PB ASSOCIATES

TRANSGRID'S FORWARD CAPITAL EXPENDITURE REQUIREMENTS

2004/05 TO 2008/9

An independent review

CONFIDENTIAL

Prepared for

AUSTRALIAN COMPETITION & CONSUMER COMMISSION

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EXECUTIVE SUMMARY

Parsons Brinckerhoff Associates ("PB Associates"), has been appointed by the Australian Consumer and Competition Commission ("ACCC") to review the proposed capital expenditure program submitted by TransGrid in accordance with clause 6.2.2 of the National Electricity Code. In particular, the review has been conducted with regard to achieving an efficient and prudent level of investment in transmission infrastructure. In addition, PB Associates has given consideration to the adequacy of TransGrid's methodology and planning processes in arriving at a forward estimate of an efficient level of capital expenditure.

The capital expenditure application submitted by TransGrid covers the period 2004/05 to 2008/09 (the current regulatory period), and covers all capital works associated with the regulated transmission Network.

This review has been conducted under the revised "ex-ante" regulatory framework which has been the subject of discussions between the ACCC and TransGrid over the past 12 months. The ex-ante framework effectively establishes a fixed revenue cap for TransGrid over the regulatory period based on underlying approved, efficient and prudent expenditures. The change in regime places much greater emphasis on demonstrating the need for, and efficient cost estimation of, proposed investments. As a result, TransGrid has been required to accelerate its planning and cost estimation processes for projects requiring expenditure during this regulatory period.

The capital program submitted by TransGrid reflects the fact that much of the detailed analysis, particularly for projects planned for beyond 2008, has been undertaken over the past 12 months and with an emphasis on managing the risks associated with the ex-ante approach – i.e. seeking to avoid the need to exceed the allowable expenditure levels.

PB Associates has conducted this review with a focus on the processes and levels of proposed expenditures under the key cost driver categories, (and consistent with TransGrid's application), as follows:

- replacement of existing network infrastructure;
- augmentation of network infrastructure (new or upgraded network assets);
- excluded projects (potentially large network augmentations that may be required under certain scenarios and may be subject to a wide range of uncertainties); and
- support the business expenditures (non-system investments such as IT, motor vehicles and office equipment).

Governance arrangements

PB Associates formed the view that the governance arrangements applied by TransGrid in determining the needs, optimal alternatives and efficient estimates for costs were generally sound. It is recognised that these practices designed to accommodate an ex-ante methodology, have only been in place for a relatively short time and that in some cases the full range of alternative project evaluations have not been thoroughly explored. There were a number of instances where projects have been duplicated or omitted and where refinements in the governance processes will be necessary to ensure congruence between business groups in the future. These issues appeared to be a function of preparing the Application for the ACCC's review and were not indicative of endemic problems with the governance arrangements. However, PB Associates is of the view that TransGrid should modify its processes so that medium range planning to the detail required to support a capital expenditure submission to the ACCC becomes a standard practice.

Overall Capital Program

PB Associates believes the asset replacement program and underlying identification of expected works are sound. However, cost estimations were at the high end of industry comparisons and reductions in unit rates for these works have been applied.

All large augmentations were identified by PB Associates as being subject to considerable uncertainty in relation to the needs and nature of optimal solutions. These projects have therefore been assigned to the Excluded Projects area and PB Associates recommends these projects be considered fully when specific triggers are reached that drive the needs for these projects. These triggers are discussed in detail in this report.

Processes for identifying and selecting smaller augmentation projects are reasonably well defined and PB Associates believes the program is generally sound. However, some projects have been recommended for deferral where the 'need' could not be demonstrated for this period. In addition, estimated project costs have been reduced in line with industry comparisons.

Support the Business (non-system) expenditures have generally been well formulated. PB Associates worked with TransGrid in order to be satisfied that there was congruence between the non-system costs and the needs of the business – in terms of the major capital expenditure categories. As a result, some changes were incorporated and some expenditures have been recommended for deferral beyond this regulatory period.

These adjustments are summarised in the following table:

Table E1 – Comparison of proposed and recommended 5 year capital expenditures ($m[1])

	TransGrid Proposed	PB Associates Recommended	Variation
Asset Replacement	326	276	**-50**
Augmentation	988	577	**-411**
Support the Business	120	101	**-19**
Excluded Projects	621	931	**310**
Pooled Contingency	93	0	**-93**
Total[2]	**2148**	**1,885**	**-263**

Replacement projects

In general, PB Associates found that TransGrid has a well developed and functional asset management process This process is supported by detailed asset information and condition data which largely confirms its proposed asset replacement program. Estimates of costs also appeared to be well formulated.

The costing process for asset replacement was a very standard bottom up approach involving estimating labour, plant and material components. External plant hire and material period contracts were used for these elements and both are obtained by competitive tender. PB Associates has proposed some adjustments to replacement expenditures where economies of scale opportunities exist for replacement of larger volumes of similar assets. Several replacement projects were also included in other sections where PB Associates considered them not to be condition based.

PB Associates has also noted that the excess land at Tamworth and at Orange can be disposed of and the proceeds used to offset the capital cost associated with these two projects. Furthermore the contingency sums allowed for in the TransGrid depot estimates have been removed as the estimates are based on current construction costs. During the review process TransGrid also removed the

1 All tables expressed in 2004 dollars unless otherwise stated.

2 Note that totals include rounding differences.

project to construct a new office building at their Wallgrove Depot site to house head office staff. This project was estimated at $20m

PB Associates has recommended that Line 875 upgrade to 132kV be included in the program and hence has removed the allowance for maintenance of this line from the expenditure projections included in the small augmentations section. In addition, PB Associates recommended that the condition of poles on line 94B continued to be monitored and be replaced when condemned under normal operating procedures.

Variations have also been made to reduce labour rates by 8.5% based on benchmark comparisons. This results in a 1.5% reduction in total project estimates. In addition there is a reduction in the scoping factor for Taree substation which reduces the estimated cost for that project by $1.25m.

For the five year period 2004/05 to 2008/09, PB Associates recommend a total replacement capital expenditure of $276.06m; a $46.78m reduction on the TransGrid proposed estimates. $20m of this amount comprises the removal of the proposed office building at Wallgrove Depot.

Large augmentation projects and Excluded investments

The augmentations of the NSW transmission network main backbone are dependant on both the load growth in NSW and the overall generation and interconnector developments. As future generation developments are uncertain, TransGrid developed a range of scenarios, which it terms “backgrounds”. These backgrounds were produced from 3 load growth forecasts, low, medium and high; a range of possible coal and gas generation developments; and possible QNI and VIC/Snowy/NSW interconnector developments. The key to the timing of the background generation developments is that required to maintain minimum generation reserve requirements as defined in the 2004 SOO.

The capital expenditure proposed by TransGrid in the ex ante cap is not a probability weighted forecast based upon the set of background probabilities. The studies conducted by TransGrid showed that the majority of projects and their timing were insensitive to the backgrounds and only a limited number of projects were sensitive to the backgrounds. These sensitive projects were considered the excluded projects. The ex-ante cap was set based upon the project timing from the medium growth background.

As the background probabilities have not ultimately been used to calculate the capital expenditure in the ex-ante cap, the assumptions behind the background probabilities and the reasonableness of the probabilities is not significant for this review. What is more important is the insensitivity to the background, which is driven by two main factors: the small difference between the low, medium and high growth rates; and the assumption that generation developments are only enough to meet minimum reserve requirements resulting in the main generation development occurring in the 2009/10 (in the medium growth background).

PB Associates considers the technical studies conducted by TransGrid to assess the needs and timing of projects were appropriate. We do consider however that for a number of the projects there has been insufficient analysis undertaken to demonstrate that optimal network solutions have been proposed. Although technical studies had been performed to assess the needs and solutions, no evidence of economic evaluation or least cost analysis of solutions has been provided. This is perhaps mainly due to the early stages of consideration for these issues, however, it is difficult for PB Associates to support such significant projects being included in an ex-ante cap without a more rigorous level of evaluation.

The load only related projects, particularly those related to Sydney supply issues, require joint planning with the relevant distributor to evaluate the optimum solution to both the TransGrid and distributors needs. For the major projects, this joint planning appears to be at a fairly preliminary stage. PB Associates considers that more detailed joint planning is required to appropriately assess the optimal solution.

For the main system needs and projects, which are based upon analysis of the backgrounds, it appears that the base assumption for generation to only meet the minimum reserve requirement is a primary driver of the need and timing of the major project projects. However, this assumption results

in new generation developments occurring after the need has arisen and as such a network solution becomes almost the only option. The NSW government in its recently released green paper is signalling its desire to see more NSW based generation. The 2004 SOO also indicated a number of significant "advanced and publicly announced" generation projects in NSW. Based upon this, and the market incentive of locating in a potentially "constrained on" location, PB Associates considers that there may be greater incentives available for generation to locate in the central coast region and based upon this there appears to be a reasonable possibility that major network reinforcement could be deferred.

With respect to DSM or grid support by generators, TransGrid is proposing nearly $1B between 2008 and 2012 in network investment to improve the supply paths to the Sydney load centre. This is matched by significant proposed investment by both Integral Energy and Energy Australia. If the market does not act to optimally locate new generation then some form of support payment may provide more appropriate commercial incentive for deferring the need for major network augmentation.

As the backgrounds do not include a range of generation developments in location, size and timing, only a limited number of the major projects near the end of the regulatory period are impacted by the assumed generation developments. The TransGrid developed background probabilities are not appropriate for a probability weighted capital expenditure for the ex ante cap, and PB Associates do not consider it appropriate within the context of this review to assign an estimate of the probabilities in order to produce an expected ex-ante cap across all the projects. For these reasons, with respect to the major projects in Table 1A of the TransGrid application, PB Associates proposes to exclude a number of major projects and accept that all the excluded projects presently proposed by TransGrid should remain excluded. PB Associates considers that some projects are linked to other major projects, and these should be grouped and assessed together for inclusion to ensure that optimal solutions are determined. It is entirely likely that the optimal solutions identified when the triggers for network augmentation occur are likely to vary slightly from those currently proposed in TransGrid's application. It is also likely that many of these projects will be linked into more consolidated and strategic groups once more information is known regarding the nature of the network requirements. This has prompted PB Associates to recommend excluding these investments from the current ex-ante cap, although we are conscious of the need to ensure adequate lead times are available for optimal solutions, including new generation if required.

The need for some of the major projects (or parts thereof) has been demonstrated by TransGrid, although we consider that there is still some uncertainty in the optimal timing. In these cases PB Associates has assumed these projects could be deferred for up to two years with an equal probability to calculate the ex ante component. The major projects or project components that remain in the ex ante cap with a probability weighting adjustment are:

- Mid North Coast reinforcement
- QNI upgrade (phase angle regulator at Armadale)
- Royalla 132 kV switching station (part of Royalla 330 kV substation stage 1)

The table below indicates the project groupings linked to Table 1A of TransGrid's Application to enable easier comparison with PB Associates' recommendations and discussion.

Table E2 – Project Groupings for Excluded Investments

Project Groupings	**Projects**[3]
• *Transfers to Sydney/Newcastle load centre and the 500 kV developments*	• Western 550 kV system • Newcastle and Lower North Coast Supply • Bannaby – Sydney 500 kV • Kemps to Sydney South

[3] As defined in table 1A of TransGrid's application.

Project Groupings	Projects[3]
• *Supplies from Sydney West*	• Holroyd Complex • Masons Park 330/132 kV GIS substation
• *Canberra and Cooma supply*	• Royalla 330 kV substation stage 1 (Canberra Supply)
• *Queensland Interconnection*	• Series compensation at Dumaresq
• *Vic/Snowy Interconnection*	• Yass – Wagga 330 kV single circuit line

Small Augmentations

PB Associates has reviewed each of the projects contained in the TransGrid Revised Transmission Capital Investment Program 2004/05 – 2008/09 Small and Committed Augmentations. In general either load growth or customer requirements/requests determine the need for these projects. Where the need is load growth resulting in unacceptable service standards, PB Associates has reviewed the load projections and planning studies and in all cases confirmed that the need exists. Where the need is customer related PB Associates has identified the customer requirement. In many instances the need for various projects has arisen from joint planning studies with the relevant Distribution Network Service Provider (DNSP). Where a written request exists it is noted in this report but where there is currently no firm commitment PB Associates has used engineering judgment to determine the probability of the project proceeding. This is also noted in the report.

In terms of TransGrid's cost estimates, PB Associates has recommended reductions in TransGrid's proposed expenditure levels through identified efficiency opportunities. One of the main issues identified by PB Associates in reviewing the small augmentation projects is that TransGrid omitted several capacitor banks which were included in the planning studies assessed during the review process. These capacitor banks were located at the proposed Cooma switching station, Cooma substation and Deniliquin substation and have subsequently been included in PB Associates recommendations.

PB Associates has recommended that Line 966 upgrade be deferred by utilising network support from Directlink, and Line 875 be upgraded to 132kV operation. In addition the replacement of the series reactor in Cable No. 41 has been included in both asset replacement and small augmentation and PB Associates has recommended that the project be removed from the small augmentation category.

PB Associates has also recommended that the reactive power projects at Narrabri substation be deferred until the next period, the Nambucca substation capacitor bank be removed from the submission and the replacement of the second Tamworth reactor be excluded from the capital program. Other projects not recommended for inclusion in the capital works program include duplicated breakers at Sydney East, West and North substations, and transformer replacements at Cowra, Dapto, Kempsey and Koolkhan substations.

In relation to Technical Services expenditure, PB Associates has made three key adjustments.

- the 10% engineering factor has been removed as this was already included in the base cost estimates;
- an additional allowance of $0.5m pa has been included for minor communications expenditures; and
- the Lismore to Dumaresq line has been removed pending TransGrid negotiating with Powerlink to extend communications from Brisbane to QNI. The amount removed is $5.5m.

Support the business (non-system) expenditure

Information Technology – PB Associates recognises that the substantial capital expenditure program proposed by TransGrid will place considerable demands on IT support to enable effective resource and project management and this has been taken into consideration during our review.

TransGrid's application divides IT expenditure projections into Replacement and Business Performance Improvement. This is to reflect the differing cost drivers for these investments. Replacement expenditures are driven by the changes in technology and the subsequent risks of reduced vendor support within relatively short timeframes. In summary, PB Associates reviewed these expectations and the anticipated expenditures and considers that they generally overstate the levels likely to be incurred. As a result, our recommended level of IT replacement expenditure has been reduced to $51.4m for the 5 year period.

In relation to business performance improvement, TransGrid has asserted that 20% of the IT expenditure will be required for this purpose. In summary, PB Associates agrees that TransGrid are likely to require capital funding for projects that assist in the delivery of business improvement programs. However, PB Associates has reviewed the basis for this estimate and compared this with historical expenditures and projects under consideration. PB Associates has formed the view that the efficient level of expenditure is more likely to be in line with historical levels and has therefore recommended expenditures of $7.8m for business improvement investments over the period[4].

Motor vehicles and mobile plant – TransGrid has based its projected expenditures for these items on maintaining the vehicle numbers at current levels, and following a replacement program based on prescribed changeover periods. Vehicle numbers were not considered excessive by PB Associates in the context of the substantial potential capital program. Change-over periods are also considered appropriate. However, TransGrid had included private contract vehicles which were removed by PB Associates in the review. The net result was a reduction in the 5 year capital expenditure program from $39.6m to $36.6m. It is also noted that vehicle disposals provide a substantial recovery of these costs which ultimately net off the amount required by TransGrid from transmission tariff revenues. Net disposals for the 5 year period, after adjusting for private vehicles, is assessed by PB Associates to be $19.9m leaving a residual capital program of $16.7m.

Miscellaneous assets – As with motor vehicles, TransGrid has based projections for replacement of office equipment on anticipated asset lives and age profiles. Replacement figures are generally based on historical figures and asset records which, for these items, appear to be in good order. PB Associates has made one adjustment to its recommendations due to the duplication of costs associated with State Records upgrading which was also included in the IT projects at $1.4m. With this removed, the 5 year projection for Miscellaneous Assets is $7.7m.

Ring fencing adjustment – PB Associates also reviewed the utilisation of shared assets included in the Support the Business category and found that it is prudent to assume that a proportion of these assets and the associated capital investment should be assigned to external non-network business operations. A proportion of 2.4% of these capital expenditures is recommended to be allocated to external business based on the proportion of revenues derived. All of the non-system recommended expenditure levels given above are, therefore, further reduced by 2.4% to account for this ring fencing adjustment.

The net adjusted capital expenditure recommended by PB Associates for support the business over the regulatory period is $101m.

[4] Note that rounding differences in figures provided by TransGrid mean that there are small variations in summary totals.

1. INTRODUCTION

This section of the report provides background on the need for the work, describes the review approach undertaken by PB Associates and sets out the structure of the report.

1.1 BACKGROUND TO THE REVIEW

The National Electricity Code ("the Code") places an obligation on the ACCC to determine, on a periodic basis, the revenues which TransGrid can collect with respect to its transmission assets.

1.1.1 The revised regulatory framework

The ACCC has previously set transmission revenues at the beginning of a regulatory period based on its consideration of required levels of network investment during the period. A review of actual capital expenditure was then undertaken at the end of the period and adjustments made in accordance with the ACCC's view of the prudency and efficiency of the investments, the actual versus projected expenditure and the subsequent need for proposed projects.

Having reviewed this approach, the ACCC is now of the view that this 'ex-post' review framework has some inherent problems and has moved to an 'ex-ante' framework where the investment cap set at the beginning of the regulatory period is not subject to an end of period prudency assessment. The ex-ante regime places greater emphasis on conducting a rigorous review of forecast investment before the investment is undertaken. The ACCC considers that this approach has a number of advantages including providing greater certainty for stakeholders; improving the assessment framework for capital investments and moving towards a more light-handed regulatory regime.

This review by PB Associates has been undertaken on the basis of an "ex-ante" regulatory framework and as such places considerable emphasis on establishing rigor in the formulation of all proposed investments and cost estimations

1.1.2 Aims, objectives and scope of the review

PB Associates has undertaken this review with the principal objective of providing the ACCC with an assessment of TransGrid's forward capital expenditure proposals for the period 2004/05 to 2008/09 for the purposes of assisting the ACCC in developing annual revenue requirements for TransGrid. The key cost classifications specified by the ACCC and reflected in TransGrid's capital expenditure program are:

- augmentation capital expenditure;
- asset replacement investment;
- proposed excluded investments; and
- support-the-business (non-system) and compliance capital expenditure.

The results and conclusions of this review by PB Associates are intended to provide an overall assessment of the relative efficiency and effectiveness of the capital investments proposed by TransGrid.

1.1.3 Process and project timetable

The Code requires the ACCC to undertake a review of the regulated revenues required for TransGrid to provide requisite levels of transmission services within its specified geographic region. The ACCC published a draft decision for these services in May 2004 with the intention that the revenue cap would apply for the period 1 July 2004 to 30 June 2009.

The ACCC has since reviewed and revised its regulatory principles for the determination of transmission revenues and is now undertaking a further review of the TransGrid proposed capital investment programme which has been compiled on the basis of the new ex-ante regulatory model.

In order for TransGrid to publish transmission prices by May 2004, the ACCC provided a provisional capital expenditure allowance based on TransGrid's proposed capital expenditure[5].

The ACCC final decision on the revised TransGrid transmission capital expenditure will be made public in April 2005. The new allowed revenue will take effect from 1 July 2005 and any required adjustments to account for the period July 2004 to June 2005 will be made in the final revenue cap decision.

Report Timeline	
TransGrid Submission	19 November 2004
PB Associates Draft Report	10 January 2005
PB Associates Final Report	27 January 2005
Stakeholder Discussions	March 2005

1.2 OUR APPROACH TO THE WORK

In this section we provide an overview of the methodology used by PB Associates in this review and the limits to, and exclusions from, the work.

Overview of methodology

In undertaking this review of the TransGrid forward capital expenditure proposals, PB Associates has adopted a methodology which includes the following key steps:

- development of questions arising from initial review of TransGrid's submission – and subsequent issues for TransGrid;
- an examination and review of the TransGrid's capital expenditure governance framework and internal approval procedures;
- a review of the application of TransGrid's policies and practices associated with transmission capital investments;
- a high level review of all proposed capital program;

[5] Revenue Application to the Australian Competition and Consumer Commission – Revised Transmission Capital Investment Program 2004/05-2008/09.

- a more detailed review of a selection of specific capital projects from the TransGrid proposed forward capital expenditure plan; and

- the formulation of views and conclusions and the development and submission of an independent report to ACCC.

The examination and review of the governance framework and transmission planning policies and practices included detailed discussions with key TransGrid staff at their offices in Sydney.

Similarly, the detailed project reviews included a number days on site at TransGrid's offices with the appropriate members of staff. TransGrid provided a high level of cooperation with PB Associates consultants and ensured that staff who had been involved in the preparation of the capital expenditure projections were available for discussion. In most cases, relevant documentation and supporting information was also provided to PB Associates during the discussions or within the 48 hour period agreed.

1.3 LIMITS TO PROJECT SCOPE WORK

This report has been prepared exclusively in relation to the forward capital expenditure program proposed by TransGrid in its submission to the ACCC[6]. For clarification, this review does not include:

- an examination of past TransGrid transmission expenditure other than as a guide to potential future investment requirements;

- a review of the ex-ante or ex-poste regulatory models; or

1.4 REPORT STRUCTURE

This report has generally been structured to facilitate ease of comparison with TransGrid's Application and in accordance with the ACCC's scope of works. The key sections are therefore:

- overview of TransGrid's proposed capital expenditure program;

- review of Asset Replacement expenditures;

- review of Augmentation expenditures and Excluded Projects;

- review of Support the Business expenditures; and

- recommendations on appropriate transmission capital expenditures for the regulatory period 2004/05 to 2008/09.

Detailed comparisons of TransGrid's application and the recommendations provided by PB Associates are incorporated into the Appendices.

[6] Revenue Application to the Australian Competition and Consumer Commission – Revised Transmission Capital Investment Program 2004/05-2008/09.

2. METHODOLOGY

The PB Associates approach to the review of TransGrid's capital programme is described in this section. The process was based on a series of well-defined project steps[7]. Each of these tasks was undertaken in accordance with a project work plan which was established at the start of the PB Associates review process. The principal project tasks are described below.

2.1 REVIEW OF TRANSGRID SUBMISSION DOCUMENTATION

PB Associates undertook an initial review of the TransGrid proposal capital expenditure program to assess whether sufficient information and data had been provided to enable a comprehensive evaluation of the identifiable needs for the investments and the relative efficiency of the proposed projects.

The initial review enabled PB Associates to develop a list of areas where additional information and further clarification was required. In addition, PB Associates met with TransGrid and the ACCC to consider the review process and protocols. The initial document review and meeting led to the compilation of a draft issues paper which incorporated the following components:

- the methodology and process that PB Associates would apply to the review;
- the key personnel from PB Associates and their specific roles in the review; and
- the key issues, questions and additional information requirements identified by PB Associates.

The draft issues paper was distributed to TransGrid on 25 November 2004 in preparation for on-site visits by PB Associates during the week ended 3 December 2004.

2.2 REVIEW OF GOVERNANCE FRAMEWORK

The efficiency and effectiveness of capital expenditure within an electricity transmission business is largely determined by the extent to which the organisation understands and subsequently manages the delivery of its services. In particular, with the high levels of capital investment for transmission companies and the long asset lives, optimising the timing and whole of life costs of those investments and marrying these costs with the demands for network availability and reliability is crucial.

Ensuring that investments are efficient requires a governance structure that guarantees the effective consideration of all relevant issues, evaluation of all viable alternatives and coordination of the efforts of all personnel. Good governance and capital approval processes enable consistency in the process of determining appropriate investments, integration of resource skills in each decision, a comprehensive checklist of issues requiring consideration and the application of lessons learned from previous experiences. The process also ensures effective communication across business areas to manage prioritisation and resources allocation issues.

PB Associates has undertaken a review of the governance arrangements applied by TransGrid to assess whether they provide a framework for delivering optimal investment plans. This review has been used by PB Associates to develop the level of confidence which could be applied in considering the overall efficiency capital program. It is

[7] The project process and timeframe was submitted to the ACCC and TransGrid in a paper prepared by PB Associates upon commencement of the assignment titled "Review of TransGrid's Forward Capital Expenditure Program - 2004/05 To 2008/9, Review Program and Issues Paper".

recognised that TransGrid has already introduced substantial changes to their governance arrangements following last year's ACCC review and that these changes have substantially improved the consistency of information provided for this review.

