
Communication Projects Replacement of service life expired communications equipment
Security Projects Implementation of the new physical Security Standards for TransGrid infrastructure
Major and Combined Replacement Augmentation Projects These projects have been identified as having larger scopes of work and, often, also involve augmentation considerations.
Transformer Replacements Replacement of service life expired transformers.
Wood Pole Replacement Projects Replacement of all poles on individual lines on a project basis rather than on a structure by structure basis.
Control Room Replacements Replacement of substation secondary systems as a project
Protection System Upgrades Protection System upgrades completed on a project basis
Tunnel Board Replacements Complete Tunnel Board replacements completed on a project basis.
Substation Replacements Replacement of high voltage plant, secondary systems, substation infrastructure and bringing substations to current environmental and security standards in service life expired substations while the substation remains operational.
Regional Depot Projects
Regulatory Projects The projects within this category are required to meet Regulatory Obligations.
Transformers
PCB
Mine Subsidence
Future Regulatory Projects
Support the Business
Support the Business Provision of IT and mobile plant equipment required to support the business

Table 10.2 (Continued)

Augmentation Projects Projects identified as needing to be completed to meet Planning Standards or meet other TNSP supply obligations.
Property Acquisition and Survey
Business Resources – Property Provision of property and easements associated with existing assets or committed augmentations
Property – Augmentation Projects Acquisition of easements and properties required in support ALL Included Augmentation Projects.
Small and Committed Augmentations Projects in the following section are either existing committed projects or projects that involve specific augmentations rather than a project complex involving several locations and individual projects.
Committed Projects All existing committed Augmentation Projects including the construction of transmission lines, substations and communications systems
Small Augmentations – New Lines Projects that are primarily involved with the provision of new transmission lines.
Small Augmentations – New Substations Projects that are primarily involved with the provision of new substations.
Small Augmentations – Reactive Plant Projects that are primarily involved with the provision of capacitor and shunt reactors.
Small Augmentations – Substations Projects that are primarily involved with the augmentations within existing substations and switching stations.
Small Augmentations – Transformers Projects that are primarily involved with the replacement of transformers.
Technical Service – Miscellaneous Projects that are primarily involved with the provision of communications, protection, control and metering system augmentations.
Project Complexes Project Complexes involve the completion of a number of related project elements such as the construction of new transmission lines or cables and substations to complete a planned augmentation to achieve a system augmentation.
Various Specific Project Complexes - Royalla 330kV Substation Stage 1 - Holroyd Complex - Mid North Coast Reinforcement - QNI Upgrade Proposal - Western 500kV System
Pooled Contingency
Excluded Projects Project Complexes that are not included in the ‘ex ante’ Capital Expenditure Application and are nominated as Excluded Projects.

10.5 Scope Definition and Cost Estimates of the Projects

The scope definitions, and cost estimates for the project elements within this Application, have been developed as outlined in the following sections.

Projects in Attachment 1B: Master Project List

Engineering scopes of work have been developed for each Augmentation Project and Replacement Project in this List based on advice as to the requirements for each project.

A cost estimating database has been used to estimate:

- each project cost based on the scope for the project and
- the cash flow associated with each project.

The database has also been used to project the capital expenditure requirements for the various planning Backgrounds (generation and load scenarios) under consideration.

The database is primarily a bottom-up estimating package for transmission lines and substations, which is based on current equipment and installation costs. The database has been validated against recent past projects completed by TransGrid. The database estimates are primarily based on works being completed under competitive contracts to external providers.

Individual Plant Replacement Projects (These Projects are not Included in Attachment 1B: Master Project List)

The Individual Plant Replacement Projects scope development is based on the processes outlined in Section 4 of this Application and involves many individual items of plant within the TransGrid system.

The cost estimates for these projects were individually developed based on a bottom up estimating approach. These estimates are based on extensive experience in the replacement of individual plant items in operating substations.

Support the Business Costs

The scope and costs associated with the Support the Business projects are outlined in Section 9.

10.6 Pooled Contingency

No contingency allowances have been included in the estimates for each element within the Augmentation Projects and Asset Replacement Projects. A 'pooled contingency' allowance of 7% has been included on these projects.

10.7 Planning Backgrounds

To assess the implications of alternative future developments forty three (43) Backgrounds (generation and load scenarios) have been developed based on:

- a range of load forecasts, - medium, medium & 400MW of industrial load, high and low load demand forecasts, and
- a range of generation and interconnection options.

Planning studies have been completed on all of the Backgrounds to assess the augmentation requirements for each Background.

Based on the planning dates for the relevant project lists for each Background a capital expenditure projection has been developed. Each Background has a probability estimate associated with it which should be regarded as indicative only.

10.8 Effect of Excluded Projects on the Capital Expenditure Build Up

The system development requirements across the Backgrounds resulted in changes only to Excluded Projects. Hence the variation to the ex ante capital expenditure projections across the Backgrounds is minimal.

10.6 Capital Expenditure Requirements Summary

The capital expenditure projections build-up for the period from 2004/05 to 2008/09 are provided in Attachment 1A. to Section 1. A summary table (Table is provided on the following page of this Section.

Table 10.3 – Capital Expenditure Requirements Summary

Included Projects (millions $2004)

Capex Components	Total over 5 years	2004/05	2005/06	2006/07	2007/08	2008/09
Asset Replacement Projects	326	67	74	67	57	61
Support the Business Projects	122	24	24	24	24	24
Augmentation Projects	987	70	125	170	350	273
Pooled Contingency	92	10	14	17	29	23
Total Capex	1527	171	237	278	460	382

Excluded Projects

Capex Components	Total over 5 years	2004/05	2005/06	2006/07	2007/08	2008/09
Total Excluded Projects	620	0	3	26	239	353