Examination of Policy and Practice

As part of the review of governance arrangements and through detailed project evaluations, PB Associates has identified the key policies and practices applied by TransGrid on a day-to-day basis. In undertaking this task, PB Associates has spoken to key staff within TransGrid and observed office practices. This section of the review also helped PB Associates gain a further understanding of the drivers behind some of the proposed individual capital investment schemes. In this task our review included:

- power system planning (philosophy, internal standards, documentation, planning criteria etc.);
- long-term network development strategies ('big picture');
- tools and applications used;
- links between asset replacement and augmentation investment;
- network data availability and integrity;
- links between costs and service level outcomes in project capital evaluations;
- application of NEC requirements;
- separation of monopoly and regulated expenditures and revenues;
- link between short-term and long-term investment;
- relationship between new connections and general augmentation capital;
- links and interdependencies between expenditures on business support and network investments (eg the links between IT, plant and communications expenditures and replacement/augmentation investments);
- asset management plans; and
- specific policies and programs (e.g. pole replacements, voltage rationalisation, risk management; etc.).

In this review PB Associates has focused its efforts on the areas most relevant to its review of the forward capital plan and in conjunction with the detailed evaluation of identified projects.

2.3 HIGH LEVEL REVIEW OF PROJECTS AND INVESTMENT PROGRAMME

The scope for reviewing capital expenditure requirements as an independent advisor to the ACCC required consideration of the overall program proposed by TransGrid in conjunction with detailed evaluations of specific projects. The high level evaluation has been undertaken to identify changes in policies and trends over time so that greater understanding can be obtained about the environment in which TransGrid is developing its investment plan.

The high-level project review is contained within Sections 3 and 4 which addresses the following considerations for each area of the overall capital expenditure program.

- consistency of information provided;

- historical and projected trends;
- relationships between programs;
- cost estimates;
- strategic alignment; and
- risk assessment.

The primary focus of this section is on determining the levels of resource requirement, effective application of strategic investment and governance arrangements and a coordination of investment planning across the organisation.

2.4 DETAILED REVIEW OF IDENTIFIED PROJECTS

To fully understand the process applied by TransGrid in the determination of capital investment requirements, it is necessary to undertake a comprehensive review of specific projects. This process tracks the application of governance procedures and policies through from initial identification of the investment 'need' to the approval stages for the proposed projects.

It is recognised that projects included in TransGrid's submission incorporate projects that are at various stages of consideration. Some are committed and entering the construction phase, whilst others proposed for later in the regulatory period may not have been fully scoped or costed. The level of information provided and the detail and accuracy of that information will vary depending on the type of project and the required completion date. The governance and approval procedures should provide the appropriate levels of guidance for staff in developing the information requirements commensurate with the type and timing of each project.

PB Associates has undertaken a comprehensive review of the processes and analyses applied by TransGrid for a range of specific projects they have proposed. This provides both an opportunity to assess the needs and costs of those projects, as well as an indication of the effectiveness and implementation of governance arrangements. In particular, these reviews included the following analysis:

- extent of application of policies and procedures;
- accuracy and consistency of data;
- interrelationships with other projects;
- reasonableness of assumptions and costs;
- overall efficiency;
- consistency with other projects; and
- alignment with overall strategies.

2.5 FORMULATE VIEWS AND REPORT ON FINDINGS

Following the four steps outlined above – i.e. initial review, governance review, high level assessment and detailed project assessments – PB Associates has prepared this report in accordance with the ACCC's project scope. The findings and recommendations have been prepared with the specific purpose of facilitating the ACCC's assessment of revenues requirements for TransGrid over the period 2004/05 to 2008/09.

3. TRANSGRID'S CAPITAL EXPENDITURE GOVERNANCE

In reviewing TransGrid's capital expenditure projections it is fundamental to first appreciate the process by which projects are identified, evaluated, selected, prioritised and approved. This allows both an insight into the managerial effectiveness of the organisation and a method by which sample auditing can be extrapolated to various aspects of the capital expenditure program.

There are therefore two components to the PB Associates review of TransGrid's governance arrangements.

1. a high level comparison of the capital expenditure governance and approval framework with "good industry practice"; and

2. testing the application of these prescribed processes through the detailed project reviews.

In this section of the report the focus is on reviewing the prescribed governance arrangements as they apply to the various categories of capital expenditure. The application of these arrangements is then discussed in each section in relation to the detailed project assessments.

3.1 TRANSGRID'S ORGANISATION STRUCTURE

Based on energy delivered, TransGrid is Australia's largest electricity transmission business, comprising 12,426 km of transmission lines (500kV, 330kV, 220kV, 132kV and 66kV) over an approximate area of 500,000 km^2. TransGrid provides supply to 12 customers including four electricity distribution businesses (Energy Australia, Integral Energy and Country Energy (including Australian Inland Energy) and ActewAGL), through its 82 switching stations and substations. TransGrid provides interconnection services to Queensland, the ACT and Victoria, and is directly connected to 10 generation sites throughout NSW. The following map illustrates the magnitude of the TransGrid network.

Figure 3-1 – NSW Transmission Network

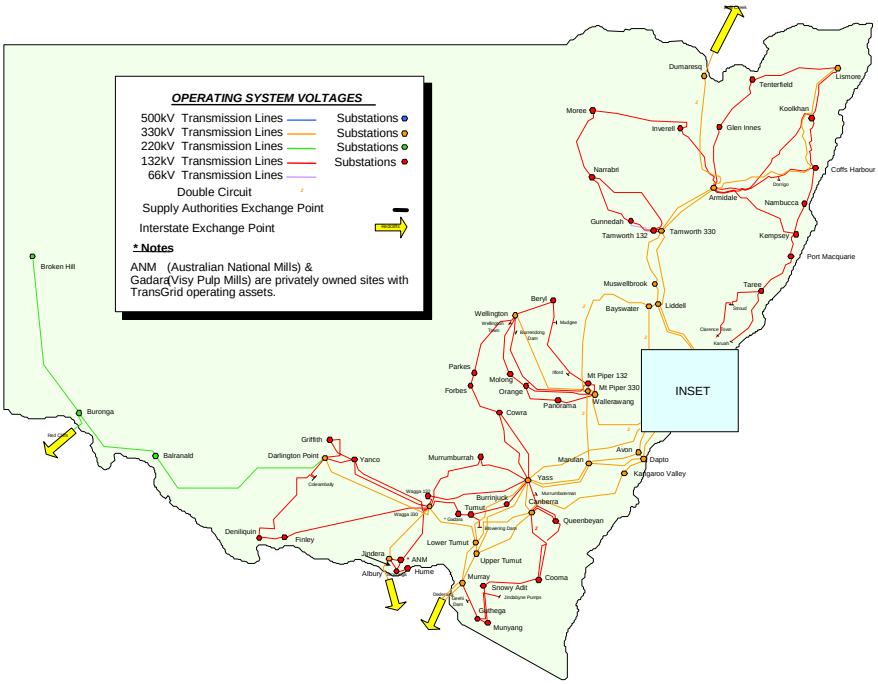
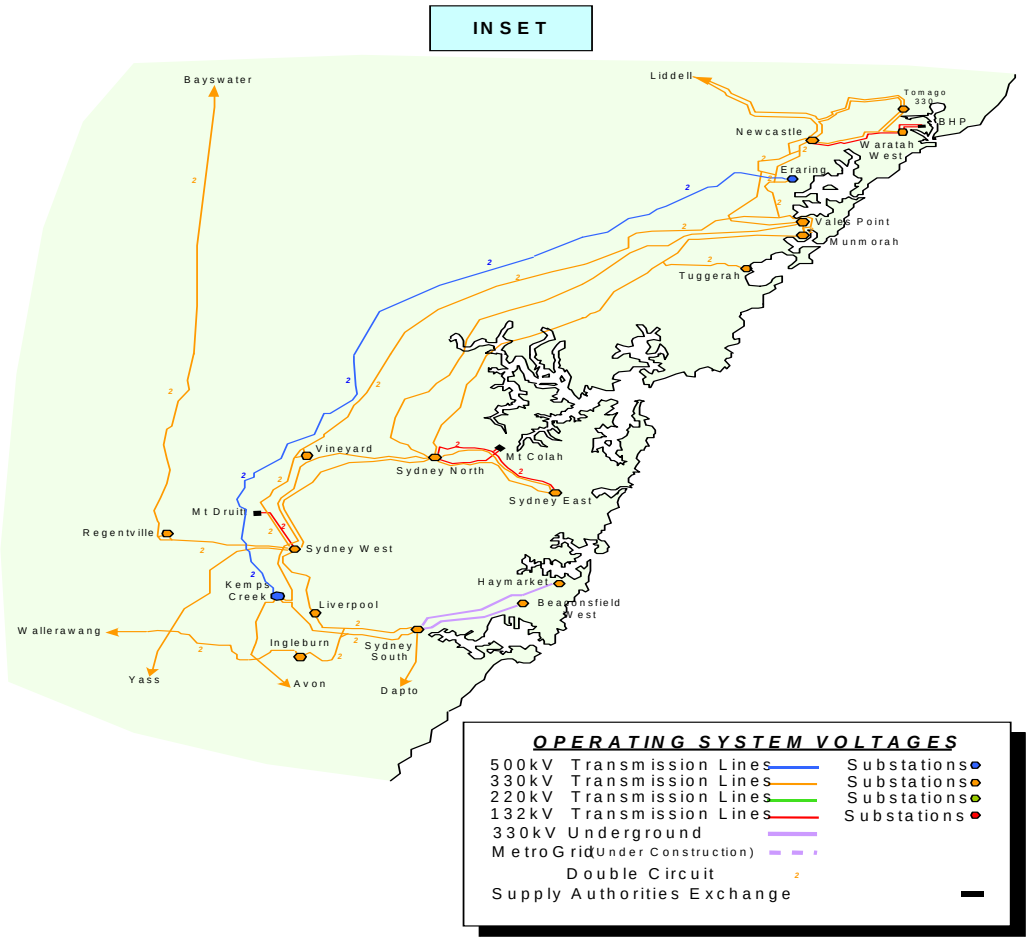


Figure 3-2 – NSW Metropolitan Transmission Network

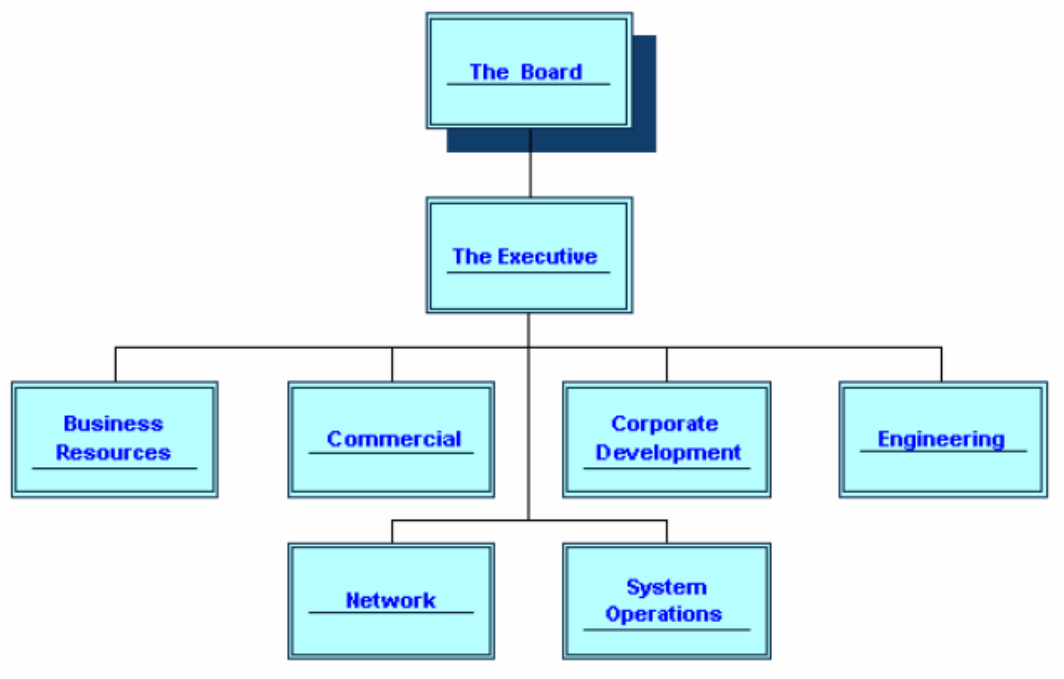


As a result of the geographic area covered and the size of many of the generators and customer loads, TransGrid has developed a largely decentralised network management structure that facilitates local decision making for the day to day operations and management of the network assets. This involves 3 large regional centres and 3 sub-regional depots. Over 548 staff operate from these regional sites, which represents 57% of total staff numbers.

The network, however, is largely automated to enable the rapid switching required to maintain supply in accordance with National Electricity Code (Code) requirements and customer expectations. This means that system control is centralised to points at Wallgrove (Sydney), Yass and Waratah (Newcastle). These facilities offer, to some extent, backup capabilities in the event that a system control centre is off-line.

In addition, the network planning, general administration and management functions are largely centralised at TransGrid's Sydney CBD premises. The structure of the business and the key functional and geographic divisions is shown in Figure 3-3.

Figure 3-3 – TransGrid Organisational Chart



TransGrid derives a proportion of its total revenues (5% in 2003/04) from non-monopoly services such as overseas consultancies and contract line construction and maintenance works. These revenues (and costs) are ring fenced from the monopoly network services and excluded from this review – other than to ensure that capital expenditures have been assigned to external business where appropriate. The allocation of "Support the Business" capital expenditures to this segment is discussed further in Section 7.

3.2 THE CAPITAL INVESTMENT FRAMEWORK

TransGrid has developed a process for identifying, evaluating, prioritising and approving capital investments across all areas of the business. The vast majority of its capital expenditures relate to network augmentation and replacement which is illustrated in the following section in Figure 4-1. Replacement and augmentations (incorporating excluded projects) account for around 90% of TransGrid's proposed total capital expenditure. Expenditure trends in each class are discussed later in this report. In terms of investment governance this demonstrates the significance of network asset investment decisions on the overall business performance.

In undertaking this review PB Associates is aware that TransGrid has been continually improving its processes for estimating future capital expenditure requirements. TransGrid has also been required to accelerate the identification and costing of projects to facilitate the introduction of the ACCC's "ex-ante" regulatory regime.

TransGrid's previous planning and governance processes did not require specific project identification and costing prior to normal planning and lead time requirements. However, under an ex-ante approach, revenues are prescribed for the period and any additional expenditures incurred (other than those identified as "Excluded Projects) do not attract the assigned return on capital during the regulatory period. This places a symmetrical risk on TransGrid that encourages underspending against the allowed capital expenditure levels. This incentive arises from commercial benefits for the business when expenditure levels are less than the ACCC's assumed expenditure targets.

TransGrid has accelerated its capital expenditure review process to accommodate the introduction of the ex-ante methodology. Under the previous approach applied by the ACCC, TransGrid's expenditures were reviewed ex-post and, where expenditures were deemed to be prudent, TransGrid's revenues were subsequently adjusted to adequately compensate for the level of efficient investment – even where this may have exceeded the originally anticipated levels. However, under a fixed cap ex-ante approach, any expenditure in excess of prescribed levels would not necessarily be recognised until the following regulatory reset. Therefore TransGrid is required to undertake far more exhaustive investigations and cost estimation than previously, even though in many instances, particularly for projects to be undertaken in the latter years of the regulatory period, the exact nature and scope of works are not readily definable.

The new processes adopted by TransGrid for identifying and costing projects over the regulatory period in response to the ex-ante approach have significantly improved the quality of data available to the business and supporting information for this PB Associates review.

3.2.1 Capital Expenditure Review and Approval Process

TransGrid has been reviewing and improving the Project Development process on an ongoing basis for some time. The Project Development process for Major Capital Expenditure Projects is important because these projects represent the majority of TransGrid's capital expenditure.

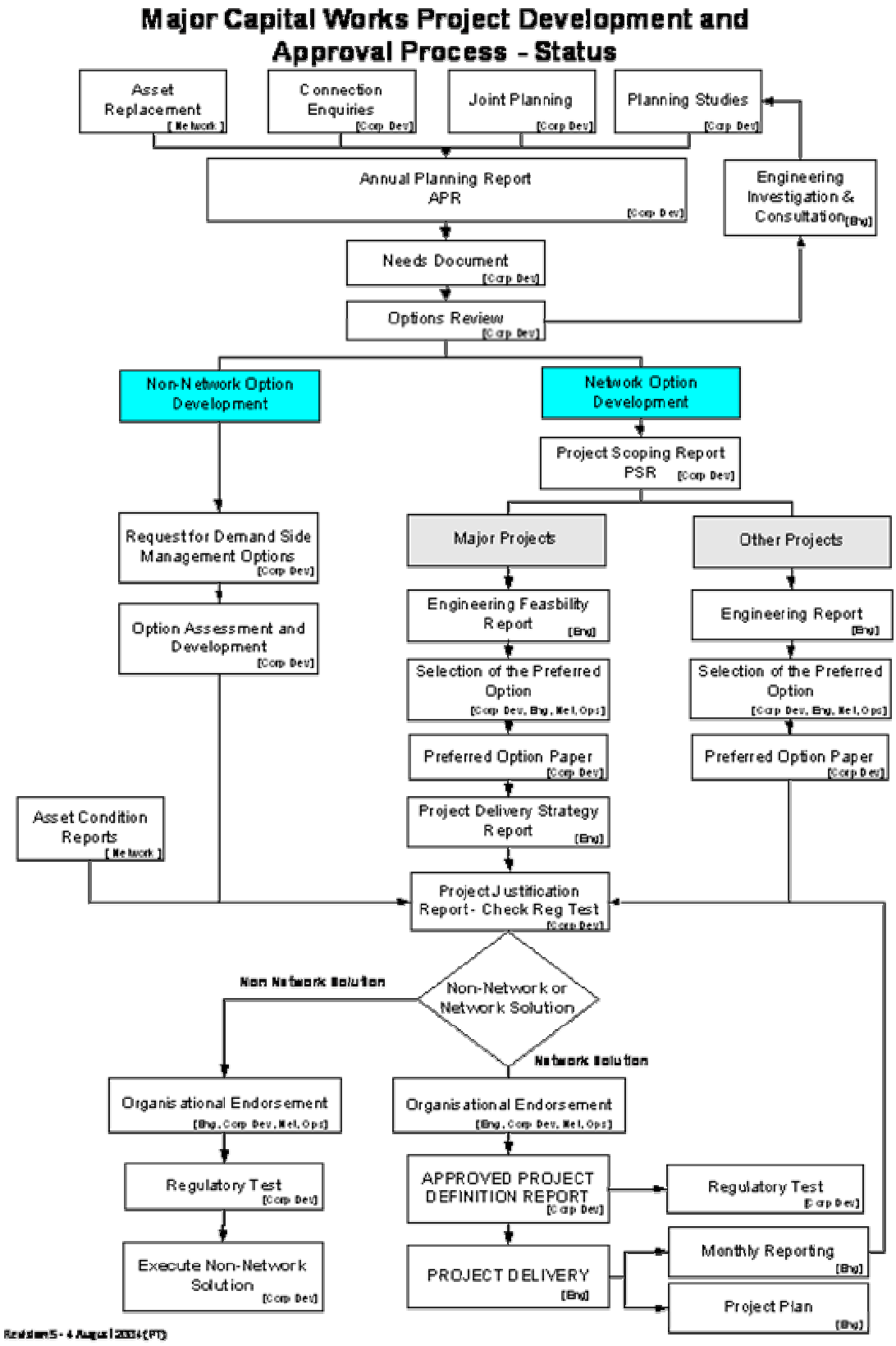
Figure 3-4 shows the planning and project development path up to the commencement of project delivery for Major Capital Expenditure Projects. These projects include augmentation projects and major replacement projects requiring specialist input from TransGrid's Engineering Group. Capital expenditure associated with other projects such as minor replacement projects, some communication projects and IT projects are subjected to different processes. These are discussed below and are also addressed within the specific sections of this report.

The flowchart of the process for TransGrid's Major Capital Expenditure Development and Approval provided in Figure 3-4 shows that Feasibility Studies and cost estimates are routinely produced by TransGrid's Engineering Group in response to a Project Scoping Report from the Corporate Development Group. This is carried out as part of the project development process before the Project Definition Report is approved[8].

TransGrid officers have noted that a key objective of developing the Major Capital Expenditure Project Development process as set out in Figure 3-4 has been to ensure that the network development options are properly assessed and costed prior to being subjected to the public assessment processes. Accordingly, where projects have reached this stage then, under existing governance arrangements, PB Associates would expect comprehensive documentation associated with each step of the process.

[8] It is worth noting that the flow chart shows the planning and project development path up to the commencement of project delivery. For large augmentation projects (estimated cost of more than $10 million) the first step in project delivery is the undertaking of the Regulatory Test process. This is where TransGrid's internal assessments of project need, options, and evaluation of options is tested publicly against the ACCC's Regulatory Test. For smaller augmentation projects TransGrid's assessments are tested publicly via the Annual Planning Review (APR) process. Formal commitment to project execution, including establishment of competitive contracts to deliver augmentation projects, is dependent on the outcome of these public review processes.

Figure 3-4 – Major Capital Expenditure Approval Process[9]



In order for the ACCC and PB Associates to assess the validity of TransGrid's capital expenditure requirements over the current regulatory period TransGrid were required to

[9] TransGrid's Revised Application.

accelerate the normal development and approval process to accommodate the many project evaluations that would not normally only be at preliminary stages of consideration.

To address this challenge for major projects, as well as to incorporate capital expenditure estimates for projects not normally subject to the Major Capital Project Expenditure process in Figure 3-4, TransGrid based its capital expenditure application on the six work streams shown in Table 3-1 below. The outputs of these work streams were rolled into a master database to enable consolidation and sorting of forecast capital expenditure requirements. It is the consolidated version of this data base that appears in TransGrid's application as Attachment 1A.

Table 3-1 – Work streams for Identification and Scoping of Capital Projects

Work Stream	Project Category	Scope Definition	Cost Estimate
1	Committed Augmentation Projects	Project Plan	Forward Cost Estimate to Complete
2	Augmentation Projects with Feasibility Reports well advanced or approved	Feasibility Report & summarised in the Planning Scope document	CAPEX Estimate Database
3	Replacement & Augmentation Projects without existing Feasibility Reports	Planning Complex Scoping Document	CAPEX Estimate Database
4	Minor (Asset Strategy driven)_ replacement projects without existing feasibility reports	Asset strategies and supporting documents	Prepared by Network Group utilising TransGrid Corporate costing systems
5	Technical Services Projects	Scope provided by Corporate Development	Cost Estimate provided by Corporate Development
6	IT and Other Support the Business Projects	See Section 9 of the Application	Development by relevant TransGrid Groups e.g. IT costs by Chief Information Officer

PB Associates has reviewed the documentation associated with each of the six work streams to ensure that the processes are robust and that forecasts of capital expenditure requirements arising from these processes are efficient. It was also important to ensure that there was sufficient co-ordination between processes to properly manage cost burdening and avoid any double counting. The above table sets out the various stages and section responsibilities for cost estimation in the review process. Each of these is described in turn as background to the assessments and findings discussed in the remainder of this report.

Work Stream 1: Committed Augmentation Projects

This work stream typically includes major projects that are already incurring expenditure, usually involving contracts already in place for the delivery and/or execution of part, or all, of the project. As such, the projects in this work stream have usually completed the process set out in Figure 3-4, including regulatory approvals (such as the Regulatory Test process where needed); has a project manager appointed from the Engineering Group and approved budgets in place.

Cost estimates for these projects, including prices established under competitive tendering arrangements for the remainder of the 2004/05 to 2008/09 regulatory period, have been provided by project managers and included in the overall capital expenditure data base.. Some costs were also provided separately by specialist areas such as TransGrid's Property Group.

Work Stream 2: Augmentation Projects with Feasibility Reports Well Advanced or Approved

This work stream typically includes projects that have a feasibility report and are summarised in a planning scope document in accordance with the steps in Figure 3-4. As such, documentation would be expected to be available in accordance with TransGrid's normal governance process. This documentation is used by TransGrid to formulate forecast capital expenditure requirements for these projects using the major capital expenditure estimating data base described in Section 0 of this report.

As with Work Stream 1, some costs are also provided separately by specialist areas such as TransGrid's Property Group where related capital expenditures are involved. Work stream 2, as with work stream 1 involves all steps within Figure 3-4 for developing accurate cost estimates and project justification.

The following work streams involve projects where the review process has needed to be accelerated and strengthened in order for more accurate cost estimates and project verification to be developed for the ex-ante capital expenditure application to the ACCC.

Work Stream 3: Replacement & Augmentation Projects without existing Feasibility Reports

This work stream typically includes projects that did not, initially, have a feasibility report and/or were not summarised in a planning scope document in accordance with the steps in Figure 3-4 above. Generally this was due to the early stage of project consideration within the normal governance process.

To address this, in preparing its Application, TransGrid accelerated its normal planning work to complete studies, review development options, and develop 'planning complex' work scopes. TransGrid's Engineering group has carried out detailed cost estimates based on these work scopes using the major capital expenditure estimating data base described in Section 0 of this report. As with Work Streams 1 and 2, some costs are also provided separately by specialist areas such as TransGrid's Property Group where related capital expenditures are involved.

Work Stream 4: Minor (Asset Strategy Driven) Replacement Projects Without Existing Feasibility Reports

This work stream covers projects arising from asset strategies that do not require detailed involvement of TransGrid's Engineering Group. The asset strategy process is set out in Section 4 of TransGrid's Application and is conducted by TransGrid's Network Group. This Group has prime responsibility for ensuring that TransGrid's existing assets remain in an effective working condition that is safe, reliable and meets environmental requirements. This Group undertook a major review of TransGrid's asset replacement strategies ahead of TransGrid's revised application and accelerated the development of relevant work scopes for this type of work. Cost estimates for each project were based

on historical cost data for similar work held in TransGrid's corporate work management and costing systems.

Work Stream 5: Technical Services Projects

These projects are specialist projects primarily involving communications equipment needed for protection, SCADA, or market operation. TransGrid have advised PB Associates that the relatively short lead times associated with these projects means that medium term project identification and costing has required a substantial amount of project scoping and cost estimating work to be accelerated for this Application. This work was undertaken by Technical Services planning specialists with input from officers responsible for designing and commissioning this type of equipment. In this case, most of the expenditures relate to upgrading communication system to improve reliability levels in accordance with NEMMCO's revised requirements over the regulatory period.

Work Stream 6: IT and Other Support the Business Capital Expenditure

The normal Governance framework for developing and approving IT expenditure is set out in Section 9A of TransGrid's Application. Given the relatively short lead times and rapid market developments associated with IT projects, TransGrid had not progressed the governance process to detailed stages for the medium term in many instances. TransGrid identified probable IT projects and expenditures by using historical information as the basis for forecasting future needs. An assessment was also carried out of what might represent reasonable levels of business improvement IT expenditure.

For other Support the Business capital expenditures including Miscellaneous Assets, Motor Vehicles and Mobile Plant, historical information along with known asset age and life data was used as the basis for levels and timing of expenditures.

3.2.2 PB Associates' views on TransGrid's capital expenditure governance arrangements

TransGrid relies on a high level working group structure to coordinate and manage network investments. PB Associates reviewed minutes of these working groups and the relationship with specific functional management positions. Our findings indicate that the new governance arrangements are still at an early stage of implementation. Nevertheless, the arrangements appear to cover all aspects of the process and have the potential to enable an effective integration of operating and capital decisions across the key functional business groups. Over time, and with the continued support of senior management, this process should provide an effective investment governance framework.

However, PB Associates believe that there are opportunities for TransGrid to further improve the process by linking performance indicators and accountabilities more directly to working group members to ensure congruence between organisational objectives and the working group's consideration of critical issues.

Additionally, TransGrid's Major Capital Works Development and Approval Process was accelerated in a number of areas to facilitate the ACCC's pricing review. Given the fundamental nature of the ACCC's role in determining allowable revenues/prices for TransGrid, PB Associates is of the view that TransGrid should modify its processes so that medium range planning is a standard operation. It has been noted that the link between the costing and planning information developed by the Engineering Group is not always consistent with information developed and provided by other sections within TransGrid. This manifested in some project omissions, cost duplications and expenditure timing issues. By formalising the accelerated planning approach and ensuring systematic project evaluation for regulatory consideration (internal and external), an improved capital investment process should emerge.

Nevertheless, it is PB Associates' view that the approach adopted by TransGrid for this application was effective and that the organisation is becoming more aware of the

importance of undertaking the work necessary to demonstrate its capital requirements to the regulator in the required timeframe. Future iterations of the regulatory review process should see the governance arrangements deliver effective capital investment programs which address the issues arising in this review relating to the accelerated planning and estimating processes.

4. OVERVIEW OF TRANSGRID'S CAPITAL PROGRAMME

This section provides detailed analysis of TransGrid's proposed capital expenditure program for the current regulatory period, 2004/05 to 2008/09. This analysis is presented in a manner consistent with TransGrid's revised application and reviews the expenditures in terms of Replacement, Augmentation, Excluded Projects and Support the Business.

4.1 TRANSGRID'S PROPOSED CAPITAL EXPENDITURE PROGRAMME

TransGrid's revised capital investment programme for the period 2004-2009 describes a total capital expenditure requirement for the period of $2,148 million. Figure 4-1 illustrates the level of historical and forecast expenditures by category for each year.

Figure 4-1 – Forecast capital expenditure 2004/05 to 2008/09 (2004 Dollars)

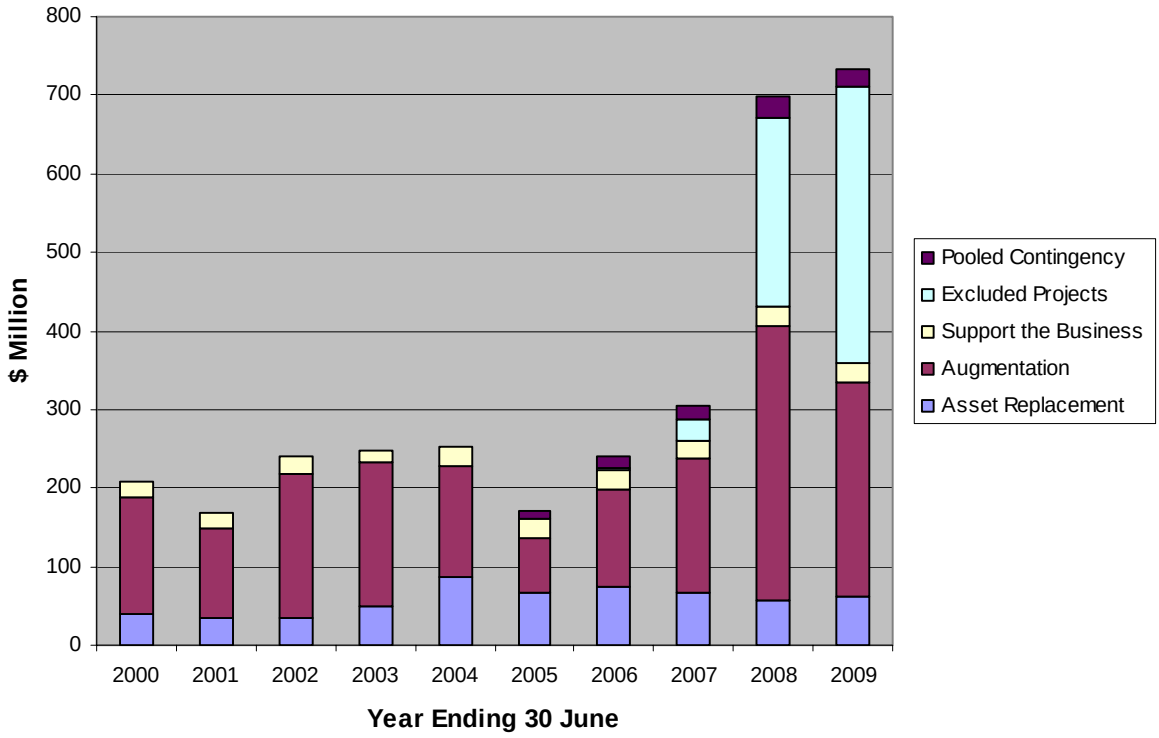


Figure 4-1 shows that the overall capital expenditure program reduces significantly in 2005 relative to historical levels but then increases rapidly over the current regulatory period. In particular,

- asset replacement expenditures climbed in 2004 but are projected to reduce slightly and then remain relatively constant over the current regulatory period;
- augmentation requirements reduce substantially in 2005 but grow rapidly over the current regulatory period;
- excluded projects represent those expenditures which are highly uncertain and materially impact on the capital requirements of TransGrid. Allowing for the potential that some of these expenditures may eventuate substantially increase TransGrid's anticipated capital expenditure requirements overall;

- support the business investments (IT, motor vehicles, plant and administrative equipment) remain constant in real terms over the current regulatory period and were relatively stable over the past period; and

- TransGrid has included a contingency allowance of 7% for expenditures over the current regulatory period to account for expenditure uncertainties.

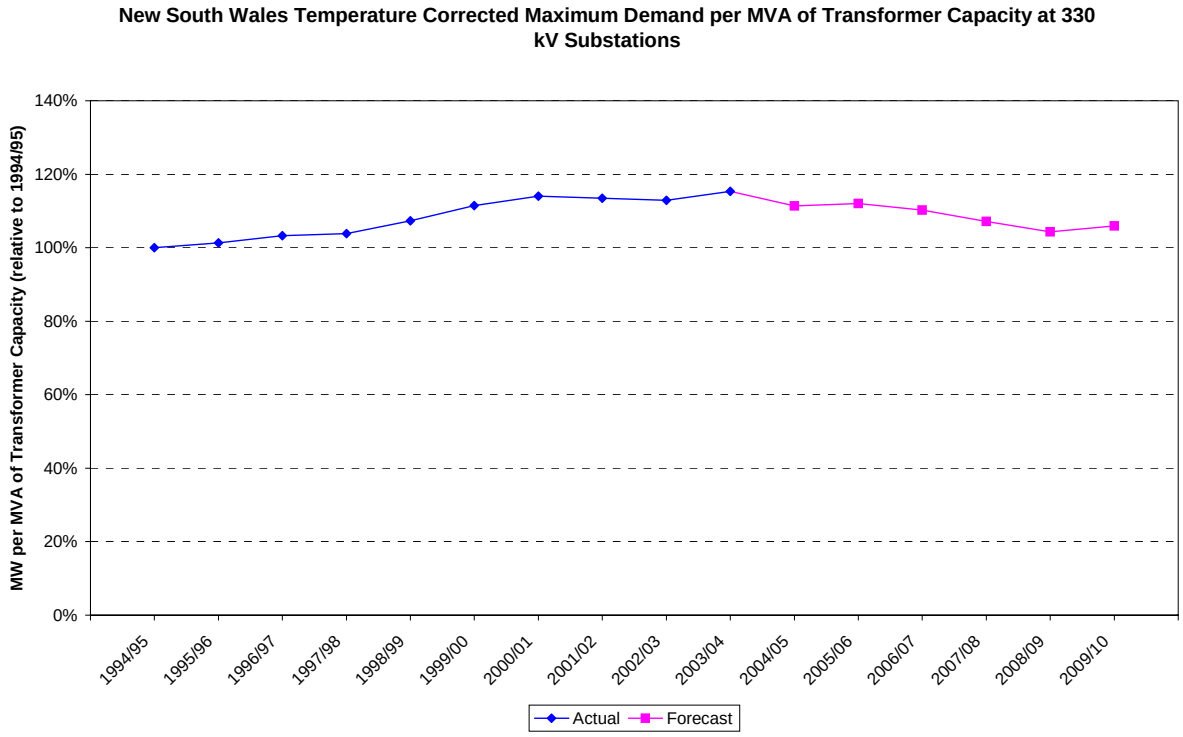
TransGrid has advised that the reduction in augmentation expenditures in 2005 were the result of:

1. not proceeding with the proposed South Australia/NSW interconnector; and

2. completion of Haymarket substation in 2003/04 and the subsequent transfer of internal resources back to operating and maintenance works.

Overall, TransGrid's proposed five year capital expenditure program represents an increase of 92% over the previous period in real terms, allowing for all Excluded Projects. If Excluded Projects are removed the real increase is 37%. Over the same period, growth in peak demand has gradually eroded the redundant capacity which provides the network support necessary to maintain the requisite transmission reliability levels. The following chart, provided by TransGrid during this review, demonstrates how redundant capacity has reduced relative to 1994/95 levels, and how the proposed capital expenditure program re-establishes those redundancy levels.

Figure 4-2 – TransGrid Demand per MVA of Transformer Capacity[10]



In reviewing TransGrid's proposed capital expenditure program PB Associates has noted the resource allocation issues which arise. In particular, the steep rise in proposed expenditures in the latter years of this regulatory period indicates the need for considerably greater resources to be applied to capital works. This could clearly be achieved in a number of ways, either through additional internal resources, shifting labour from operating to capital projects or increased use of external resources.

[10] Chart provided by TransGrid to PB Associates during the review.

PB Associates recognises this is potential issue for TransGrid and has discussed the impact of resourcing on TransGrid's ability to deliver the proposed program. Whilst there are challenges facing TransGrid in undertaking the scale of the proposed program, PB Associates has not commented on the resourcing issues. Similarly, PB Associates has not reviewed the impact on operating expenditures which might occur through the reallocation of resources from operating to capital projects as this was beyond the scope of this review. However, PB Associates acknowledges that there are significant implications for TransGrid's operating expenditures which are likely to arise as a result of the recommendations in this report regarding capital expenditures.

4.2 TRANSGRID'S COST ESTIMATIONS FOR REPLACEMENT AND AUGMENTATION

In reviewing TransGrid's overall capital program PB Associates has taken account not only of the nature of projects required, but also the underlying principles applied in formulating cost estimates. PB Associates is required to ensure that the levels of expenditure are efficient in accordance with the National Electricity Code (NEC) and hence considerable effort has been devoted to assessing the relative unit costs applied by TransGrid for labour, materials and expenses, and comparing these to data from other networks and information sources. The following information reflects this evaluation and recommendations proposed by PB Associates relating to cost estimates and resulting capital expenditures.

4.2.1 Cost Estimation Process – Replacement and Augmentation

TransGrid's Engineering Group has refined an estimating software package and process that appears to produce accurate estimates of the costs for TransGrid to deliver projects in accordance with their project scope. TransGrid used this process to determine the expenditure estimates in their application for all augmentation and replacement projects except for minor asset replacement works, Technical Services costs and Property costs.[11]

The source data used to develop base project construction estimates was obtained from averaging unit costs from a sample of completed projects over a reasonable time frame and adjusting all costs to 2004 dollars. PB Associates recognises that these unit construction costs were obtained from construction contracts originally let by a tendering process but there are a significant number of issues that could impact on the completed costs and hence the efficiency of the final unit costs incurred. Such issues could include tender selection, pre contract investigation to minimise latent conditions, contract supervision, management of contract variations, and project design etc.

Hence the use of historical costs does not necessarily imply that these costs are efficient, but the averaging process over a significant range of projects and over a reasonable time frame may mitigate the influence of abnormal or outlying occurrences.

The engineering and network cost components were derived by researching the in-house engineering and network costs charged to a number of completed projects and averaging those costs as a percentage of the associated construction contracts. Whilst the design costs are self evident the network costs primarily include project supervision, provision of access and commissioning works. This process indicated that design costs were on average 10% of base contract costs and network costs were also on average 10% of base contract costs. Again PB Associates notes that this process does not necessarily provide an indication of efficient engineering and design costs. In this instance the quantum of time charged to each project and the hourly rates of staff involved in the design, project administration, contract supervision and commissioning can influence the efficiency of the completed project costs. However the averaging process over a significant range of projects over a reasonable time frame may mitigate the influence of abnormal or outlying occurrences.

[11] Costs for Technical Services and Property are discussed in sections 6.6.8 and 6.7 respectively.

TransGrid then checked their estimating system by re-estimating completed projects and determining average scaling factors in to order reconcile total project costs. These scaling factors were called "scoping factors" by TransGrid and they have been applied to the estimates for all projects included in their submission with the exception of committed projects, but are not applied to the plant and equipment component of the estimates nor the property costs associated with the project. For the majority of the projects in the TransGrid capital program the scaling factor was 10%. TransGrid have advised that plant and equipment comprise on average approximately 32% of total estimates and the property costs 14.3% of the total estimates. PB Associates has incorporated these variations into its efficiency adjustment calculations.

The minor asset replacement works were estimated using a standard labour, material and plant cost build-up. The estimates were developed using TransGrid labour rates grossed up to include direct and indirect overheads, current period contract prices for supply and installation of equipment, and both internal and external plant hire rates.

The issue for PB Associates, however, is to determine if the outcomes from these processes also produce efficient costs leading to a prudent level of capital investment.

4.2.2 PB Associates assessment of cost estimations

PB Associates has reviewed the processes applied for augmentations/major replacements projects and minor replacement projects independently and, where appropriate, we have developed scaling factors to adjust TransGrid's estimates.

PB Associates, whilst recognising the challenges associated with accurately determining efficient construction costs, has formed the view that the estimates produced by the TransGrid estimating system excluding the scoping factor is an acceptable surrogate for efficient construction costs. This effectively results in all the substation and transmission line projects being scaled back by 6.8%.

In addition PB Associates has compared a range of unit costs developed using this process with the standard replacement costs contained in the NSW Treasury, Valuation of Network Assets[12] document[13]. PB Associates recognises the limitations of such comparisons particularly in relation to design and equipment ratings, however it is noted that these rates have been used by the NSW government for the valuation of electricity assets and were subject to substantial and broad scrutiny during that process. Across the asset categories compared, in general TransGrid's substation costs, which comprise by far the majority of the projects in the TransGrid Application, are on average approximately 6.5% higher than the NSW Treasury Replacement Costs in 2004 dollars. TransGrid's line costs are on average approximately 17% higher than NSW Treasury Replacement Costs in 2004 dollars,

Substation construction units were selected and adjusted to ensure that the scope of works was aligned as far as possible. Transmission lines were compared, as far as possible, on a like for like cost per kilometre basis.

In its report on Energy Australia's transmission capital expenditure requirements[14], PB Associates concluded that in the majority of the proposed augmentation projects, the Energy Australia estimated project costs were within a small margin of the estimates developed using the NSW Treasury standard replacement costs adjusted to 2004 dollars.

12 NSW Treasury Valuation of Network Assets, 2004

13 Adjusted to 2004 dollars.

14 Energy Australia's Forward (Transmission) Capital Expenditure Requirement – An independent review prepared for the ACCC, PB Associates, December 2004 (http://www.accc.gov.au/content/index.phtml/itemId/554861/fromItemId/379646)

On this basis PB Associates believe it reasonable to assume that the prudent level of capital investment for substation and transmission line projects could be achieved at 6.8%[15] less, on average, than that estimated by TransGrid. PB Associates has therefore incorporated these reductions in determining its recommended expenditures.

In reviewing the estimates developed by the Network Group for minor asset replacement projects, PB Associates has relied upon the period equipment contracts and external plant hire rates as these were obtained through a competitive tendering process. Internal plant hire rates were reviewed and PB Associates has formed the view that they are reasonable. In determining an appropriate labour rate PB Associates reviewed TransGrid's rates incorporated in their application estimates, as well as TransGrid's labour rates used in tenders for external work, along with current rates for similar classifications at Country Energy, EnergyAustralia and ACTEW including TransGrid's burden for overheads. The average of these rates across the three classifications was 8.5% less than the rates used by TransGrid in determining the estimates in their application.

TransGrid were also requested to provide a breakdown of components of their asset replacement estimates. These were labour 18%, plant 1.6% and material 80.4%. Thus, a reduction in the labour rate of 8.5% would result in a reduction in the total estimate of 1.5%. PB Associates believes it reasonable to assume that the prudent level of capital investment for asset replacement projects could be achieved at 1.5% less, on average, than that estimated by TransGrid. PB Associates has therefore incorporated these reductions in determining its recommended expenditures.

[15] The scoping factor was not applied to plant and equipment costs by TransGrid which is 32% of the total. Therefore the reduction incorporated by PB Associates relates to 10% of the remaining 68% of project costs.

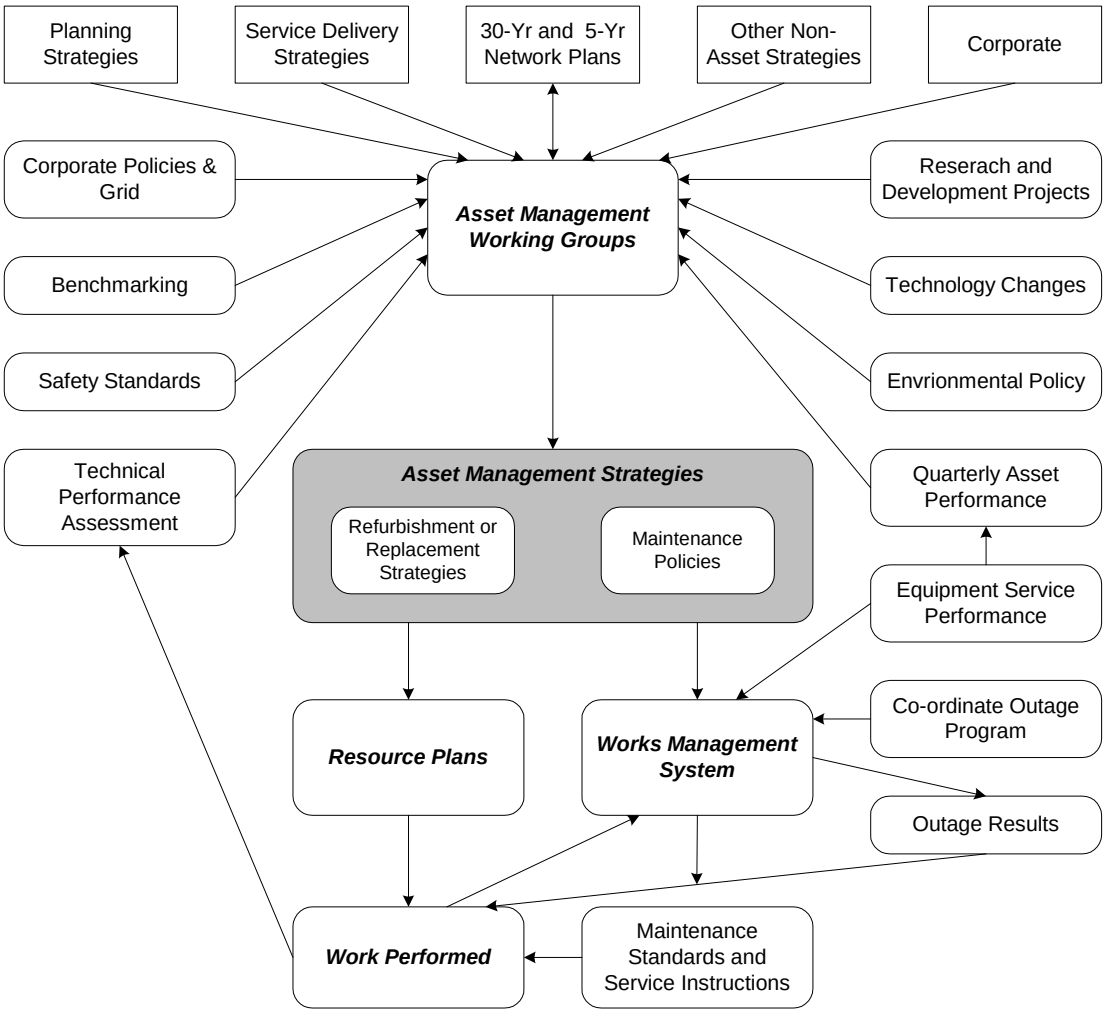
5. ASSET REPLACEMENT

5.1 OVERVIEW OF ASSET REPLACEMENT

TransGrid has a well developed asset management strategy with individual maintenance strategies for each category and class of electrical equipment. It is supported by a well populated data base which contains equipment manufacture details, service information, condition data, inspection reports and records of all maintenance. The system is also integrated with a works management system which simplifies the programming of the inspection, testing and maintenance functions.

The process is continually reviewed and improved by the Asset Management Working Groups to ensure continual process improvement. TransGrid has had a 5 year Network Plan for some time which specifies all the known asset replacement work required for the 5 year period but have developed a 30 year Network Plan which should assist them predict the asset replacement projects which may arise on the forthcoming 5 year period. Following is a diagrammatic representation of the TransGrid asset replacement process.

Figure 5-1 – TransGrid's Asset Management Strategy Process



In reviewing the projects included in the TransGrid Revenue Cap Application PB Associates has assessed each individual asset category strategy, the timing of the replacement, the costing for each project and the scale and scope of the work.

A brief description of each project follows including identifying the need for the work and PB Associates' recommendation.

5.2 MINOR PROJECTS

5.2.1 Substation Projects

Buildings

Buildings – 4988Y002 TO 4988Y011. These asset replacement projects relate to the provision of air conditioning to various substation sites. Control rooms in locations which experience extreme temperature variations and where electronic protection and control equipment is installed requires a controlled temperature and humidity environment to operate effectively. In other locations frequently visited by staff where extreme weather variations are experienced the meal room also requires air conditioning. TransGrid have included a total estimate of $588,674 for expenditure in the period and PB Associates has identified that 4988Y005 relates to the refurbishment of Upper Tumut Switching Station and thus $305,888 of the total Buildings estimate relates to this project. This project is required as TransGrid staff do not have access to the Snowy buildings which contain the amenities and abolition facilities.

The majority of this expenditure is based on quotations for the installation of split air conditioning units and therefore PB Associates has formed the view that the total amount should be included in the recommended capital expenditure for the control period.

Buildings – Murray Oil Spill Tanks. This project involves the installation of secondary oil containment due to environmental risks associated with the proximity of the switching station to Khankoban pondage. TransGrid have included an estimate of $168,979 and PB Associates recommends that the project be included in the capital works program.

Buildings – Armidale Substation Control Room – 4988C001. This project involves the installation of air conditioning to the Armidale substation control room. Armidale experiences extreme temperature variations and the electronic protection and control equipment installed requires a controlled temperature and humidity environment to operate effectively. TransGrid have included an estimate of $15,200 and PB Associates recommends that the project be included in the capital works program.

Buildings – Canberra Switchyard Drainage and Gravelling -4988Y001. The Canberra substation was constructed in the late 1960s and the switchyard is grassed. Rabbits are a major problem undermining foundations and burrowing beside cable trenches causing the brick sides to collapse. This allows rats to enter the trenches and gnaw the cable insulation causing cable faults. Gravelling the yard will control the rabbit situation and substantially reduce ongoing maintenance costs. TransGrid have included an estimate of $340,000 for this project. In considering the problems of removing the grass and topsoil and delivering and spreading gravel in an operating substation PB Associates recommends that the project, including the TransGrid estimate, be included in the current capital works program.

Buildings – Air Conditioning – Multiple Repeater Sites – 4988N004. This project involves the installation of split system air conditioning systems at approx 40 radio repeater sites. These repeater huts contain sensitive electronic equipment and have historically been fitted with domestic style window air conditioners. Running almost continuously, they have a short service life of approximately 10 years. The installation of split systems should extend replacement intervals and reduce operating costs. PB Associates has reviewed the information provided and recommends that the total estimated expenditure and the project be included in the current capital works program.

Buildings – Tamworth Substation Control Room – 4988. This project involves the installation of air conditioning to the Tamworth substation control room. Tamworth experiences extreme temperature variations and the electronic protection and control equipment installed requires a controlled environment to operate effectively. TransGrid have included an estimate of $15,200 and PB Associates recommends that the project be included in the capital works program.

Buildings – Coffs Harbour. This project relates to the minor extension of the staff accommodation building at the Coffs Harbour substation. TransGrid have included an estimate of $40,000 and PB Associates recommends that the project be included in the capital works program.

Buildings – Newcastle. This project relates to the demolition of the patrol building at Newcastle substation. TransGrid have included an estimate of $50,000 and PB Associates recommends that the project be included in the capital works program as it will reduce operating costs.

Circuit Breakers

TransGrid have a circuit breaker replacement program to replace circuit breakers at the end of their service lives, when they become unreliable, unsafe or when they are no longer maintainable due to lack of spare parts or manufacturer support.

This strategy has been used to identify replacement projects in the current application. As there are 97 circuit breaker replacements scheduled for the current 5 year regulatory period PB Associates has reviewed the circuit breaker replacement strategies rather than each individual project.

The replacement strategies usually involve a phased replacement program over a number of years with each breaker replacement prioritised based on condition. Spares are obtained from replaced breakers to maintain serviceability of those breakers still in service and awaiting replacement.

PB Associates reviewed the following circuit breaker replacement strategies, a brief description of the major reason for replacement is provided for each type of breaker:

- 132kV Galileo OCERD – in service since 1961 and have major sefton jelly leaks, slow operation and lack of spare parts.
- 22kV Sace – located at Broken Hill, which has a high incidence of faults, 900km from nearest depot. Marginal fault rating and require major overhaul after each five operations.
- 33kV Westinghouse GC – uneconomic due the high level of maintenance. Problems with burning out of closing coils, failure to latch closed, bushings that require regular overhaul.
- ABB 132kV HLD – problems with this breaker, commissioned in 1968, include failure to operate correctly during switching operations, pole timing difficulties, incorrect damper operation, failure to fully open, moisture ingress and oil leaks.
- AEI 33kV Bulk Oil – these are also a high maintenance breakers that experience failure of the latching mechanism, are unreliable under fault conditions and prone to bushing failure. They are over 33 years old and no spares are available.
- AEI GA 11 W8 Circuit Breakers – these 330kV breakers are air blast and were installed from 1959. They are complex and time consuming to maintain as there are 8 interrupters per phase. The porcelain stacks are failing and there are no spares available. In addition the aging air system needs constant attention to maintain functionality.

- ASEA 132kV and 66kV HKEY Circuit Breakers – these 132kV breakers have been in service for over thirty two years and have problems with latching failures, moisture ingress and pole timing discrimination. No spares are available from the manufacturer.

- Brown Boveri 66kV ELF Circuit Breakers – these circuit breakers have not been in service very long but are requiring high levels of maintenance. Although spares are available they are expensive. Failures include the control mechanism, HV contacts, compressor and Lucifer valves, high probability of failure on closing.

- BTH 66kV Circuit Breakers – these bulk oil breakers have been in service for over 50 years and no spares are available. Faults include burnt out closing coils and operating mechanism faults. Maintenance requirements are high and time consuming.

- DELLE 66kV Circuit Breakers – these circuit breakers have been in service for approximately 40 years and common faults are control mechanism latching failures. Moisture ingress and corrosion on external linkages. Spare parts are unavailable and it is extremely difficult to repair the latching mechanism. There are approximately 74 breakers in service and TransGrid propose to replace them all over a 15 year period in order of priority.

- Oerlikon FS13C3.1 and FR – these 132kV minimum oil circuit breakers have continual problems with the hydraulic operating system, resulting in many forced outages. They have only been in service for 22 years and spares are difficult to obtain.

- POW Circuit Breakers – the point of wave circuit breakers are particularly suitable for switching capacitor banks and hence have been selected to replace circuit breakers on capacitor banks at Sydney East and Sydney South substations. The problems currently being experienced are surge issues when the banks are first energized and restrike problems when the breakers are opened. The breakers being replaced will be assessed for reuse within the network.

- Reyrolle 132kV OS Circuit Breakers – these Reyrolle circuit breakers have been in service for over 37 years and are air operated. Spare parts are no longer available from the manufacturer and seals present a major problem. Faults include low Insulation Resistance, compressor failures and operating mechanism faults.

In reviewing these circuit breaker replacement strategies PB Associates are not able to find any reason to reject or defer any of the proposed projects. The circuit breakers' age, their condition, fault history and maintainability indicate that replacement is the most economic option. Accordingly, PB Associates recommends that all the projects be included in the current circuit breaker replacement program.

However in reviewing a sample estimate used by TransGrid to determine the replacement costs, PB Associates has formed the view that as there are a large number of breakers in the replacement program hence there are opportunities for efficiencies of scale. In particular, in relation to the preliminary investigation and design areas, PB Associates has formed the view that bundling similar projects should result in at least a 20% saving in the time TransGrid have allocated for these functions, based on market information. This saving is equivalent to an average of 3.07% reduction in the total estimate for the two typical project estimates provided. Hence PB Associates has applied a 3.07% efficiency factor to the entire circuit breaker replacement estimate of $11,718,247. PB Associates believes that the time allocated by TransGrid for these aspects of the work more accurately reflect an estimate for a one off project, and there are efficiencies to be gained in bundling like projects to provide continuity of similar work either in house or externally.

Condition Monitoring

TransGrid have established a Condition Monitoring Working Group to develop a strategy and ongoing approach to online condition monitoring. The deployment and interpretation of online condition monitors is an emerging issue and TransGrid intend to commence pilot trials for critical power transformers, tapchangers with a history of faults, bushings and CTs. The trial proposed by TransGrid is well researched and developed, designed to trial a number of different instruments and to develop an understanding of the correlation between the results obtained and the actual condition/fault in the equipment being monitored.

PB Associates has reviewed the report produced by the working group and also Strategy S6.14 and recommends that the estimated expenditure for this project be included in the current capital works program.

DC Systems

TransGrid substations have two DC systems, a 50V and a 110V, and each system has full redundancy. The DC battery systems are a very important and integral part of every substation. They provide the power to operate protection and control systems, in most instances closing and trip coils of circuit breakers, provide supply to communication and SCADA systems and provide emergency backup lighting.

Batteries have a finite life and there are well developed testing techniques to ascertain condition and capacity. Lead acid batteries have a life of between 10 -15 years and NiCad cells 20 years. NiCad batteries also have much less demanding housing requirements due to being sealed.

Battery charges have also developed over time from the very basic rectified DC supply to the current self diagnostic remotely monitored units currently being installed.

PB Associates has reviewed the battery and battery charger replacement strategies including the detailed business case developed for the Substation Battery Replacement Program and the formed the view that all the 102 projects should be included in the current capital works program.

Disconnector/ESW

PB Associates has reviewed the Asset Maintenance Strategy S5.3.6 and also the specific information provided for each of the three types of disconnector included in the replacement program. A brief discussion of the faults currently being experienced for each type of disconnector and the recommended replacement strategy follows:

- 330kV ALM THDB 1273 Disconnector – in service for over 25 years, the operating system binds and contacts fail to make properly. Spares are difficult to source.

- 330kV Stanger Disconnector – commissioned in 1968 – central pivoting assembly forms part of the HV path. Corrosion of stainless steel bolts in aluminium threads makes maintenance extremely difficult and the contact design is flawed and unreliable. Spares unavailable existing units cannot be repaired.

- Switchgear 330kV Disconnectors Vales Point – commissioned 1975, these disconnectors are of the centre break type and suffer from seizing of the pivoting assemblies due to ingress of moisture and lack of lubrication points[16].

[16] PB Associates notes TransGrid's comments that spares are no longer available but that the units can be refurbished for reuse.

PB Associates has formed the view that the ALM and Stanger disconnectors should be replaced as proposed by TransGrid. In regard to the disconnectors at Vales Point, PB Associates suggest that only one unit be replaced in the first instance and that original unit be refurbished and used to replace the second unit, and that this process be repeated until all the remaining units in service have been refurbished, and the last unit retained as a spare. This process will reduce costs and in particular civil works. As replacement will be like for like (except for the first unit) PB Associates estimates that this should reduce the need to purchase six new disconnectors and estimates that the TransGrid estimate for the work at Vales Point could be reduced by $240,000.

Fire

TransGrid have included 44 individual projects relating to fire protection at their substation. The projects range from the replacement of fire suppression sprinkler systems, replacement of corroded fire hydrants, and installation of Vesda fire protection to the coating of control cables with fire retardants. TransGrid have advised that all the work is in accordance with their Fire Protection Policies and Procedures Manual which was developed in consultation with the NSW Fire Service. PB Associates has reviewed the Fire Protection Manual and hence recommends that all the fire related projects in the submission be included in the current capital works program.

When required, TransGrid is replacing the current deluge fire suppression systems with uncharged misting systems. These newer systems avoid water damage if accidentally triggered as they only charge when a fire is detected.

GIS

This project relates to the procurement of additional spares for the 132kV GIS switchgear at Beaconsfield West substation. TransGrid engaged ABB to carry out an inspection of the switchgear and recommend additional spares required to maintain the switchgear until 2006. There are only four other examples of this switchgear in the world. The estimate relates to the purchase of the spares to extend the operating life of the switchgear and hence PB Associates recommends that the project be included in the current capital works program.

Instrument

This group of projects relates to the replacement of instrument transformers including current transformers (CT), capacitor-coupled voltage transformers (CVT) and magnetic voltage transformers (MVT). Very little maintenance can be carried out on instrument transformers but their condition should be monitored due to the potential for explosive failure.

Dissolved Gas Analysis (DGA) has proven to be a reasonable indication of the condition of oil filled instrument transformers – particularly CTs. TransGrid have introduced a strategy to replace all older CTs, where the oil cannot be sampled, by 2008.

With the exception of specific Tyree current transformers the primary reason individual instrument transformers have been scheduled for replacement by TransGrid is high DGA readings indicating possible explosive failure. Tyree current transformers supplied on contracts 2909, 2794 and 3113 have been separately assessed in terms of risk, history and current condition. These CTs or similar ones have a history of explosive failure and hence they are either condition monitored online or progressively replaced.

In total there are 183 instrument transformers scheduled for replacement by TransGrid. and 124 have been included because of high DGA readings. A further 45 are Tyree current transformers supplied under contracts 2909, 2794 and 3113. The remaining instrument transformers include non standard CTs and those that cannot be sampled.

TransGrid have also included a probability based provision for replacement of additional instrument transformers over the five year control period using the methodology identified in the 30 year Network Plan. The provisions are as follows:

- High DGA ITs – 132kV $2,470,000
- High DGA ITs – 220kV and above $1,900,000
- High DGA CTs – 66kV and below $345,000

PB Associates has not reviewed each individual project due to the high number involved, but has reviewed Strategy S5.4.3 including the attached specific strategies up to and including S5.3.4.11. PB associates did not identify any specific projects that should be excluded and hence recommends that they all be included in the current capital works program.

However, in reviewing a sample estimate used by TransGrid to determine the replacement costs, PB Associates has formed the view that as there are a large number of instrument transformers in the replacement program there are opportunities for efficiencies of scale, particularly in the project management and design areas. PB Associates has formed the view that bundling similar projects should result in at least a 20% saving in the time TransGrid have allocated for these functions to each of the individual projects. This saving is equivalent to a 3% reduction in the average total estimate for 330, 132, and 66kV CT project estimates provided.

As a consequence, PB Associates has applied an average 3% efficiency factor to the entire instrument transformer replacement estimate of $25,895,475. PB Associates believes that the time allocated by TransGrid for these aspects of the work more accurately reflect an estimate for a one off project, and there are efficiencies to be gained in bundling like projects to provide continuity of similar work either in house or externally.

Other Equipment

This project relates to the provision of alternate supply to Avon substation and is described in Asset Management Strategy 5.3.4.12. The existing 415V supply to Avon substation is via a 33kV BHP feeder and a 100KVA transformer. This feeder will be decommissioned in 2005 by BHP and TransGrid propose to install a MVT to provide a station auxiliary supply.

PB Associates recommends that this project be included in the current capital works program.

Property

The two projects in this section involve relatively minor civil works at the Liddell and Nambucca Substations. At Liddell substation TransGrid have allowed an estimate of $100,000 to install secondary oil containment. At Nambucca substation TransGrid have allowed an estimate of $150,000 to construct a retaining bank to control soil erosion.

PB Associates has reviewed both of these projects and recommends that they be included in the current capital works program.

Reactive Plant

There are six individual projects in the category. The first four relate to the replacement of capacitors at the Coffs Harbour, Newcastle and Taree substations. The Coffs Harbour 66kV capacitor bank was manufactured in 1979 has external fuses and limited spare cans available. The 132kV capacitor bank at Taree has a history of fuse operation. Both capacitor banks are integral to the maintenance of voltage support to the North Coast and due their reliability history are recommended for replacement.

The No.1 and No.2 132kV capacitor banks at Newcastle have a history of can failure. Seven cans on the No.1 bank and six cans on the No.2 bank in the last 9 years. Both banks also have a history of hot joints and hot conductor sections which require constant monitoring. Due to the integral part these banks play in maintaining voltage support and security to the 132kV system in Newcastle, their replacement is recommended.

The last two projects included in the Reactive Plant section relate to the purchasing of additional spares and control cards for the static VAr compensators at Broken Hill substation as these particular units will no longer be supported by their manufacturer. The projects also include the replacement of water cooling pipes that have become brittle due to exposure to UV light. The units were commissioned in 1986 and as these measures will substantially extend their service lives PB Associates recommends that they be included in the current capital works program.

Servers

This section relates to the purchase of servers for the online condition monitoring trial program. The servers will be installed at the various substations where the condition monitoring equipment will be installed on the critical equipment identified for inclusion in the trial and will collate the data for the various monitoring devices and channel the data to the central processing unit.

PB Associates supports the online conditioning monitoring trial due to its likely impact on extending the service life of TransGrid's electrical assets and therefore recommends that the estimate for the provision of the necessary servers be included in the current capital works program.

Substations

This project relates to the demolition of outbuildings at the Dapto substation. These buildings were previously used to house a system control centre and the rationalisation of control centres in combination with the reduction in staffing are no longer required. Their demolition would reduce ongoing maintenances costs

PB Associates recommends that this project be included in the current capital works program.

Transformers

This category consists primarily of four sections. The first relates to the purchase of additional spare transformers that TransGrid project will have to be procured during the regulatory period to replace power transformers that fail in service. TransGrid have allowed a total of $9,000,000 for these replacements. TransGrid have developed a business case for the Provision of Spare Transformers and this document contains a probabilistic determination of spare transformers requirements based on historical failure rates. This exercise produced a recommended spares listing which over the 5 year control period and TransGrid included an estimate of $9,000,000 in their application for this purpose.

The second section relates to the reconditioning of 8 power transformers as follows:

- 330kV SE1 No.1 transformer $400,000
- 330kV SE1 No.2 transformer $400,000
- 330kV SE1 No.3 transformer $400,000
- No.2 transformer SYN $190.000
- No.3 transformer SYN $190,000

- TA1 No.1 transformer $700,000
- No.2 transformer WW1 $190,000
- No10 transformer WW2 $190,000

TransGrid have allowed a total of $2,660,000 for life extension projects for the 8 transformers.

The third section relates to three projects at Newcastle substation including the installation of two oil spill tanks and the construction of a long recall spare transformer bay. This will provide the capability to use the spare transformer stored at Newcastle substation as a long recall spare. The need for this capability was highlighted with the recent transformer failure at Newcastle substation in June this year.

The forth section relates to two projects at Taree substation, the replacements of No.1 and No.2 transformers. The No.2 transformer has been replaced and the estimate includes the last of the commissioning works currently being undertaken. Work has not commenced on the No.1 transformer replacement and hence the larger estimate.

PB Associates has reviewed the information provided and recommends that the work be included in the current capital works program.

5.2.2 Mains Projects

Cables. This project relates to the temperature monitoring of Cable 41 and the development of real time rating of the cable. The increased loading on cable 41, particularly during summer days has resulted in the presently applied cyclic rating being reached on a number of occasions. Also, contingency constraints are resulting in the ability to schedule outages on other critical items of plant in the Sydney area becoming very limited.

TransGrid have identified that the capacity of the cable can be safely increased under a number of operating conditions. However there is a need to avoid hot spots on the cable particularly in deeply buried sections that could prematurely degrade the paper insulation resulting in a shortened service life.

The real time cable rating system measures cable sheath and soil temperatures at a number of critical locations and computes the normal and emergency rating of the cable in real time.

This project has a two fold advantage as it can potentially extend the cable service life and also allow TransGrid to safely operate the cable up to its full capacity. PB Associates therefore recommends that the project be included in the current capital works program.

Fault Locator. TransGrid have been involved in a research project where travelling wave fault locators are utilised to locate faults on the main system. The results of the project are extremely encouraging and the installation of these 5 fault locators will enable TransGrid to pinpoint faults on their entire main system with a high degree of accuracy. This facilitates reduced restoration times as field crews can be directed quickly to the fault location.

PB Associates has discussed this project with TransGrid and is of the opinion that it will reduce both restoration times and operating costs over time and hence recommends that it be included in the current capital works program.

Grillage Foundations. This project involves the installation of sacrificial magnesium anodes to three steel towered lines in the Snowy Mountains, lines 64, 65 and 66. TransGrid have been using this form of protection rather that the much more expensive treatment of excavating the grillage footing and encasing it in concrete. The condition of

the galvanizing on the grillage footing can be determined by the use of copper –copper sulphate half cell test and where appropriate the sacrificial magnesium anode can be thermally welded to the tower leg.

This procedure substantially extends the tower service life at relatively low cost and hence PB Associates recommends that the projects be included in the current capital works program.

Insulators. This category relates to the replacement of corroded or faulty discs on 7 feeders. Corrosion of the disc pins, particularly in coastal areas, is an ongoing issue and it is extremely difficult to inspect pins without removing the disc from the insulator string. Accordingly, it is normal practice to routinely monitor the condition of discs by removing and testing representative samples. This procedure has highlighted the need to commence a disc replacement program ion certain feeders.

In addition, the quality control on discs from some Chinese manufacturers was lacking and TransGrid have instigated a program of monitoring the performance of all discs of Chinese origin..

These projects relate to the replacement of disc insulators on lines 964, 96P, 973, 991, 14, 27 and 81 with polymeric long rod insulators and PB Associates recommends that they be included in the current capital works program.

Laser profiling. This project relates to a trial of laser profiling which can be used to determine conductor and vegetation height and ground features accurately, to a fraction of a meter, from an aircraft flying at moderate heights. TransGrid report that initial trials have been promising and that they wish to continue the trials to determine the relevance of the technology to their application.

PB Associates believes this to be of a more operational nature as it relates primarily to maintenance functions and there recommends that it not be included in the capital budget.

Marker balls. This project relates to the installation of marker balls in accordance with the appropriate Australian Standard[17]. The standard requires all transmission line spans of greater that 90m in height to be fitted with marker balls.

TransGrid have identified 31 lines where there are spans in excess of this height and have decided to comply with the Australian Standard and fit the required marker balls. This will minimize the risk associated with aircraft colliding with the conductors and the resultant damage to both the aircraft and the line.

PB Associates believes that this project is a compliance and safety issue and therefore recommends that it be included in the current capital works program.

Restoration Systems. Transmission lines are subject to storms and other events, such as vehicle collision, which can result in a structure failure at the rate of approximately one every 2.5 years. There are also other issues now impacting on transmission line operators that require faster restoration time than previously considered acceptable. For example the greater reliance on dual circuit lines as it becomes more difficult to obtain transmission line routes and the impact on the NEM. Terrain and access issues can also have a large impact on restoration times.

To address these issues TransGrid have decided to purchase emergency temporary guyed structures, one suitable for a pole line and the other for a steel tower line.

TransGrid have included $1,150,000 for these structures and PB Associates recommends that their purchase be included in the current capital works program.

17 AS 3891.1 – 1991 “Air navigation –Cables and their supporting structures – Mapping and marking”.

Wood Poles. This category relates to the accelerated replacement of poles in transmission lines where the risk of failure is impractical to monitor and control in accordance with industry practice based on regular pole inspection and replacement of defect poles. PB Associates acknowledges that where steel sleeves have been used to construct composite pole structures it is extremely difficult to monitor wood decay within the sleeve. Structural failures occur randomly and the issues associated with staff climbing composite structures are also acknowledged. PB Associates notes that another failure occurred on line 966 during the review process. Accordingly PB Associates recommends that lines 945, 94T, 967, 994, and 996 be included in the capital works program.

PB Associates is also aware that ground line maintenance and inspection techniques are well developed and cannot, therefore, support the accelerated replacement of poles where the primary source of failure can be inspected, and either treated or scheduled for replacement – as required. However PB Associates acknowledges that due to local conditions the defect rate can increase to a rate such that it is impractical to implement an inspection cycle that is frequent enough to ensure that defect poles are detected and replaced while providing an acceptable risk of pole failure. Accordingly PB Associates recommends that 96M be included in the capital works program on this basis.

PB Associates also acknowledges TransGrid's view that where the general population age has increased to a stage where replacement rates will become impractical to manage on a defect basis ("bow wave effect") that accelerated replacement programmes becomes an appropriate management response. However, in the case of line 94B, PB Associates recommends that the lines continue to be inspected as required and pole replacements are carried within the operational expenditure budget, and that it continues to be monitored and appropriate action taken as future assessments warrant.

5.2.3 Protection and Metering Projects

Metering. This project relates to upgrading of older metering equipment at 8 locations, from Class 1.0 to Class 0.5 in order to comply with the current NEM Metrology requirements.

These projects are primarily proposed for compliance and PB Associates recommends that this expenditure be included in the current capital works Budget.

Differential Metering. The D21se, D22se and D202 differential relays used to protect transformers have a known history of mal function on inrush current. This makes it extremely difficult to discern between a genuine fault and a false trip. This type of relay has been in service for 36 years.

TransGrid propose to replace both of the duplicated differential protection systems with modern relays sourced from different manufacturers.

PB Associates acknowledges the issues associated with restoring supply under false trip circumstances and therefore recommends that the proposed differential relay replacements be included in the current capital works program.

Distance Relays. This project involves the replacement of Reyrolle Selecta Mho, Reyrolle TH1A, Reyrolle THR and YTG distance relays. The Selecta Mho relays have been in service over 40 years, the TH1A for 38 years, the THR for over 25 years and the YTG for up to 34 years.

The Selecta Mho suffer from the element sticking due to electrolytic growth on the coil former, and the THR from slow fault clearing times as well as a lack of remote communication and condition monitoring facilities. The THR relays have been found to mal-operate under through fault conditions in certain circumstances and the YTG's phase potentiometers develop open circuit faults or stick resulting in changes to the relay's zones of protection.

PB Associates has reviewed all the information provided for this category of relay replacement and recommends that the projects be included in the current capital works program.

Fault Recorders. These projects relate to the replacement of the Sorrel fault recorders that were part of the asset transfer from SMEC. They can no longer be maintained due to lack of spares and manufacturer support. It is planned to replace them with modern units that have a high internal memory capacity, LAN connectivity and GPS time synchronisation. TransGrid also propose to replace one CSD fault recorder at Newcastle to avoid the need to rely on dial up modem data transfer as the modern units have LAN capability.

PB Associates ahs reviewed the information provided in support of these proposals and recommends that they be included in the current capital works program.

5.2.4 Communication Projects

Alarm Systems. TransGrid has established a replacement program for alarms installed during the 1970s which are no longer maintainable due to lack of spares and manufacturer support. These programs have spanned a 5 year timeframe ending in 2005/06 and this proposed expenditure represents the final stages of the replacement program. Due to the importance of the alarm and back up alarm systems PB Associates recommends that the proposed expenditure be included in the current capital works program.

Carrier Systems. TransGrid had a well developed PLC system which was progressively installed from 1974 until 1987 with 188 systems installed. The system used Fujitsu equipment which is no longer supported. Spares have been almost totally exhausted.

TransGrid are looking to replace the Fujitsu PLC system with a Dimat PLC system.

PB Associates acknowledges the issues associated with the Fujitsu PLC systems and therefore recommends that the projects be included in the current capital works program.

Microwave. This category relates to a number of individual projects ranging from the retirement of superseded links due to the roll out of OPGW and the installation of small capacity 900MHz radio to the replacement of unsupported microwave links where spares are no longer available with new Alcatel equipment.

PB Associates has reviewed the information provided, in particular strategy 6.3.7 relating to these projects, and recommends that the expenditure be included in the current capital works program.

Power Supplies. This project relates to the replacement of 50V and 12V DC battery and charger systems. TransGrid have decided to standardise on low maintenance sealed NiCad battery banks and battery chargers are replaced to match the replaced battery banks.

PB Associates recommends that this project be included in the current capital works program as it relates to the replacement of failed battery banks and their associated chargers.

Protection Inter-trips. This category covers two projects. The first is the replacement of VF Intertrip Systems. These systems were manufactured by Fujitsu in 1970 and hence are more than 30 years old. They have not been supported by the manufacturer since the early 1990s and system spares have been depleted. In addition, the rack wiring has deteriorated and when disturbed during card replacement further faults are experienced. The preferred option is to replace the aging Fujitsu units with systems manufactured by Dewar.

The second project relates to the replacement of Fujitsu PLC Intertrip equipment supplied between 1968 and 1985. This equipment has not been supported by the manufacturer since the early 1990s and spare parts are becoming depleted. The monitoring functions of the equipment is failing and causing high maintenance costs. The preferred option is to replace this equipment with the Dewar VF intertrip equipment.

PB Associates has reviewed both of the business cases developed for these projects and recommends that they be included in the current capital works program.

Radio Network. This project relates to the replacement of all VHF Philips radio equipment in the TransGrid network. The Philips radio equipment is experiencing unreliable service with an increase in failure rates, the equipment has been in service for 20 years and spare parts are in short supply for both links and repeaters.

The preferred option is to progressively replace the Philips links and repeaters over a four year period as other options involving maintaining the existing radios in service are costly.

PB Associates recommends that this project be included in the current capital works program.

Substation Automation Systems. This project relates to the retirement of the Toshiba RTUs and replacement with the new type SCADA RTU equipment. The primary drivers of this project are the increased faults due to failure of the RAM boards, spare parts are no longer available and the 4K RAM memory chips are no longer manufactured.

These Toshiba RTUs use outdated technology that is no longer supported and additional services cannot be provided without changing out the RTUs. The Toshiba units were installed in the 1970s and the manufacturer has ceased support. The RTUs form an integrated network with the master station, but as the master station was replaced in 2002 the new SCADA RTUs can now be installed.

PB Associates has reviewed the information provided and discussed the issues with the Manager responsible for the project and recommends that the work be included in the current capital works program.

Telephony. This category consists of two projects. The first relates to the retirement of Ericsson telephone exchange equipment with equipment yet to be determined. TransGrid rely on manufacturer support due to the complex nature of the telephone network and Ericsson has advised that they will cease support in 2009/10. This project includes an estimate of $40,000 to review options with a view to determine an appropriate action.

PB Associates recommends that this project be included in the current capital works program as TransGrid will be forced to decide on an appropriate course of action when Ericsson ceases maintaining the current exchange equipment.

The second project relates to the installation of telephone isolation equipment on Telstra lines entering high voltage substations. This is a compliance issue as the installations have to comply with the National Electricity Code. The equipment has to be installed at 34 sites with metering installations by 2005. The estimated cost for this project is $200,519.

As this second project is essentially a compliance issue PB Associates recommends that the project be included in the current capital works program.

5.2.5 Security Projects

The recent emphasis by both Federal and State Governments on the protection of critical infrastructure has resulted in the development of “National Guidelines for Prevention of Unauthorised Access to Electricity Network”.

TransGrid have developed an internal document titled Network Security Standard and have assessed the risk for all their sites in accordance with this document and have risk ranked all the sites into separate bands of risk criticality. For substations and communications sites they have developed specific security treatments and these are applied as appropriate to each of these sites depending on the risk rating.

PB Associates has been specifically instructed to treat all security information as mandated in the Commonwealth Protective Security Manual (2000) and therefore has not detailed individual projects in this Report. However discussions with TransGrid's Network Security Manager have confirmed that all the projects included in the capital works program for the current regulatory period are in accordance with the National Guidelines, The majority of the estimated expenditure is based on supplier costs obtained via a competitive tendering process.

Accordingly PB Associates recommends that the total estimated expenditure for security projects be included in the current capital works program.

5.3 COMMITTED ASSET REPLACEMENT PROJECTS

Yass Substation. This project involves the complete reconstruction of the Yass substation. The need for the reconstruction was established during the last regulatory period but approximately half of the expenditure will be incurred during this regulatory period. The project was expected to be completed in the last quarter of 2004 but constraints on the 330kV network has resulted in outage being deferred and TransGrid do not expect the project to be completed until mid 2006. Although the estimated completion date is now mid 2006 TransGrid have advised that they do not expect the cost for the project to vary from the original estimate.

PB Associates was involved in the evaluation of the original proposal and acknowledges that the need for the project was clearly demonstrated. Accordingly PB Associates recommends that the project completion expenditures be included in the current capital works program.

QNI Completion. This project relates to the completion of clearing works for the QNI easement. The original clearing works involved the felled timber being stacked in windrows for onsite burning but subsequent fire bans prevented the windrows from being burnt. Agreement was reached with the property owners to chip the timber but, because it had dried out, a large chipper had to be sourced to carry out the chipping operation.

The work was completed by 31 October 2004 and the expenditure during the current regulatory period was $1,000,000.

PB Associates acknowledges that the work had to be completed and therefore recommends that the expenditure be included in the current regulatory period.

Sydney West SVC. This project was commissioned during September 2004. The allowance in the current regulatory period relates to an outstanding contractor payment and TransGrid staff commissioning costs. The need for this project was evaluated during the last regulatory period and the majority of the construction also took place during the last control period.

PB Associates therefore recommends that the expenditure incurred during the current period be included in the capital works program for the current regulatory period.

5.4 MAJOR AND COMBINED PROJECTS

5.4.1 Transformer Replacements

5.4.1.1 Reactors

Cable 41 Shunt Reactor Replacement. The cable 41 shunt reactor was manufactured by Parsons in 1978 and usually operates at full load which exposes it to high temperatures. The insulating oil is showing extremely high levels of Furans, as high as 2.5ppm, which is of major concern to TransGrid as 0.5ppm is the trigger level for investigation. This high level of Furans indicates that the paper insulation is in poor condition.

This condition is related to continual operation at high temperatures and the fact that the sound insulation material has rusted and is adding to the problem of overheating. A failure due to condition is possible and hence TransGrid have included the replacement of the reactor in their proposed expenditure. Their estimated cost of the project is $2,188,508.

PB Associates has reviewed the condition report on the reactor and recommends that the reactor on cable 41 be replaced during the current regulatory period.

No. 1 Reactor Tamworth Replacement. The ASEA 330kV reactor was constructed in 1970 but was returned to the manufacturer in 1972 due to excessive noise levels. It was recommissioned in 1973. It is a three phase shunt reactor unit with radiators. Oil sampling shows that the Furan level is extremely high at 2.35 ppm indicating that the paper insulation is at end of its serviceable life and that it has a reduced capability to handle electrical and mechanical stresses.

Recent electrical test results indicate moisture contamination and possible oil sludging. The oil is of poor quality, with bad values for Myers, DDF and resistivity. Furthermore, the oil DGA shows very high levels of CO and CO2, which is consistent with deteriorating cellulose.

TransGrid have included the replacement of this reactor in their expenditure application and their estimate for the project is $2,636,860. TransGrid also wish to relocate the reactor from beneath the line landing span to the 330kV busbar so that future maintenance can be programmed without the need to arrange an outage on QNI which has adverse NEM impacts.

PB Associates has reviewed the information provided and recommends that the reactor be replaced and relocated during the current regulatory period.

5.4.1.2 Transformers

Armidale No.1 Transformer Replacement. The No.1 Transformer at Armidale substation is a 30MVA 132/66/11kV Lepper transformer and was manufactured in 1969. The Myers index number indicates oil is in poor condition and the DDF and oil resistance are far from acceptable. Dissolved gasses are stable. Acetylene is high but has been at this level since 1978.

PB Associates' review of the condition report did not indicate that this transformer required immediate replacement so a request was made as to why it was included in the replacement program. TransGrid provided additional information regarding a type fault associated with these Lepper transformers which causes axial displacement of the tertiary winding. The fault does not allow monitoring with normal condition based techniques and results in sudden failure. All Lepper transformers with this type fault are being replaced.

TransGrid have commenced replacement of the transformer and included an estimate of $1,792,074 for the work. PB Associates has reviewed the additional information regarding the type fault and endorse the action taken to replace the transformer.

Armidale No.3 Transformer Replacement. The No. 3 transformer at Armidale in a 150MVA 330/132/11kV ASEA, manufactured in 1968. TransGrid have advised PB Associates that electrical tests indicate that the insulation is in poor condition with the insulation resistance results for the HV insulation of 200MOhm well below the acceptable 682MOhm limit.

The Meyers Index graph indicates that the oil quality has degraded since 1998 to the point where the results are now indicating deterioration of the insulation requires urgent attention. In addition the DDF of the oil is well over accepted limits.

TransGrid have scheduled the transformer for replacement during the regulatory period and included an estimate of $5,085,000 for the work. PB Associates has reviewed the condition report for the transformer and recommend that the transformer be replaced.

Finley No. 1 Transformer Replacement. The No.1 transformer at Finley substation is a 30MVA English Electric manufacture in 1959. The Degree of Polymerisation (DP) level of 230 indicates that the paper insulation in the transformer is reaching the end of its service life. DP levels below 275 are considered too low indicating that the paper may break at any time under any mechanical force. The Polarisation Index (PI) value of 1.19 for the HV winding places it in the "questionable condition" category.

A Furan reading of 1.11ppm indicates that the condition of the paper insulation is poor and the presence of CO and a high concentration of CO2 indicates that substantial paper degradation is present.

TransGrid have scheduled the transformer for replacement during the regulatory period and included an estimate of $990,030 for the work. PB Associates has reviewed the condition report for the transformer and recommend that the transformer be replaced.

Glen Innes No. 1 Transformer Replacement. The No.1 transformer at Glen Innes is a 30MVA ELIN transformer manufactured in 1961. The insulation resistance levels are a third of what is considered acceptable indicating the insulation is in poor condition. The DDF reading of the tertiary winding is unacceptable and the DDF reading of the primary winding is close to policy limits. Furan reading are not considered reliable due to the amount of top up oil added because of chronics oil leaks. The oil condition is poor and there is 15ppm of PCB in the oil requiring oil replacement as the only option to improve oil quality.

Methane and carbon monoxide are above policy limits but more significant is that the levels rose markedly in the three months to March 2004.

ELIN transformers of this type have a design fault called "solid type insulation" where the insulation arrangement results in disproportionate voltage distributions across oil and paper layers. This results in the oil carbonizing and the paper deteriorating until the insulation fails. This was the failure of a similar ELIN transformer at Narrabri in 1992.

TransGrid have scheduled this transformer for replacement during the regulatory period and have included an estimate of $990,030 for the work. PB Associates has reviewed the condition report for the transformer and recommends that the transformer be replaced due to its condition and the lack of options to extend its service life.

Glen Innes No. 2 Transformer Replacement. The No.2 transformer at Glen Innes is a 30MVA ACEC transformer manufactured in 1961. The condition report indicates that the insulation resistance is good to fair, the HV windings have acceptable measured level of insulation resistance and DDF values and a fair PI value. All LV windings results were good. The Furan level indicates that there is about 60% of the insulation's life remaining, and the oil condition is good.

DGA results show all gasses within policy and stable levels. The 132kV bushings are planned to be replaced as they have a DDF above policy limits but the 66kV bushings DDF results appear acceptable.

It is noted that the impedance, tapping ranges and tapping steps are different to TransGrid current design standards but the transformers can still be operated in parallel for changeover operations.

TransGrid have scheduled this transformer for replacement during the control period and have allowed an estimate of $990,030 for the work. PB Associates does not recommend that this transformer be replaced but that the 132kV bushings be replaced as planned and that the condition of the transformer continue to be monitored.

Newcastle No.1 Transformer Replacement. The No.1 Transformer at Newcastle substation is three phase transformer, each phase of which is from a different manufacturer with differences in capacity, manufacture date and condition. The blue phase transformer in manufactured by CGEC in 1965 and out of a population of three two have explosively failed – the last on 30 June 2004.

Electrical test on the blue phase transformer insulation system show the HV insulation resistance to be below acceptable limits at approx 500MOhms. The DDF of the oil is just above acceptable limits. The main risk factor present is that the results of tests carried out on the transformer that explosively failed in June this year had better insulation readings than this transformer.

The white phase transformer is an ASEA transformer manufactured in 1970 and it is showing signs of paper insulation stress. The red phase transformer is a Mitsubishi manufactured in 1967 and the DDF of the oil is bordering on acceptable limits and the DGA results prior to the oil treatment during maintenance operation in April 2004 indicate that gasses were above limits and Roger's analysis indicated low temperature thermal overheating was occurring in the transformer.

TransGrid have scheduled this transformer for replacement during the control period and have allowed an estimate of $7,499,938 for the work. PB Associates recommends that this transformer be replaced due to risk associated with explosive failure and the obvious high levels of maintenance required to keep the transformer in service indicating that the units have reached the end of their service life.

Orange No.1 Transformer Replacement. The No.1 transformer at Orange substation is a 30MVA 132/66kV English Electric, manufactured between 1949 and 1953. Oil analysis indicates that the moisture content in the paper insulation is high. Furans levels are of concern indicating degradation of the paper insulation, this is also supported by high levels of CO and CO2. Meyers Index results indicate that the oil is also in poor condition and combustible gases indicate the presence of hot spots. There signs of oil leaks in the bund area.

Increased load at Orange substation will require higher capacity transformers to be installed at the site but due to the age and condition of the existing No.1 transformer, TransGrid are recommending that it be scrapped. TransGrid have included the asset replacement portion of the combined Orange Substation augmentation project in this category. The TransGrid estimate for the replacement of the transformer is $1,949,547.

PB Associates has reviewed the condition report for this transformer and recommend that it be scrapped and its replacement cost be included in the augmentation of the Orange substation.

Orange No.3 Transformer Replacement. The No.3 transformer at Orange substation is a 30MVA 132/66kV English Electric, manufactured during the period 1949 to 1953. The condition of this transformer mirrors the condition of the No.1 transformer which is to be expected as the transformers are identical and have experienced similar operating conditions.

Oil analysis indicates that the moisture content in the paper insulation is high. Furans levels are of concern indicating degradation of the paper insulation, this is also supported by high levels of CO and CO_2. Meyers Index results indicate that the oil is also in poor condition and combustible gases indicate the presence of hot spots. There signs of oil leaks in the bund area.

Increased load at Orange substation will require higher capacity transformers to be installed at the site but due to the age and condition of the existing No.3 transformer, TransGrid are recommending that it be scrapped. TransGrid have included the asset replacement portion of the combined Orange Substation augmentation project in this category. The TransGrid estimate for the replacement of the transformer is $1,949,547.

PB Associates has reviewed the condition report for this transformer and recommend that it be scrapped and its replacement cost be included in the augmentation of the Orange substation.

Port Macquarie No.1 Transformer Replacement. The No.1 transformer at Port Macquarie is 30MVA 132/33/11kV GECHED manufactured in 1953, it does not have an OLTC but a regulating transformer. The replacement of the Port Macquarie is a combined project with the augmentation portion detailed in PB Associates Report Section 10, Small Augmentations – Transformers. PB Associates has recommended that the transformers are not required to be up-rated until 1 April 2004 and therefore the expenditure associated with the asset replacement portion can also be delayed until that time.

The condition report for Port Macquarie No.1 transformer indicates that the DDF readings for the HV, LV and TV windings to earth are below acceptable standards, and the moisture content by dry weight of the paper insulation is 2.5% indicating that dry out action is required. The Furans level is at the "investigate" point and the high concentrations of carbon monoxide are indicative of paper stress.

In relation to the regulating transformer the Polarisation Index (PI) values indicate "questionable" condition of the insulation, CO and CO_2 gasses are above acceptable levels indicative of paper stress. There is severe rusting on the tank, radiators and conservator.

TransGrid have recommended replacement of the transformer and have allowed $1,997,990 for the project with the majority of the expenditure scheduled for expenditure in 2006. PB Associates has reviewed the information provided and based on the condition and age of the transformer recommends that the transformer be scrapped as there would be little benefit obtained from any life extension work as both transformers are at the end of there service lives. PB Associates also recommends that the asset replacement estimate should be contributed to the upgrade project which is scheduled for commissioning by 01/04/2007.

Port Macquarie No.2 Transformer Replacement. The No.2 transformer at Port Macquarie is 30MVA 132/33/11kV GECHED manufactured in 1953, the associated regulating transformer was manufactured in 1955. The replacement of the Port Macquarie is a combined project with the augmentation portion detailed in PB Associates Report Section 10, Small Augmentations – Transformers. PB Associates has recommended that the transformers are not required to be up-rated until 1 April 2007 and therefore the expenditure associated with the asset replacement portion can also be delayed until that time.

The oil analysis is similar to the No.1 transformer as expected due to the similarities between the age and service conditions experienced by both transformers. The moisture content is high and the Furan level indicate insulation paper stress. Rust is a problem on both transformers but is more serious on the regulating transformer which requires rust treatment and repainting.

TransGrid have recommended replacement of the transformer and have allowed $1,997,990 for the project with the majority of the expenditure scheduled for expenditure

in 2006. PB Associates has reviewed the information provided and based on the condition and age of the transformer recommends that the transformer be scrapped as there would be little benefit obtained from any life extension work as both transformers are at the end of there service lives. PB Associates also recommends that the asset replacement estimate should be contributed to the upgrade project which is scheduled for commissioning by 1 April 2007.

Sydney West No.1 Transformer Replacement. The No.1 transformer at Sydney West has separate tanks for each phase, the red and white phase transformers were manufactured by Tyree in 1972 and the blue phase was manufactured by Mitsubishi in 1963. The oil condition for all three transformers indicates that moisture content of the paper insulation is high. Furan levels indicate that the paper in under stress and the presence of CO and CO2 near acceptable limits confirms the degradation of paper insulation. The Meyers Index has risen above acceptable levels recently indicating that the oil is in poor condition. The presence of acetylene points to leaking diverter switches.

All tap changer operations are in excess of 400,000. There is a history of failures of similar transformers, one explosive failure of a similar Tyree and two of similar Mitsubishi transformers. There is a history of tap changer problems with out of step operations resulting in circulating current causing trips and lock outs of the protection.

TransGrid have allowed $5,832,384 for replacement of the transformer with the majority of the expenditure occurring in 2007.

PB Associates has reviewed the condition report for these transformers and recommends that due to the age and condition they be replaced.

Sydney West No.2 Transformer Replacement. The No.2 transformer at Sydney West has separate tanks for each phase, all manufactured by Mitsubishi in 1963. The DDF of the HV and TV windings is below acceptable levels for each of the three transformers. All three transformers have high moisture content in the paper insulation. Furans are at the "investigate" level and there are increasing levels of CO and CO2 in two transformers indicating that the paper insulation is under stress and starting to degrade. The Meyers Index is indicating bad oil in each transformer. The DDF on the 330 and 132kV bushings on each transformer are below acceptable levels.

All tap changer operations are in excess of 500,000 which is considered very high. There is a history of failures of similar transformers, two similar Mitsubishi transformers have explosively failed. There is a history of tap changer problems with out of step operations resulting in circulating current causing trips and lock outs of the protection.

TransGrid have allowed $5,832,384 for replacement of the transformer with the majority of the expenditure occurring in 2009.

PB Associates has reviewed the condition report for these transformers and recommends that, due to the age and condition, they be replaced.

Sydney West No.3 Transformer Replacement. The No.3 transformer at Sydney West has separate tanks for each phase, the red phase transformer was manufactured by ASEA in 1970, the white and blue phase transformers were manufactured by Mitsubishi in 1963. The red phase transformer DDF reading are acceptable and stable, the moisture content and Meyers Index indicate that oil treatment is appropriate. The Furan levels are at the investigate level but the CO and CO2 levels are below concern levels. DDF readings on the bushings are within acceptable limits. This transformer could have maintenance carried out and be suitable as a spare transformer

The white and blue phase transformers are showing high moisture content in the paper insulation, and the Meyers Index is indicating that the oil is in bad condition. The major concern for both transformers are the DGA results. There are high levels, well above acceptable limits and trending upwards, of combustible gasses such as hydrogen, methane, ethane, ethylene and acetylene, indicating the presence of electrical faults in the

transformers such as arcing and hot spots. White phase transformer is also showing signs of increasing CO which, in combination with the Furan result, indicate the paper is also under stress. Both transformers are known to have leaking diverter switches.

All tap changer operations are in excess of 500,000. There is a history of failures of similar transformers; two similar Mitsubishi transformers have explosively failed. There is a history of tap changer problems with out of step operations resulting in circulating current causing trips and lock outs of the protection.

TransGrid have allowed $5,832,384 for replacement of the transformer with the majority of the expenditure occurring in 2008.

PB Associates has reviewed the condition report for these transformers and recommends that due to the age and condition the No.3 transformer be replaced and the two Mitsubishi units be scrapped. PB Associates recommends that the ASEA unit be kept as a spare.

Sydney West No.4 Transformer Replacement. The No.4 transformer at Sydney West has separate tanks for each phase and the transformers were manufactured by Ferranti in 1967. The DDF readings for the windings are acceptable and stable for the three transformers. Moisture levels are around the 1.5% for the three transformers and in the "consider dry out" range in accordance with industry standards. Furans are at the concern level but the CO and CO_2 levels are at, or below, policy levels indicating paper insulation degradation probably consistent with the age of the transformers. The Meyers Index is indicating that the oil is in bad condition. Combustible gas levels are all acceptable. Bushing DDF tests indicate that the results are stable and acceptable.

TransGrid have allowed $5,832,384 for replacement of the transformer with the majority of the expenditure occurring in 2006.

PB Associates acknowledges that the transformers are approaching the end of their service lives but is of the opinion that there does not appear to be any indications of imminent failure, nor has TransGrid provided information relating to similar transformers explosively failing such as is the case with the Tyree and Mitsubishi transformers. Accordingly, PB Associates recommends that these transformers be scheduled for replacement in 2010 and that the ASEA transformer recovered during the replacement of Sydney West No.3 transformer be kept as a spare.

Wellington No.2 Transformer Replacement. This transformer is 330/132kV 195MVA transformer manufactured by Tyree in 1971 and is fitted with a Reinhausen tapchanger. The DDF tests results for the transformer windings are satisfactory and the Furan levels also appear satisfactory but high levels of CO and CO2 indicate that the paper insulation is degrading, probably due to overheating. The main areas of concern are the DGA results that show high concentrations, trending upwards, of hydrogen, methane, ethane, ethylene and acetylene. These DGA results indicate the presence of electrical faults in the transformer such as arcing and hot spots.

TransGrid have allowed $7,584,308 for replacement of the transformer with the majority of the expenditure occurring in 2006.

PB Associates has reviewed the information provided including the condition report for the transformer and recommends that the transformer be replaced.

5.4.2 Transmission Line Reconstruction 990 And 875

875 Tamworth – Narrabri 66kV Line. PB Associates has recommended that this line be re-constructed at 132kV as soon as practicable and hence has removed the expenditure included in this category for maintenance works on the line.[18]

[18] Refer to Small Augmentations – New Lines Section 7, Reconstruction of 875 at 132kV.

990 Wagga – Yass 132kV Transmission Line. The reconstruction of this line at 330kV has been included in the TransGrid Application under the Excluded Projects section. However the line, which was originally constructed in 1959, was uprated in the 1970s by replacing every second pole with a composite structure to increase ground clearances. There are now major maintenance issues affecting the line relating to deterioration of the composite poles, replacement of poles where they were not originally installed to the correct depth and the replacement of DIA and NGK insulators which are exhibiting poor performance due to age.

The cost to maintain the line has been estimated by the Engineering Group to be $10,086,672 and the estimate to rebuild the line at 330kV including easement costs is approximately $62m. Hence, unless the line is required to be operated within the next two years at 330kV the most economical way forward is to schedule the required maintenance and uprate the line as and when required. As there is presently no information to support uprating the line in the short to medium term PB Associates recommends that the maintenance works be scheduled on a priority basis and the expenditure be included in the current regulatory program.

5.4.3 Control Room Replacement Taree Substation

The Taree substation was originally commissioned in 1958 and the secondary equipment is approaching the end of its service life. The control room comprises two tunnel boards fitted with 62 protection, metering, control and 110VDC distribution panels. Both tunnel boards are fully populated with no spare capacity to support augmentation or usual panel equipment upgrade programs which use spare panels. There has been significant renewing of substation HV equipment at Taree over the last 14 years to preclude the option of rebuilding the entire substation.

Furthermore modern secondary systems equipment has more stringent environmental requirements than previous systems. UV protected, dust controlled air conditioned facilities are now strongly recommended to ensure a long and reliable service life of microprocessor based secondary systems.

Generally the protection equipment comprises older style electromechanical or transistor based relays that have been identified as having a variety of faults indicating that the equipment is at the end of its service life and requiring replacement. For example, the transformer protection can trip on inrush, line protection does not provide for fast clearance on earth faults, and bus bar protection can fail non auto (fails and lockout). The metering equipment is old with the exception of the 132kV meters.

TransGrid have investigated a number of possible options relating to the replacement of the secondary equipment and the most likely outcome is to replace the control room with a prefabricated building, pre fitted with modern protection, metering and control equipment. In conjunction with this option it is proposed to install new CT, VT and Bus Bar protection switchyard marshalling kiosks to allow parallel services to be commissioned to minimize HV equipment outages.

In addition, TransGrid plan to run new secondary cables from the new control room to the new switchyard marshalling kiosks leaving the existing services undisturbed until the new services are ready to be commissioned.

Should this replacement strategy prove effective TransGrid may employ similar strategies at Sydney South and Sydney North substations that also have replacement challenges.

PB Associates has reviewed the information provided on this project including the estimate calculated by the Engineering Group. PB Associates recommends that the project be included in the current capital works program but notes that the estimate prepared by Engineering incorporates a 30% scoping factor and not the 10% which might usually be associated with this type of project. Therefore TransGrid's estimate for this project, adjusting for the scoping factor change, is $6,850,000.

5.4.4 Protection System Upgrades

This category include 113 individual projects to replace older style protection relays that have reached the end of their service life and are currently experiencing faults that impact on system availability. Furthermore, new spares are no longer available and only spare parts cannibalised from replaced relays are available.

Individual business cases have been produced by TransGrid for the replacement of these H type, SMHO type, TH1A type, THS type, TS Type and YTG type relays. These replacement strategies and business cases have been reviewed in relation to the Taree substation project, Queanbeyan substation and protection and metering projects sections of this report.

PB Associates recommends that these individual projects be included in the current capital works program. However PB Associates has noted that the estimate for a typical relay replacement program is $46,300 whereas $50,000 has been estimated for the majority of the projects in the application. These costs are 7.4% lower than those included in the application.

Also, in reviewing a sample estimate used by TransGrid to determine the replacement costs, PB Associates has formed the view that as there are a large number of projects in the replacement program hence there are opportunities for efficiencies of scale, particularly in the protection, panel design and WAE areas. PB Associates has formed the view that bundling similar projects should result in at least a 20% saving in the time TransGrid have allocated for these functions to each of the individual projects. This saving is equivalent to an average of 7.8% reduction in the total estimate for the typical project estimate provided. Hence PB Associates has applied a 15% efficiency factor to the entire protection system upgrade program estimate of $5,850,000 which is $877,500. PB Associates believes that the time allocated by TransGrid for these aspects of the work more accurately reflect an estimate for a one off project, and there are efficiencies to be had in bundling like projects to provide continuity of similar work either in house or externally.

5.4.5 Tunnel Board Replacement Canberra 330kv Substation

This project involves the replacement of a substantial number of H2 and TH1A relays at the Canberra substation. The project has been separately identified because of the large number of relays that require replacement and the fact that there is sufficient space in the existing control room to fit an additional new tunnel board. It is proposed to carry out a complete relay replacement by installing a new tunnel board and transferring protection cables across to the new board. This procedure is expected to reduce design, manufacture, install and commissioning times and costs and also substantially reduce the possibility of inadvertently tripping as a result of staff working behind live in-service panels.

Individual business cases have been developed for replacement of H2 and TH1A relays as a matter of priority on the network. Both of these relays have been in service for approximately 40 years and each are experiencing a significant number of problems with high failure rates. There are no new spare parts available only those recovered from replaced relays.

TransGrid have included an estimate of $1,400,000 for this project and PB Associates recommends that the project be included in the current capital works program.

5.4.6 Substation Replacement Queanbeyan Substation

The Queanbeyan 132/66kV substation was built in 1957 and has four 30 MVA 132/66kV transformers. As most of the electrical equipment at the substation was due for replacement under the relevant asset replacement strategies various replacement options were considered. These options included continue replacing the equipment under asset

management strategies, rebuild the substation on a new site and rebuild the substation on the existing site.

The option of continuing with the existing replacement program would have required a large internal resource commitment which was not available. It would be a difficult strategy to implement with contractors due to the risks associated with working in a live environment, and it did not address the bus bar or increased transformer rating issues. The option of rebuilding on an adjacent site was ruled out by TransGrid due to the unavailability of suitable sites in the near vicinity and the costs or rerouting feeders if the site was relocated any distance from the current site. Therefore the option selected was to rebuild on the current site.

This third option is TransGrid's preferred option and involves rebuilding the substation with two 120 MVA 132/66kV transformers. The new design will address the environmental, Operational, Health and Safety and security issues as well as the bus bar ratings.

The project was conceived primarily due to the following equipment issues:

- No. 1 and 3 transformers have poor oil results, increased partial discharge in solid insulation, oil leaks and are not designed for lightning impulse.
- The No. 2 transformer was built in 1966 and has a major problem with the tap changer.
- The No. 4 transformer is a Lepper with poor oil and moisture results.
- The 132kV switchgear is original with the CBs and CTs scheduled for replacement. The VTs have significant oil leaks. The disconnectors and steel water piper bus bar ratings are not suitable for transformer upgrades.
- The 66kV Transformers and CTs are scheduled for replacement. No. 2 and No.3 VT are scheduled PCB for replacements. Disconnectors and steel water pipe bus bar ratings are not suitable for transformer upgrade. Capacitor bank is obsolete.
- The protection and metering systems are mostly original and the majority of the equipment is scheduled for replacement.
- Chain wire security fence is regularly breached and should be replaced with a higher security fence.
- Oil containment does not meet current standards. Primary bund is brick with no flame trap. Splash angles do not meet current standards.

TransGrid have included an estimate of $13,774,443 to rebuild the substation on the current site and PB Associates recommends that the project be included in the current capital works program.

5.5 REGIONAL DEPOT PROJECTS

Metropolitan Regional Centre. TransGrid's main depot facility in Sydney is located at Wallgrove. The CEO had intended reducing the number of head office staff located in the Sydney CBD and relocating them to new facilities at the Wallgrove site. To this end an allowance of $20,000,000 had been included in the application for the provision of a new building at the Wallgrove site. PB Associates was advised during discussions regarding the business case for this expenditure that the project would be withdrawn from the application.

The Wallgrove facility was constructed in the mid 1960s and is currently undergoing a comprehensive staged redevelopment and upgrade in order to provide facilities better

suited to current organization needs, modernise staff facilities, and provide additional security to system control and IT functions that are now located on the site.

TransGrid have engaged an architect to assess the most appropriate options for continuing the redevelopment and to produce an assessment of future needs through to 2009 including expenditure estimates.

PB Associates has reviewed this report in consultation with TransGrid Management and recommends that the current projects be included in the current capital works program.

- upgrade 415V switchboard;
- establish new oil shed;
- re-clad existing store;
- re-construct amenities building;
- re-establish workshops and vehicle parking;
- refurbish system control facilities;
- transfer carpenters store;
- establish heavy goods delivery road;
- fence and pave store area;
- upgrade entrance gates and security; and
- establish new staff training facility.

PB Associates has reviewed the report produced by Vanovac Associates Pty Ltd and noted the inclusion of contingency sums for the individual projects, which appears to vary between projects, and also an overall contingency allowance of 5%. PB Associates therefore recommends that TransGrid estimates be reduced by a factor of 10% to compensate for these contingency allowances. This recommendation would reduce the TransGrid allowance to $5,148,540.

Orange Regional Depot. The Orange regional depot was constructed during the 1960s and was designed to accommodate a workforce of over 200 staff which is now down to 40 staff working from the depot. In addition, corrugated asbestos was used almost exclusively for sheeting the walls and roofs of the buildings. The workshop was recently closed due to the presence of asbestos dust in the building. The site covers approximately 10.5 acres of land and hence maintenance costs are high and security is also an issue.

TransGrid developed a detailed business case examining a number of viable options for the redevelopment of the site. The option selected by TransGrid as the most viable is to construct new depot facilities using the light steel framed and clad construction similar to that at the Wallgrove depot utilising approximately 3.5 acres of the existing site in the south west corner almost opposite the existing Orange substation site. TransGrid have estimated that cost to demolish the existing buildings including disposal of the asbestos material, and to construct appropriately sized new steel framed and clad buildings fitted out for current business needs is $3,513,000.

PB Associates has reviewed the cost estimates and the business case provided and recommends that the net efficient cost for reconstruction of the Orange depot be included in the current capital works program. PB Associates notes that the estimate for the construction works in 2002 dollars was $3,003,000 and that this included a contingency

sum of $150,000. Removing this contingency and inflating the construction cost to 2004 dollars results in a construction estimate of $2,997,433.

In addition PB Associates notes that the remainder of the existing site is surplus to TransGrid's needs and could be disposed of to partially offset the cost of the new depot facilities. The TransGrid business case included an allowance of $1,469,000 as proceeds from the sale of the surplus land, again in 2002 dollars. This is equivalent to $1,543,368 (2004 dollars) and would result in a net estimated cost for the reconstruction of the Orange Depot of $1,454,065.

Newcastle Regional Centre. TransGrid propose to develop the Newcastle facility as the main regional centre and this involves the closure of the Tamworth regional centre and the construction of a smaller depot at the Tamworth Substation. Closure of the existing Tamworth regional centre will also involve closure of the Tamworth main store and the relocation of stores and system spares to Newcastle store. The age and condition of the existing depot facilities and the current staffing levels support this longer term approach.

TransGrid have included three projects in their application for the Newcastle Regional Centre as follows:

- new store building;
- new substation, mains and technical services workshops; and
- road re-arrangements.

TransGrid have provided information to support the inclusion of these projects in the current capital works program. This information has been reviewed by PB Associates and a brief description of each project and their key drivers follow.

TransGrid propose to construct a modern store facility of 2000sq.m on the site of the existing workshop building. The new store would be constructed with sufficient height to allow high rise racking inventory storage as well as have sufficient internal and outdoor storage space to accommodate the inventory currently stored at the Tamworth store. The existing store (1,560sq.m) has not been substantially altered since construction in the 1960s and the roof height is too low for efficient use of high rise racking. Access to the larger delivery trucks now in use is limited as is outdoor storage.

The existing workshop building was designed and built in the 1960s primarily for use by mechanical and electrical trades working on vehicles and high voltage electrical plant. Its use has substantially changed over the decades and it is now used by technicians for the maintenance, testing and calibration of communication, protection and metering equipment. The building was designed for entirely different needs to the current business needs which requires an air-conditioned dust free work environment.

The Newcastle Regional Centre shares a common access with the University of Newcastle and there are safety issues associated with the coincident exit and entry points. However the layout of the existing site restricts access to larger delivery and transport vehicles and turning circles are extremely tight.

PB Associates has reviewed the detailed information supplied by TransGrid in support of these projects and recommends that they be included in the current capital works program. However PB Associates does not recommend that the contingency allowances be included in the estimates as they are based on current construction costs and therefore recommends that the estimates for the projects be revised to $1,635,000 for the new store, $2,290,000 for the new workshops and $425,000 for the road re-arrangements.

Tamworth Regional Centre. TransGrid propose to downgrade the Tamworth Regional Centre to depot status and have examined a number of options to house the existing staff and requisite depot facilities. The most cost effective option involves the redevelopment

of the existing site and subdividing the property and disposing of the excess land. The Tamworth facilities used to cater for approximately 200 staff but currently there are 60 employees in the region but only 50 are based in the Tamworth depot. Management has already closed the control room and garage and the store will relocate to the Newcastle Regional Centre shortly.

PB Associates has reviewed the information provided for the preferred option and recommend that it be included in the current capital works program. The present Regional Centre is located on land fronting the New England Highway on the southern approach to Tamworth. This land would be in demand for further commercial development and TransGrid have estimated that the disposal of the excess land could realise $300,000. However, TransGrid's estimate for the work includes a contingency sum of 15% and, as the estimate is based on current construction costs, PB Associates recommends that the estimate be reduced by this contingency sum.

PB Associates recommends that $2,280,480 be included in the capital works program for the redevelopment of the depot, this is different than the estimate included in the Application as the TransGrid estimate has been reduced by the expected disposal of the excess land valued at $300,000. The net depot cost would be $1,980,480.

Wagga Regional Centre. Discussion with Wagga Regional Management indicated that the TransGrid Application of the projects contained in this category is incorrect. Additional information has now been provided to PB Associates. There are three projects in this category. A brief description of each project, the need for the project as identified by TransGrid and the TransGrid estimate for each project, follows.

- Wagga Regional Centre meeting room. This project involves the conversion of the old control room into a meeting/conference room. Currently there is no reasonably sized meeting room in the facility and this project is a refit but with the construction of two additional windows through the double brick building. TransGrid have allowed an estimate of $300,000 for this project.
- Replace Air Conditioning Wagga Administration Building. This project relates to the replacement of the air conditioning system that was commissioned during the 1970 for the administration building. TransGrid allowed $55,000 for this project.
- NATA Oil Laboratory. This project largely relates to the establishment of a NATA registered laboratory to test all TransGrid oil. Currently the Northern Region has a $300,000 annual contract with Powerlink for oil testing and the central region has a similar contract with Connel Wagner for oil testing. The existing oil lab in Wagga tests the local oil samples but TransGrid are developing a business case to do all oil testing at this lab. As only one additional staff is required to do all TransGrid's oil testing and the refit of the lab is estimated to cost $360,000 it is highly likely by PB Associates that the business case will show a positive return on investment.

PB Associates has reviewed all the information provided on these projects and, following discussions with the appropriate TransGrid Regional Manager, we recommend that they be included in the current capital works program.

Yass Regional Centre. Discussion with Wagga Regional Management indicated that the TransGrid Application for the first project contained in this category should be removed from the application, $600,000 in total. The Wagga Oil Laboratory project has been included in the Wagga Regional Centre category and the refurbishment of the Upper Tumut Switching Station has been left in the Minor Projects, Substations Building Section. The Yass Car Park project has been completed and has also been withdrawn from the submission.

The project to replace the air conditioning plant at the Yass administration building has been included as the original plant has reached the end of its serviceable life and the least cost option is replacement with a new unit.

The Project Yass – Water Storage involves the construction of a water storage tank to supply a greenhouse situated at the Yass Regional Centre. The project would avoid current water charges amounting to $5,000 per annum and therefore cannot be supported on pure economic grounds. PB Associates acknowledges that the project was included on goodwill grounds but cannot support its inclusion in the current capital works program as an efficient investment. TransGrid may still wish to proceed with the project but fund it from alternate sources.

5.6 REGULATORY PROJECTS

Transformers – Vales Point (Noise Pollution). The 330/132/33kV transformers at Vales Point are both extremely noisy and the EPA has served a Prevention Notice Number 1034427 requiring TransGrid to rectify the problem. The nearest residents are located about 5km away but are separated only by water and hence the noise generated by the transformers is a problem at the residences.

TransGrid has investigated other options to contain the noise but the congested site limits the ability to construct sound absorbing walls and replacement of the transformers is the only viable option. The TransGrid 2004 APR[19] details how the existing 160 MVA Vales Point transformers will be replaced with one 200MVA unit from Vineyard and another 200MVA unit from Wellington.[20]

In addition, the replacement transformers do not have 33kV tertiary windings and hence 33kV supply has to be re-established at Vales Point to supply the Energy Australia load and the station auxiliary supply. Refer to PB Associates Report Augmentations, Small and Committed Projects – Substations, Section 1, 33kV Supply for Energy Australia – Vales Point for details of this project.

TransGrid have allowed $2,840,646 for this project in their application with the majority of the expenditure occurring in 2006 and 2007.

PB Associates has reviewed the information provided for this project and has sighted the EPA Prevention Notice and therefore recommends that the project be included in the current capital works program.

PCB Chemical Control. TransGrid have had difficulty in obtaining a contractor with the capability to dispose of solid PCB waste and had to seek an extension of the conditions of the General Chemical Control Order until a satisfactory contractor could be found. TransGrid now have an extension until 2010 to comply with the order.

TransGrid have now engaged Ergon Energy in conjunction with BCD Technology to dismantle and dispose the solid PCB waste. Ergon will dismantle and segregate the waste and BCD Technology will destroy the material and provide the required certification.

There are 15 individual CT replacement and disposal projects listed for inclusion in the current capital works program and this will complete the removal of contaminated CTs within the TransGrid network.

PB Associates has reviewed the information provided on these projects and recommends their inclusion in the current capital works program.

Mine Subsidence. This project relates to the provision of a cruciform foundation to a 330kV tower constructed over a mine site. For towers constructed prior to 1983 the Mine

19 Section 6.3.1.

20 Refer to PB Associates Report Augmentation, Small and Committed Augmentations –Transformers, Section 4 Vineyard 330KkV Transformer and Section 5 Wellington 330kV Transformer Augmentation for details of the origin of the two replacement transformers.

Subsidence Board pays for the additional footing to stabilize the tower but lines constructed after 1983 require Mine Subsidence Board approval prior to construction. Whilst it is usually granted they attach a condition requiring that the footings will be strengthened to withstand mine subsidence when encountered in the future.

Long wall mining results in mine subsidence and the footings basically tie the four independent tower footing together so that ground strains are avoided.

PB Associates has reviewed the information provided including the original letter of approval from the Mine Subsidence Board and hence recommends that the project be included in the current capital works program.

Future Regulatory Projects. TransGrid have allowed an estimate of $3m for future regulatory projects based on the estimated expenditure of $4,779,872 for known regulatory projects. PB Associates recommends an allowance of approximately 20% of the known project estimated costs, $1,000,000, be included in the capital works program to cover these future uncertain projects.

5.7 SUMMARY OF PB ASSOCIATES'S FINDINGS AND RECOMMENDATIONS

Generally PB Associates found that the assets included in the application were at or very near the end of their effective service lives and require replacement in the short to medium term. In most instances PB Associates agrees with the timetable for replacement of the assets included in the application and in only a limited number of instances has recommended deferring the projects for a short period of time.

Where a large number of similar assets have to be replaced, PB Associates has formed the view that the TransGrid estimates are based on one-off projects and that there may be opportunities for scale efficiencies. These potential savings have been included in the PB Associates' recommendations.

This section also includes recommendations on Regional Depot Projects. In the estimates for the Tamworth Depot, TransGrid included the estimated proceeds from the sale of excess land. This amount has been included in the PB Associates capital estimates but it is noted that the excess land at Tamworth and at Orange can be disposed of and the proceeds used to offset the capital cost associated with these two projects. Furthermore, the contingency sums allowed for in the TransGrid depot estimates have been removed as the estimates are based on current construction costs. During the review process TransGrid removed the project to construct a new office building at their Wallgrove Depot site to house head office staff. This project was estimated at $20m.

PB Associates has also recommended that Line 875 be upgraded as soon as practicable to 132kV and hence has remover the allowance for maintenance of the existing line from this section and included the reconstruction costs in the relevant small augmentation section.

An overview of PB Associates asset replacement expenditure recommendations is shown in Figure 5-2 compared to the TransGrid asset replacement expenditures included in their Revenue Cap Application. Over the five year period, the PB Associates recommendations are $46.78m lower than the TransGrid estimates but $20m of this amount comprises the removal of the proposed office building at Wallgrove Depot.

Figure 5-2 – Proposed and Recommended Replacement Capital Expenditures ($2004)

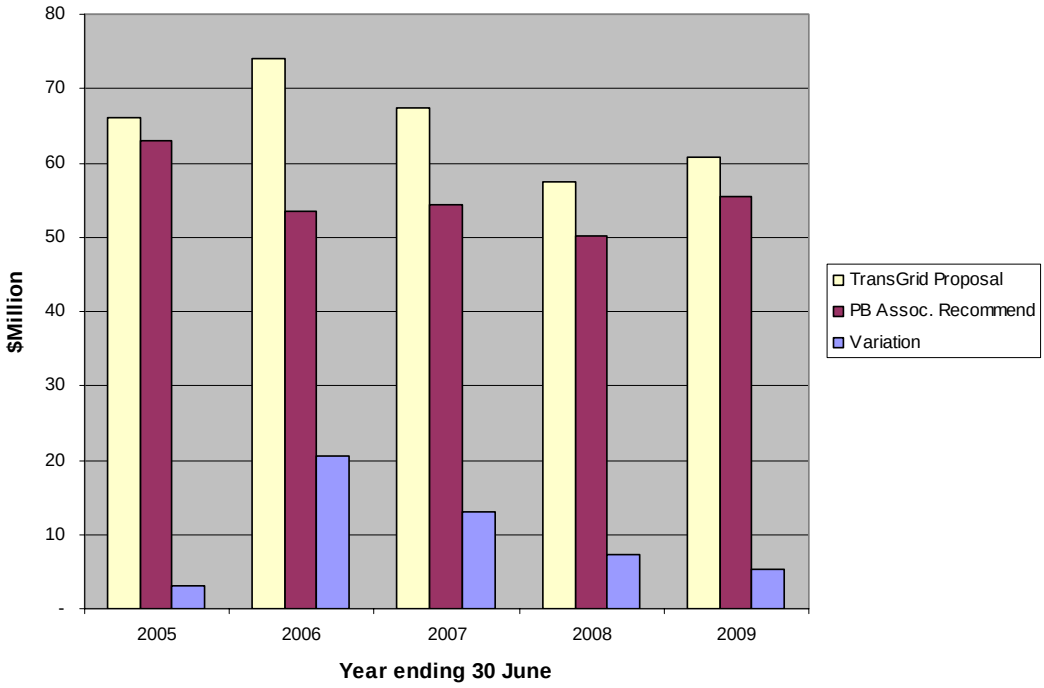
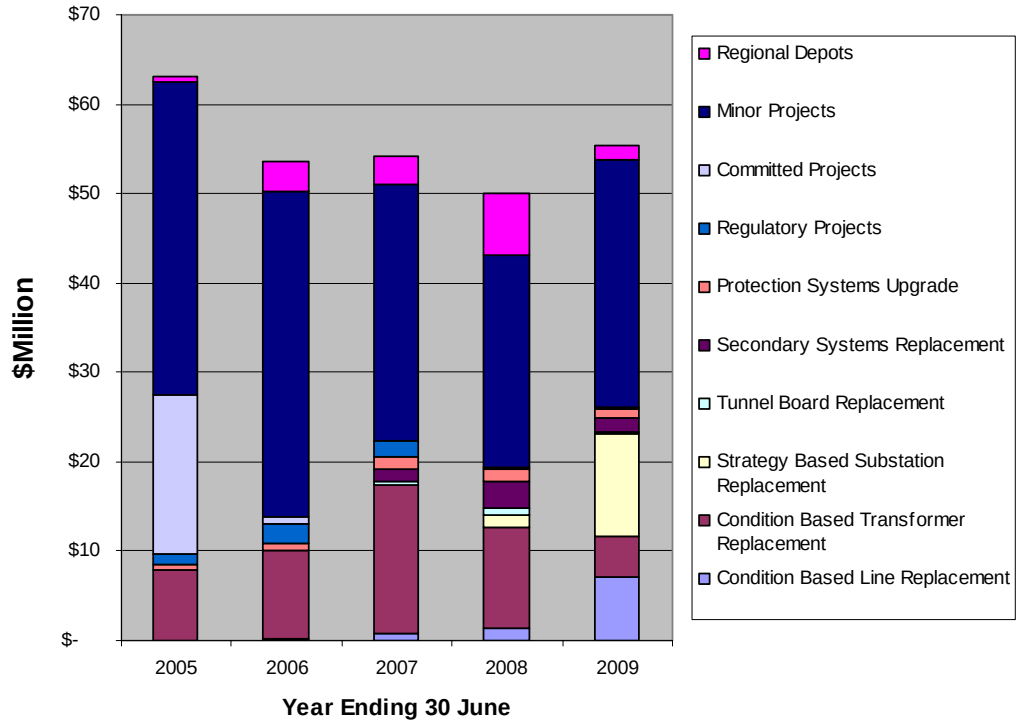


Figure 5-3 details the individual components of PB Associates' recommended yearly expenditures.

Figure 5-3 – Proposed Replacement Capital Expenditures by Segment ($2004)



The variations shown in Figure 5-2 also consist of an adjustment to labour rates of 8.5%, which results in a 1.5% reduction in total project estimates. There is also a reduction in the scoping factor for Taree substation which reduces the estimated cost for that project by $1.25m.

6. AUGMENTATION AND EXCLUDED PROJECTS

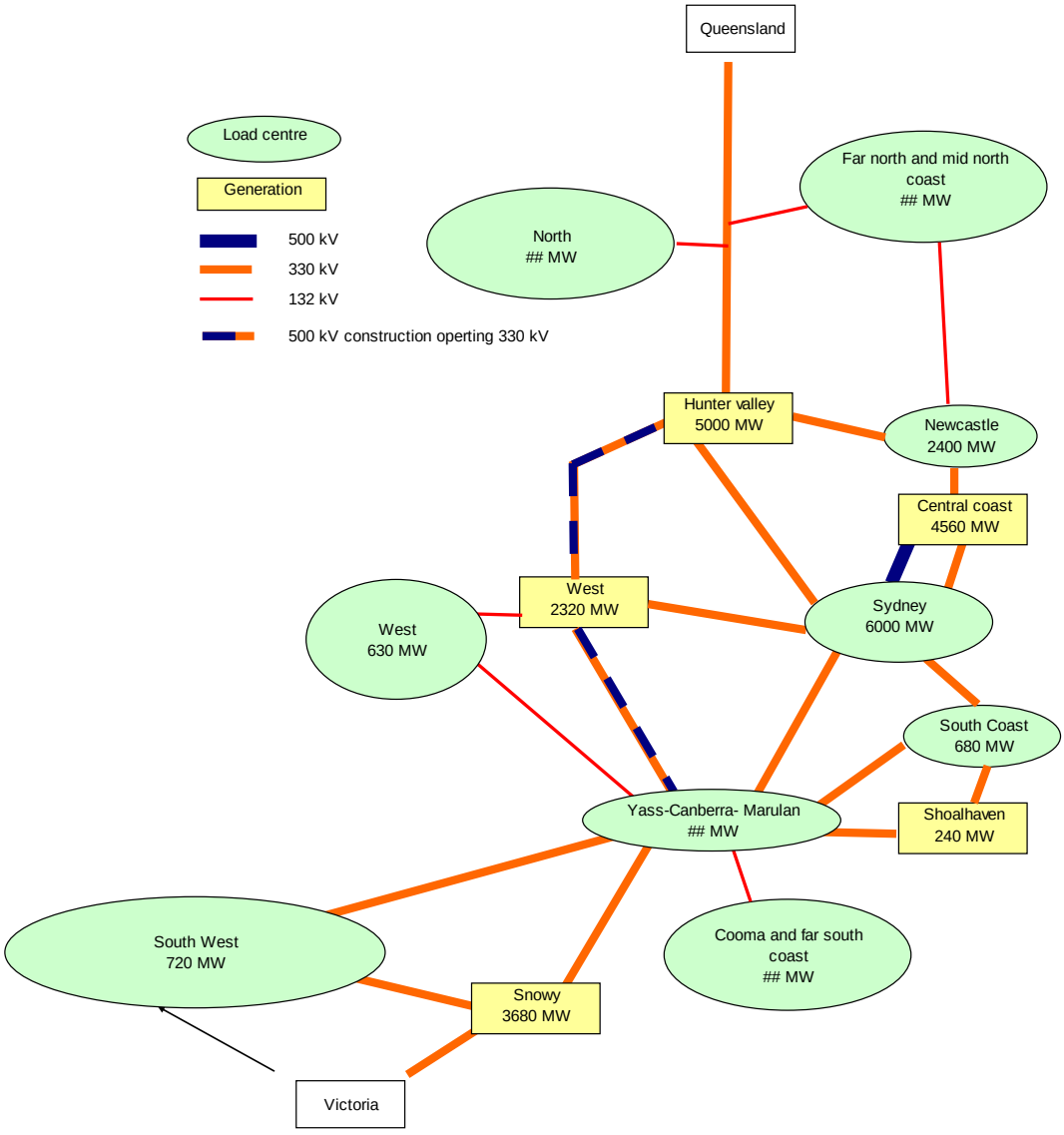
6.1 OVERVIEW OF AUGMENTATION REVIEW

In order to put the following sections into context it is important to understand the overall network conditions and drivers for augmentation capital expenditure on the NSW transmission system.

The main interconnections of the NSW transmission system are with the Queensland and Vic/Snowy transmission networks. The main sources of generation in NSW are coal generation to the west of Sydney (Mount Piper and Wallerawang), Hunter Valley (Bayswater, Liddell) and the Central coast (Eraring, Vales Point, Munmorah). The main load centre is Sydney taking approximately 50% of the NSW demand. The other load centres include North (Tamworth, Moree, Inverell) and Far to Mid North Coast (Lismore to Pt Macquarie), Newcastle, West (Wellington, Cowra, Panorama), South (Canberra, Cooma), South West (Yass, Wagga, Deniliquin, Griffith), and Far West (Balranald, Broken Hill).

The main transmission backbone of 330kV connects to Queensland at Dumarseq and then runs southwards via Armidale and Tamworth to the Hunter valley. It then tracks to the west of Greater Sydney via Lithgow and down to Marulan, and connects with Snowy and Victoria via Yass and Wagga. The main backbone is connected to the Sydney and Newcastle demand centres via a number of long 330kV circuits. Presently, TransGrid have one 500kV double circuit line connecting the Eraring generation on the central coast to the Sydney load. Figure 6-1 shows an idealised diagram of the NSW transmission system, indicating the main system backbone, main generation centres and the load centres.

Figure 6-1 – Idealised Diagram of NSW Transmission System[21]



It can be seen from Figure 6-1 that the main transfer issues of the NSW transmission system are those related to the transfer of power from the interconnectors and main generation centres to main NSW load centre of Sydney/Newcastle which accounts for approximately 70% of the NSW demand (approximately 9 GW[22]). The long term plan of TransGrid is to have a 500 kV ring that runs from the coal generation to the west (Mt Piper) to the Hunter Valley then down to Sydney via the existing Eraring 500 kV circuit and back to Mt Piper via Marulan. The western circuits of this ring, running from Marulan to Mt Piper and on to Bayswater in the Hunter Valley, have already been constructed at 500 kV but are presently operating at 330kV.

The NEMMCO 2004 Statement of Opportunities (SOO) has indicated that NSW may become more reliant on imports from Queensland and Victoria/snowy, and with currently committed NSW generation projects, will have a minimum reserve margin deficiency by 2008/09.

21 It should be noted that this diagram is not to scale, and the lines are an idealised version of the circuits, and do not indicate the number of circuits or the capability.

22 Based upon 2004/05 forecast 10% PoE – TransGrid 2004 APR.

The NSW transmission network main backbone augmentations are dependant on both the load growth in NSW and the overall generation and interconnector developments. As future generation developments are uncertain, TransGrid have developed a range of development scenarios, which TransGrid term "backgrounds". The development of these backgrounds, and the impacts on the main system backbone augmentation requirements, are discussed in Sections 6 and 7 of the TransGrid application.

The augmentations of the supplies to the loads centres, which are predominantly localised 132kV systems that connect to the main system backbone, are more dependant on the load growth in the specific regions. The "backgrounds" do not assume significant generation to be embedded into the load centres and as such augmentation of these systems has been studied independently, albeit with a view of the main system development. The load centre augmentations are discussed in section 5 of the TransGrid application.

TransGrid has classified the augmentations of both the main system and load centre supplies to be either small or major projects. The small projects relate to specific projects generally costing less than $10 million that will be required to overcome specific network violations or constraints. This generally relates to projects such as terminal uprating, minor line uprating or re-building, reactive plant additions, and transformer upgrades. These small projects have been separated and classified in Table 1A of the TransGrid application.

The major projects relates to more significant projects such as major line upgrading, new line developments, and major substation upgrades or establishments. These projects may include a bundle of smaller works that are required to overcome a projected network violation or group of related violations in a defined region. This bundle of works may include new lines construction, substation upgrades and establishments, and the staging of these works. TransGrid defines these bundles of project works as a "complex". These project complexes have been separated and classified in Table 1A of the TransGrid application. The projects have also been split between those considered to be within the ex-ante cap and those considered to be excluded.

6.2 AUGMENTATION REVIEW PROCESS

The general review process undertaken by PB Associates in assessing the TransGrid augmentation requirements in the TransGrid application included:

- a review of the TransGrid application and supporting documentation;
- meetings with key TransGrid planning staff; and
- requests for additional information and studies.

A number of meetings have been held with relevant TransGrid personnel during the course of this review. The nature and purpose of the meetings was as follows:

Overview of network issues

The purpose of this meeting was to gain a broad overview of the NSW transmission system, covering the main load centres, generators, interconnection, power flows, network limitations, possible solutions and the longer terms network development strategy.

The generation/interconnector forecasts and development of background probabilities

This meeting was held in order to gain an understanding of the process behind the background development discussed in Section 6 of the TransGrid application. Issues covered included: base assumptions on generation and interconnection developments;

the probability assignment and calculation and use of the backgrounds and associated probabilities in determining the TransGrid application capital expenditure, both ex-ante and 'excluded' investments.

The load forecast applied by TransGrid in determining its augmentation plans

The purpose of this meeting was to gain an understanding of the process behind the development and application of the peak demand forecasts used in the TransGrid methodology for producing the application capital expenditure. Issues considered included main drivers of demand growth; weather correction; relationship with distribution forecasts and the production of node level forecast for system studies.

The technical study/planning methodology (load/reliability and main system)

The meeting was held to determine the overall process TransGrid applied to develop the project plans that are discussed in the TransGrid application. Issues covered included the technical analysis performed and applications for analysis, planning criteria and equipment ratings, and project evaluation.

Sample project reviews

A review of a sample of network constraints and projects was undertaken. This review involved the selection of a number of major projects and complex schemes. These projects were reviewed in more detail, involving a review of the studies performed by TransGrid to determine its capital expenditure plan. The main purpose of this review was to determine that the process understood to be applied had been applied, the solutions determined were prudent and efficient, gain an understanding of the key drivers of the augmentation and their impact on the solution and timing, and assess the uncertainties surrounding the needs and optimal solution.

6.3 MAIN SYSTEM BACKBONE AUGMENTATIONS REVIEW

This section covers the PB Associates' review of the main system backbone augmentations, covered in section 6 and 7 of the TransGrid application. This section mainly focuses on the process applied by TransGrid to determine augmentations of the main system backbone, and the process applied to determine the backgrounds. Individual major projects that result from this process are reviewed in Section 6.5. Comments on specific small projects are discussed in Section 6.6.

6.3.1 Process applied by TransGrid

The process applied by TransGrid to determine the 'needs', and to confirm the proposed solutions to meet those needs, is mainly via power system studies. The studies determined the needs based upon violations of the planning criteria adopted by TransGrid in accordance with the requirements of the National Electricity Code and the NSW jurisdiction. Further studies are then undertaken to assess possible solutions and confirm the violations would be removed. The studies involve various interconnection and dispatch patterns to assess the impact of dispatch on the violation.

The projects and timings developed by the planning department are then passed to TransGrid engineering department to determine project costs and feasible timings. It is the costs and timing from the TransGrid engineering group that have been used in the TransGrid application. The process for determining the project cost is discussed further in Section 4.2.1.

6.3.2 Planning criteria

The planning criteria applied by TransGrid in its analysis of the main system are essentially a strict application of continuous N-1, other than the inner Sydney region for

which a modified N-2[23] criterion is applied. The specific criteria are defined in the TransGrid application and TransGrid APR.

The identification of needs was achieved via contingency load flow analysis within the analysis of the individual backgrounds. Within a particular background, various generation dispatch patterns that TransGrid considered likely and relevant are studied to determine network violations for different dispatch patterns. The three main dispatch patterns relevant to the main backbone background analysis are: high northern generation/QNI import into NSW; high central coast generation and high southern generation/Vic/Snowy import into NSW.

TransGrid have assessed circuit and transformer overloads as continuous rating under normal operation, sustained emergency rating (SER) under sustained contingent conditions and short terms ratings if available for contingency conditions when some form of re-dispatch or switching is available.

PB Associates comment

PB considers the planning criteria adopted by TransGrid for the analysis, and process applied to undertake the analysis based upon these criteria to be reasonable. During the review of actual studies relating to the TransGrid application projects, PB found the planning criteria to be applied correctly and consistently, and that appropriate equipment ratings have been used to determine the needs.

6.3.3 Load forecasts

The peak demand forecasts used within the load flow modelling were based upon the system level peak demand forecast developed by TransGrid. This system forecast is as that provided to NEMMCO for the SOO. The methodology and the forecast are discussed in more detail in Appendix A of the TransGrid 2004 APR.

The node level peak demands applied in the load flow model relate to 10% probability of exceedance (PoE) conditions. The total demand modelled is set to be the system peak demand. The model node loads are calculated from the node level diversities at the time of the peak winter or summer demand[24].

PB Associates comments

Due to the time constraints in performing this review, PB Associates has not been able to perform a detailed review of the TransGrid methodology for producing the peak demand forecast. However, PB Associates do not consider the methodology described by TransGrid to be unreasonable. As can also be seen from the review of projects later, the sensitivity of the need for the projects is not great between the low to high growth rate scenarios. What may be more significant is the first year forecast 2004/05 peak demand as this forms the reference point for the growth rates.

PB has noted two issues with respect to the TransGrid peak demand forecast that were brought to the attention of TransGrid:

- Based upon the last 11 years of 10% PoE weather corrected actual, the unadjusted actual was always less than the weather correct value. This indicates that in the last 11 years, NSW has never experienced a 1 in 10 year summer peak demand. This appears to be at odds with other states.

[23] N-1 and N-2 refer to the number of outage contingencies during which the network is designed to maintain supply.

[24] TransGrid has advised that adjustment was made to the forward forecast at the node level to account for the Tomago smelter forecast demand at the system level.

TG has provided the calculated historical temperatures and the standard reference temperature for the 10% PoE. This information confirms that based upon the methodology applied by TG in assessing the summer temperature impact on the peak demand. NSW has not had a 1 in 10 year peak demand occurrence in the last 11 years.

- The step increase from the 10% PoE weather corrected actual summer 2003/04 to the equivalent first year of forecast was significantly greater than the previous three years actual increments. PB Associates requested TransGrid to determine the assumption or parameter within its forecasting methodology that drove this increase in order to determine whether this step increase has a reasonable driver or is some form of initialisation error.

  TG has provided the following response with respect to the methodology applied to forecast the 10% peak system demand, and how this forecast may be impacted by historical actuals.

  "*Primarily this is due to the technical features of the peak demand forecasting model. The model incorporates the effect of economic variables via its input of predicted average demand given by the energy model. It predicts the 50th percentile SWPD using an estimated relationship with average demand that includes a long run component and some lagged variables. This ensures that over a ten-year period the forecast will always have a tendency to return to its long run growth path. This feature of the model means that it will have a tendency to grow faster in the first year of the forecast if the previous year's growth was below the long run trend. It also means that the forecast several years out is insensitive to the starting year base for the forecast.*"

TG has also provided additional information including the formula behind the forecast.

PB Associates are satisfied that the methodology that translates the actual peak demand to the weather corrected value via the temperature measurement is not biased. Although within this review we can not comment on the appropriateness of the methodology to calculate the actual average temperature and reference temperature.

With respect to the second issue, the step increase in the first year of the forecast only amounts to an approximate 50 MW increase above the average long term step. As this difference is most pronounced in the first few years and reduces as the forecast advances, and the increase is across the whole system, we do not consider the impact to be material to project timings.

6.3.4 Generation/interconnection backgrounds

Due to the uncertainty in generation developments, TransGrid has produced a number of load/generation/interconnection backgrounds from which to assess the augmentation needs of the main system backbone. The probabilities on key assumptions within the background development lead to a probability that each background would occur. The individual backgrounds essentially being mutually exclusive outcomes of which one outcome must occur (i.e. the probability of all backgrounds sum to one).

The backgrounds were produced from three load growth forecasts, low, medium and high; a range of possible coal and gas generation developments; and possible QNI and VIC/Snowy/NSW interconnector developments.

The uprating of Mt Piper to provide an additional 80 MW and the Eraring units to provide an additional 160 MW was also assumed within the background developments.

The backgrounds assumed a 20% probability of coal generator development (660 MW) either in the Hunter Valley, Ulan/Rylstone, or Mt Piper[25]. TransGrid has assigned an equal probability to these locations.

The backgrounds assume an 80% probability of gas generators of 300 MW each at Tomago, Eraring, Munmorah on the central coast near Newcastle; Port Kembla and Tallawarra near Wollongong; Tomerong; Wagga and Marulan south of Sydney; and Victoria. The backgrounds for gas plants assume two plants are developed (i.e. 2 x 300 MW).

The probability assigned to the individual gas generators is dependant on existing gas prices and weighted such that the probability increases as the location becomes more southerly (i.e. gas price reduces).

The key to the timing of the background generation developments is that required to maintain minimum generation reserve requirements. The 2004 SOO indicates that NSW will have reserve deficit by 2008/09 based upon the medium growth 10% PoE forecast.

The order of priority of developments to ensure reserve requirement assumed in the backgrounds is as follows: maintenance of existing interconnectors capability; uprating of existing coal units; then development of new generation plants.

The medium load growth backgrounds assume:

- augmentation of the existing QL and VIC interconnectors to maintain capability plus and augmentation of the QNI in 2008/09 to increase capability by 150 MW;
- uprating of existing Mt Piper and Eraring units in 2009/10 or 2006/07; and
- new generation developments at the three prospective coal locations or 6 prospective gas locations in 2009/10 (either one coal development or two gas developments).

The low load growth background assumes only the maintenance of interconnector capability plus the augmentation of QNI in 2009/10 to increase capability by 150 MW.

The high load growth backgrounds assume:

- augmentation of the existing QL and VIC interconnectors to maintain capability plus and a major augmentation of the QNI in 2009/10 to increase capability by 950 MW;
- uprating of existing Mt Piper and Eraring units in 2006/07; and
- new generation developments at the three prospective coal locations or 6 prospective gas locations in 2008/9.

The medium load growth (+400 MW in the Newcastle area) backgrounds assume:

- augmentation of the existing QL and VIC interconnectors to maintain capability plus and an augmentation of the QNI in 2008/9 to increase capability by 150 MW
- uprating of existing Mt Piper and Eraring units in 2007/08; and
- new generation developments at the three prospective coal locations or 6 prospective gas locations in 2008/9.

[25] Noting each of these units is on the outside of the main transfer paths to the Sydney load centre.

It is important to note that the capital expenditure proposed by TransGrid in the ex ante cap is not a probability weighted forecast based upon the set of background probabilities. The studies conducted by TransGrid showed that the majority of projects and their timing were insensitive to the backgrounds and only a limited number of projects were sensitive to the backgrounds. These sensitive projects were considered the excluded projects. The ex-ante cap was set based upon the project timing from TransGrid's "M" background.

As the background probabilities have not ultimately been used to calculate the capital expenditure in the ex-ante cap, the assumptions behind the background probabilities and the reasonableness of the probabilities is not so significant for this review. What is more significant is the reason the majority of the projects are insensitive to the background, particularly the low medium or high load forecast, and the assumed location of generation developments and their impact on network needs.

Specific projects and the sensitivities to load forecast and generation developments will be discussed in more detail in Section 6.5 which reviews specific projects. In general however, the insensitivity to the back ground was driven by two main factors:

1. There is not a great difference between the low, medium and high growth rates. As such it takes almost four years for high growth to advance one year from the medium growth or low growth to defer one year from the medium. For the majority of works in the first three to four years, the difference in peak demand is not sufficient to warrant a change in timing from the medium forecast. Only a number of projects near the end of this regulatory period are impacted by the difference in demand growth.

2. The assumption that generation developments are only enough to meet reserve requirements results in the main generation development occurring in the 2009/10 (in the medium growth background). The tightening of the supply demand balance results in an inability to use constrained generation to relieve network violations near the end of the period. In effect, projects may be required under the reliability clause of the regulatory test.

PB Associates Comment

The methodology applied by TransGrid in determining the background interconnection and generation developments and probabilities, and the assumptions applied in defining the set of generation locations does not appear unreasonable from a purely 'most likely least cost' generation location point of view. However, two main assumptions within the development of these backgrounds are key in driving the needs for the projects, particularly in the later years of the period.

1. The new generation development location and size may well be partly driven by the forecast network limitations, and commercial benefit that may exist in placing the generation in appropriate location to leverage this benefit. This impact does not appear to have been examined in the TransGrid background development. The impact of generation location on network augmentation, and hence the resulting impact this may have on influencing generation development locations can best be understood from the knowledge of the possible network constraints that are discussed in the following sections, particularly those relating to the transfers to the Sydney/Newcastle load centres that result in the proposed 500kV network developments.

2. The base assumption that new generation is only developed to meet minimum reserve requirements only results in significant new generation connecting by 2009/10 in the medium growth backgrounds. This effectively results in the ability to relieve network violations by generation dispatch patterns becoming increasing limited as the regulatory period advances. This tends to force network augmentation into being the only feasible solution to relieve violations near the end of the regulatory period.

Both of these issues will be discussed further with respect to there impact on specific projects in Section 6.5.

6.4 CUSTOMER DEMAND (LOAD) DRIVEN AUGMENTATION REVIEW

This section covers the PB review of the customer demand (load) driven augmentations[26],. This section mainly focuses on the process applied by TransGrid to determine augmentations of specific load centres. Individual major projects that result from this process are reviewed in Section 6.5. Comments on specific small projects are discussed in Section 6.6.

6.4.1 Process applied by TransGrid

The process applied by TransGrid to determine the needs and confirm solutions met these needs is mainly via load flow studies. The studies determine the investment 'needs' based upon violations of the planning criteria adopted by TransGrid. Load flow studies are then undertaken to assess possible solutions and confirm the violations could be removed.

The projects and timings developed by the planning department are then passed to TransGrid engineering department to determine project costs and feasible timings. It is the costs and timing from the TransGrid engineering group that have been used in the TransGrid application. The process for determining the project cost is discussed further in Section 4.2.1. In some cases, the TransGrid engineering timings have been deferred due to resource issues.

6.4.2 Planning criteria

The planning criteria applied by TransGrid in its load flow analysis are essentially an application of continuous N-1. This is achieved via single contingency load flow analysis. Circuit overloads are assessed as continuous rating under normal operation and sustained emergency rating (SER) under sustained contingent conditions. Transformer loadings are assessed against nameplate ratings or appropriate cyclic ratings if available.

The low voltage condition is generally determined as not to allow a voltage below 1.0 per unit at the low voltage side of the customer transformer with the taps at full range.

In assessing the timing of the N-1 violation, the actual timing of the solution may be deferred depending of the cost of the solution. This is based upon the acceptance of some load at risk if:

- the cost of upgrade is considered high; and/or
- the risk exposure is considered to be small; and/or
- the cost of supply interruptions is considered to be low.

PB Associates comment

It is noted that the low voltage condition, which is a driver for a many proposed projects, does not appear to be defined via the connection agreement, and as such, TransGrid have some latitude in applying this planning criteria. The actual worst case low voltage condition would be related to the distribution network and the voltage drops through its system. The actual optimal timing for the TransGrid project should, therefore, be determined via the joint planning process. In the absence of a codified low voltage

[26] This is covered in section 5 of the TransGrid application.

condition or those defined in a connection agreement, the 1.0 per unit criteria does not appear unreasonable.

The method of deferring projects and accepting load at risk appears somewhat subjective with respect to the major projects in the TransGrid application. However, this may be partly due to the preliminary stage of planning for these projects which tend to occur in the later years of this regulatory period. PB Associates was not provided with any formal economic evaluation of major projects and load at risk for the major projects in the TransGrid application[27].

Noting the issues discussed above, PB considers the planning criteria adopted by TransGrid for the analysis, and the process applied to undertake the analysis based upon these criteria, to be reasonable.

6.4.3 Load forecasts

The peak demand forecasts used within the load flow modelling are based upon the bulk supply point (BSP) peak demand forecast developed by distributors and provided to TransGrid for joint planning purposes. The forecasts are discussed in more detail in Appendix A of the TransGrid 2004 APR.

The node level peak demands applied in the load flow modelling relate to the 50% PoE conditions. The node level forecast applied for a specific load region is defined as the individual BSP peak demand applicable to the model load.

PB Associates comments

PB has not performed a detailed review of the methodology for producing the BSP peak demand forecast applied by each distributor. The method of defining the BSP peak demand forecasts from distributor forecasts appears reasonable and is that reported in the TransGrid 2004 APR.

Although the diversity between peaks does not appear to be accounted for in the TransGrid analysis, diversity within a region may not be great. Noting that a 50% PoE is used and levels of load at risk are adopted, PB Associates considers the method of applying the model node level forecast directly from the BSP peak forecast, to be reasonable.

6.5 NETWORK LIMITATIONS AND PROPOSED PROJECTS

In general, this report follows the format of TransGrid's Application in order to simplify comparisons and conclusions. However, in the case of larger augmentations, it was necessary to aggregate projects into key drivers as many projects have inter-relationships and inter-dependencies. The sections below discuss all the major projects proposed in the TransGrid application. A number of the projects have been grouped by PB Associates where it is considered that similar or related issues may have an impact on the projects.

[27] PB notes that TransGrid do perform a more formal evaluation for more advanced projects.

Table 6-1 indicates the relationship between projects itemised in Table 1A of the TransGrid application, the section of the TransGrid application within which these projects are discussed and the section of the PB Associates report where the project is discussed.

Table 6-1 – Link between TransGrid's application Table 1A and this report

Project as defined in Table 1A of TG Application	TG Application section discussion	PB Associates report section discussion
Augmentation Sub Total (Complex)		
Royalla 330kV Substation (Stage 1)	Section 5.5.1, 5.5.10 – Customer Demand (Load) Driven	Section 6.5.4 - Canberra and Cooma supply
Holroyd Complex	Section 5.5.20, 5.5.21, – Customer Demand (Load) Driven	Section 6.5.2 - Supplies From Sydney West
Mid North Coast	Section 5.5.24, 5.5.31 – Customer Demand (Load) Driven	Section 6.5.3 - Mid North Coast development
QNI Upgrade proposal	Section 7.9.2 – Interconnection	Section 6.5.5 - Interconnectors
Western 500 kV system	Section 6.6.1 – Main System (Generation and Customer Demand) Driven	Section 6.5.1 - Transfers to Sydney/Newcastle load centre and the 500 kV developments
Excluded projects		
Newcastle and Lower North Coast Supply (Stage 1)	Section 6.6.2 – Main System (Generation and Customer Demand) Driven	Section 6.5.1 - Transfers to Sydney/Newcastle load centre and the 500 kV developments
Bannaby – Sydney 500 kV Development	Section 6.6.2 – Main System (Generation and Customer Demand) Driven	Section 6.5.1 - Transfers to Sydney/Newcastle load centre and the 500 kV developments
Kemps – Sydney South Development	Section 5.5.23, – Customer Demand (Load) Driven Also includes Section 6.6.4 – Main System (Generation and Customer Demand) Driven	Section 6.5.1 - Transfers to Sydney/Newcastle load centre and the 500 kV developments
Masons Park 330/132kV GIS Substation	Section 5.5.22, – Customer Demand (Load) Driven	Section 6.5.2 - Supplies From Sydney West
Series Compensation at Dumaresq	Section 7.11.1 – Interconnection	Section 6.5.5 - Interconnectors
Yass – Wagga 330kV SC TL	Section 7.11.2 – Interconnection	Section 6.5.5 - Interconnectors

6.5.1 Transfers to Sydney/Newcastle load centre and the 500kV developments

Included in the review of these projects is the Western 500kV system project in the major projects; and the Newcastle and Lower North Coast Supply project and Bannaby – Sydney 500 kV development project in the excluded projects. The issues around these projects also impacts the needs and timing of the Kemps to Sydney South project in the excluded projects, particularly the timing of the upgrade of transformer capacity at Kemps.

Also included in this review are a number of the small augmentations related to improving the power transfers to the Sydney/Newcastle load centres. These small augmentations are discussed in more detail in Sections 6.6.

Identification of need

The diagram in Section 6.1 shows the main load and generation levels in the Sydney and Newcastle regions, and the main transfer paths for generation to these load centres. The 2004/05 10% PoE peak demand for the Sydney/Newcastle load is approximately 9000MW, this diagram indicate that at times of high Sydney/Newcastle demand then the power transfers must flow to Sydney/Newcastle from the main generation sources in the Hunter Valley and West, and from the Queensland and VIC/Snowy supplies.

There are two main issues exists that can limit the transfers across the 330kV network into Sydney and Newcastle. The first is a potential thermal overload of the 330kV lines from the Hunter Valley to the Newcastle/Tomago on the loss of the other line at times of Sydney/Newcastle peak demand. The second is a reactive power deficiency limitation in the Sydney area at times of high transfers into Sydney, particularly for the loss of a Bayswater to Regentville 330kV circuit or the loss of a Wallerawang to Ingleburn 330kV circuit[28]. Under these conditions large amounts of power must be transferred across long distances through the existing 330kV system from the generation and interconnection sources. This transfer of power across the large distances results in the requirement for large amounts of reactive power in the Sydney area to maintain the voltage levels in Sydney[29]. Bound up within the reactive deficiency issue is a voltage stability issue[30]. Effectively, there is a limit to the amount of power that can be transferred to Sydney via the existing transmission system without falling below the reactive margin criteria in Sydney and risking voltage collapse under the contingent conditions.

Both limitations are sensitive to the demand in the Sydney and Newcastle area, and the location of the dispatched generation. Increased generation at the outer of the main transfer routes, particularly to the North (e.g. Hunter valley, Mt Piper, Queensland imports) worsens the problems. Increased generation in the Central Coast region (e.g. Tomago, Eraring, Vales point, Munmorah), and/or Wollongong / Sydney region, and VIC/Snowy imports to NSW that offset northern generation, relieve the problems.

The Hunter Valley to Newcastle 330kV circuit loading increases as generation levels increase from the Hunter Valley and to the North. The following approximately indicates the sensitivity of the Liddell-Newcastle overload limitation to demand and generation levels:

- 5MW increase in supply from QNI, Bayswater, or Hunter Valley increases circuit loading by 1MW;
- 4MW increase from South of Sydney (e.g. Vic/Snowy import) offsetting northern generation reduces circuit loading by 1MW;
- 16MW increase in supply from Mt Piper or Wallerawang increases circuit loading by 1MW;
- 5MW increase in demand from Newcastle increases circuit loading by 1MW;

28 A reactive deficiency issue is also forecast for the loss of the Newcastle to Eraring 330kV line. The solution to this is discussed in the Small Augmentations - Section 6.6, and this issue is not covered in this section.

29 It is important to note that the reactive deficiency does not solely relate to the reactive requirements of the Sydney load, but also relates to the requirement to have excess MVAr in the Sydney area to maintain the voltage when large MW flows have to be transferred to Sydney. Effectively, Sydney needs to export MVAr to maintain the voltage during large imports of MW.

30 The voltage stability issue relates to the relationship between the Sydney voltage level and the reactive deficiency. In general, it is preferable that as the voltage drops the reactive deficiency would drop. However, due to the transfer requirements, at a defined knee point voltage the reactive deficiency increases. This can result in voltage instability if this knee point is close to the nominal voltage. TransGrid studies indicate for certain dispatch conditions, this knee point is approximately 5% of the nominal voltage and increasing approximately 1% per year.

- 30MW increase in demand from Sydney increases circuit loading by 1MW; and

- 7MW increase in supply from Eraring, Vales point, or Munmorah decreases circuit loading by 1MW.

Based upon the above and the TransGrid load forecast, the contingent loading on the 330kV circuit would be increasing approximately 23MW per annum and, as such, the generation level in the central coast would have to be increased by approximately 161MW per annum to counter balance this or supply would have to swing by approximately 100MW from northern generation to southern generation. In reality, the increase in loading may be above 23MW as the increase demand in Sydney would have to be met by an increase in supply in generation. If this is via the Hunter Valley or QNI then the circuit loading would increase further.

TransGrid studies indicate that based upon the peak demand forecast, the reactive deficiency limitation is increasing by approximately 400MVAr per annum with the voltage collapse point increase by approximately 1% per annum in the current review period. These study results indicate that for each MW of Sydney load increase (assuming a 0.95 power factor) increases the reactive deficiency by up to 2MVAr. The reactive deficiency can be reduced by increasing the generation from the South (e.g. Snowy/Vic) to offset generation from the north (e.g. Hunter valley and QNI). Load reduction or additional generation in the greater Sydney area would need to offset the increase in Sydney demand (approximately 200MW per annum) to defer project needs. The TransGrid studies indicate 300MW of additional generation at Munmorah gives 200MVAr reduction (i.e. may need up to 600 MW of generation developments depending on the location). It should be noted that as a generator may be able to operate at a power factor less than 0.95, then a lower MW rating of generator may be possible to reduce the reactive deficiency.

Comments on backgrounds and review of studies of needs.

TransGrid has provided load flow studies that show that these limitations presently exist. However, these studies indicate that with the backgrounds assumed by TransGrid in its analysis, the limitations can be managed via generation dispatch, reactive plant additions, and minor upgrade works up to around 2008/09 under a medium growth forecast.

This insensitivity to the medium background chosen for the date of the need is driven by two main factors. Both relate to the main assumption in the background development that only sufficient new generation is assumed to connect to maintain the reserve margin above the minimum requirement, these factors being:

1. the generation plant additions occur in year 2009/10, and therefore, relief can not be achieved from suitably placed new generation in 2008/09; and

2. insufficient generation is assumed to connect to the NEM to allow high southern flows to offset the high northern flows to relieve the violations.

Based upon the study result provided during this review it would appear that, provided the majority of central coast generation can be dispatched, and NSW import from the south is near full capability, offsetting generation in the Hunter Valley and/or QNI, then these constraints may not bind under contingent conditions[31].

By 2009/10, the TransGrid medium growth backgrounds require around 600MW of additional generation to maintain the reserve margin above minimum levels. Dispatch of additional generation in the Hunter Valley would significantly increases the contingent overload on the Hunter Valley to Coast 330kVlines and the reactive deficiency, due to the growth of the Sydney demand, would increase by approximately 400MVAr.

[31] PB does not make any assertions here with respect to the timing when dispatch of generation to this pattern would still result in an economically reliable system.

Dispatch of additional generation on the Central Coast and down to Wollongong would improve this situation, however, this is offset by the worsening of the limitations due to the increased load growth. Based upon the study result provided during this review, it would appear that, provided the majority of central coast generation can be dispatched (including an additional 600MW) and NSW import from the south is near its full capability, (offsetting generation in the Hunter Valley and/or QNI), then these constraints may not bind under contingent conditions. Of course, by 2009/10, depending on the levels and location of new generation, and the diversity between regions, it may not be possible to achieve this dispatch pattern.

The relative insensitivity of the investment timings to the high or low growth forecast from that of the medium forecast is due mainly to the scale of difference between these forecasts. Based upon the difference between growth rates, it takes approximately four years of growth before the overall peak demand level advances by one year from the medium forecast. Therefore, for the high forecast, 2009/10 projects are advanced one year. Projects prior to this date are not considered advanced sufficiently by the higher load growth to warrant an earlier commission date. In a similar fashion for the low load growth backgrounds, only projects in years 2008/09 and 2009/10 of the medium growth background are considered sufficiently deferred by the low load growth to warrant a deferral of the commissioning date. This sensitivity to growth rate tends to only impact the major augmentation project needs at the end of the regulatory period.

Identification of solutions

The studies performed by TransGrid have indicated the need for a number of minor augmentations prior to 2008/09 to increase the capability of supply into the Sydney/Newcastle load centres. The solutions to these needs are line and line terminal uprating to remove certain potential overloads that may constrain generation. TransGrid is also proposing to significantly increase the number of shunt capacitors in the Sydney/Newcastle region to counteract the worsening reactive deficiency. These small augmentations are covered in more detail in Section 6.6.

It is important to note with respect to the reactive deficiency issue that there is a limit to how much shunt reactive support can be provided before the point of voltage collapse is considered too high. Based upon the backgrounds assumed by TransGrid, the ability to use additional capacitors and re-dispatch generation to relieve the reactive deficiency and Hunter valley to coast overload is not feasible by 2008/09. TransGrid has considered the following options to overcome these potential network violations:

- upgrade of Western 330kV lines to 500kV (presently operating at 330kV but constructed to 500kV);
- new line developments;
- line series compensation;
- phase angle regulators;
- shunt compensation;
- load control via a special protection scheme (SPS); and
- line switching.

DSM and generation were not considered in detail as TransGrid considered these options to be assessed as part of the regulatory test process. TransGrid assessed the upgrade of the Western 330kV lines to 500kV to be the preferred option. This project involves the establishments of 500kV substations at Bayswater, Mount Piper, Wollar, and Bannaby.

Based upon studies performed by TransGrid for the medium growth backgrounds, the upgrade of the Western 330kV lines to 500kV only give a temporary relief to the violations. Further augmentation of the network would be required in 2009/10. TransGrid are proposing the preferred options to be either a new 500kV line forming the northern section of the 500kV ring (Bayswater to Eraring) operating initially at 330kV, or a new 500kV line forming the southern section of the 500kV ring (Bannaby to Sydney). The preference of this line depends on the location in the North or South of new generation. Although, the backgrounds indicate that one of these new lines is required by 2009/10, the staging of the construction requires approximately 50-60% of the total capital expenditure associated with these projects to occur near the end of this regulatory period.

The development of the new Hunter Valley to coast 500kV line would increase the power flow through the existing Eraring to Sydney 500kV lines. Studies indicate that the 500/330kV transformer capacity at Kemps would be required to be reinforced when the new Hunter to Coast line was commissioned.

Depending on the location of new generation and Sydney demand growth, an additional 330kV supply from Kemps to Sydney would be required around 2011/12. Although, the needs for this new 330kV line relates to limitations in the southern Sydney 330kV system, the solution and timing relate to the developments of generation around Sydney and the impact of these on the developments of the transmission network in this area.

PB Associates comments

PB has been provided with a large amount of reports and studies identifying the needs from the backgrounds studied. Based upon our review of these, we consider the need to be appropriately identified. That said, the timing of the need appears to be driven by the base assumption that additional generation is only sufficient to meet the minimum reserve requirement. Our analysis of the TransGrid studies provided indicates that suitable levels of generation located between Newcastle to Wollongong, and/or sufficient generation from the south offsetting generation from the North may defer the requirement for major network augmentation.

The TransGrid medium backgrounds assume an additional 600-660MW of new generating plant (accounting for the up-rating of existing plant) are installed in 2009/10. The NSW government in its recently released green paper is signalling its desire to see more NSW based generation. The 2004 SOO also indicated a number of significant “advanced and publicly announced” generation projects in NSW. Based upon this, and the market incentive of locating in a potentially “constrained on” location, PB Associates considers that there may be a greater incentive to locate in the central coast region than accounted for in the TransGrid backgrounds, and possibly in advance of the 2009/10 date assuming in the TransGrid backgrounds. Based upon this there appears to be reasonable possibility that the major 500kV projects could be deferred.

With respect to the solutions considered, TransGrid appears to have only performed a preliminary assessment of the options. This is due to the timing of these projects near the end of the regulatory period. Technical analysis has been performed but more detailed economic analysis or PV least cost analysis does not appear to have been performed to more critically assess the optimum project and optimum staging.

The main issue to relieve both constraints is to increase the transfer paths to the Sydney/Newcastle load areas. The initial Western 500kV upgrade project does not achieve this; although it does help to balance the transfer, giving a brief respite. As all medium growth backgrounds indicated the requirement for a new major line requirement one year after the Western 500kV upgrade, PB Associates requested additional studies examining the impact of either a new 330kV connection from the Hunter Valley to the Coast, or from Bannaby/Marulan to Sydney (operating at 330kV but constructed at 500kV). These studies indicated the Hunter Valley to coast option provided improved relief over the Western 500kV upgrade. This option may also provide opportunities of

more optimally staging the 500kV development dependent on generation/interconnection developments[32].

With respect to DSM or grid support by generators, TransGrid are proposing around $0.5bn between 2008 and 2010 in network investment to improve the supply paths to the Sydney load centre. If the market does not act to optimally locate new generation then some form of support payment may provide sufficient commercial incentive deferring the need for major network augmentation.

Due to the above factors, PB Associates considers it more appropriate to exclude all major network developments associated with these limitations as we consider the uncertainty of the timing of the need and the optimal solution to be significant.

The suggested assessment criteria for inclusion of projects would be based upon the following:

- demonstration of the lack of appropriately located market driven committed generation projects;
- demonstration by TransGrid that they have sufficiently examined DSM options and grid support; and
- demonstration that TransGrid have appropriately evaluated both technically and economically the optimal project and staging of the network development.

The excluded projects would be the Western 500kV system presently in the ex ante cap; and the Newcastle and Lower North Coast Supply (Stage 1), Bannaby – Sydney 500kV Development, and Kemps to Sydney South Development for which TransGrid has already considered excluded.

It is important to note that dependant on the generation/interconnector developments and more detailed analysis conducted by TransGrid, the actual network developments, staging and timing may be significantly different from the four projects above. It can not be stated at this stage how many individual projects may be required for inclusion from these issues in this regulatory period. However, it may be between zero and three. Due to the greater certainty of generation developments when a request for inclusion would occur, it may well be that a single request could be made across all the projects.

Although we consider that sufficient analysis has not been performed to determine the most appropriate upgrade path to the 500kV ring, albeit due to the uncertainty in key drivers, the strategic long-term plan of the ring does appear reasonable. PB Associates therefore believes that a significant portion of the 500kV ring investments will need to be undertaken within a reasonable planning horizon (3 to 10 years) which means that there is reasonable certainty that the existing 500kV lines which currently operate at 330kV will be required to operate at 500kV within this period. Due to lead times required on new lines and substation land, TransGrid may still require expenditure during this regulatory period to ensure commissioning of new lines and substations can be achieved within time following a formal regulatory test process. These expenditures have also been classified as Excluded in this report.

TransGrid has advised of the need for expenditure irrespective of the project outcome. The most significant is that required to establish the 500 kV Bayswater substation. The timing of this could be fixed to certain windows of opportunity to coordinate with known outages of certain Bayswater units. However, we do not consider that this element of the project can be assumed certain at this stage due to the factors discussed above.

[32] PB Associates note that the construction of the new line holds certain technical issues with respect to possible fault level limitation and lead time issues with respect to environmental assessments. However, this indicates that there is still uncertainty in what would be the least cost development option even if there were increased certainty in the generation developments.

TransGrid has also requested expenditure associated with planning and project assessment, and expenditure associated with generator or DSM programmes. PB Associates does concur that this expenditure for these items will be required, irrespective of the project outcome. However, we consider the issue of this expenditure being included in an ex ante cap or excluded to be outside the scope of our work, and as such, we have classified all expenditure as excluded here.

It should be noted that the Kemps to Sydney South project is not strictly related to the transfer limitation discussed in this section. However, the specific project and timing is related to generation developments and the major developments of the Western ring and any new lines to the south of Sydney. As such we consider that this project needs to be more formally assessed within the analysis of the other developments.

6.5.2 Supplies from Sydney West

This section covers the Holroyd complex in the major projects and the Masons Park 330/132kV GIS substation in the excluded projects. Although these projects relate to different Sydney supply issues, the Masons Park development requires the Holroyd development, and as such we discuss both developments in this section.

TransGrid considers both of these projects to be load (reliability) projects and independent of the background analysis. The Holroyd project also relates to the Sydney West 330/132V transformer replacement projects, which is the condition related replacement of the four existing 330/132kV transformer at Sydney West between 2005 and 2008 (1 per year).

Identification of need

The greater Parramatta area is supplied by a 132kV network owned by Integral Energy (Integral Energy). The IE 132kV system encompasses four 132kV cables from IE Guildford substation. The Guildford substation is supplied by two double circuit overhead lines from the TransGrid Sydney West 330/132kV substation.

The Holroyd complex relates to two main needs:

1. IE require additional supplies to Parramatta, however the Guildford substation can not accommodate additional cable circuits; and

2. the 330/132kV transformers at Sydney West are forecast to become overloaded under contingency conditions.

Holroyd is also related to the Mason Park 330/132kV project. This project relates to upcoming supply issues to the Energy Australia (EA) network to the East of the proposed Holroyd site. EA own the 132kV network in the inner Sydney region. This 132kV network operates as a meshed network linking the TransGrid BSPs supplying the 132kV network at Sydney South, Beaconsfield, Haymarket and Sydney North.

Although the IE and EA supply needs are relatively independent, the Mason Park project is linked to the Holroyd complex project as a new 330kV supply to the IE network at Holroyd could be extended to supply the EA network at Mason Park.

Comments on backgrounds and review of studies of needs.

The IE and EA supply needs have not been studied as part of the background analysis. This is mainly due to these issues being considered predominantly load issues, and as such, independent of the likely generation locations assumed in the background analysis.

It would appear that for both IE and EA supply needs, only limited joint planning has been performed. The TransGrid overloads related to the issue are mainly to the 330/132kV

transformers at Sydney West for the IE supply issue and 330/132kV transformers at Sydney South for the EA supply issue.

Initial studies conducted by TransGrid indicate that the Sydney West 330/132kV transformers could become overloaded under N-1 contingency conditions by around 2009/10 and the Sydney South 330/132kV transformers under N-2 contingency conditions by around 2008/09. Further analysis requested by PB Associates of Sydney West, considering available transfers and cyclic loading of transformers, indicates that the overload may be able to be managed well into the next regulatory period.

Identification of solutions

The solution to the Integral Energy (IE) supply to Parramatta is the establishment of a new 132 kV switching station at Holroyd owned by TransGrid, west of the existing Integral Energy Guildford substation. New IE 132 kV cables supplying the Parramatta area will be connected to this new switching station. The supply to the new switching station would be via existing lines presently supplying Guildford substation.

A 330 /132 kV substation would be established at Holroyd when required to relieve the loading on Sydney West.

TransGrid considers the determination of the optimal option for supply to the inner metropolitan area to be at a preliminary stage. The actual solution would depend, to a great extent, on the joint planning between EA and TransGrid. For the TransGrid application, it has assumed a likely solution to be the construction of a new 330/132kV GIS substation at Mason Park. This substation would be supplied via 330kV cables from the new Holroyd Park 330/132kV substation.

PB Associates comments

Both projects appear to be at an early stage of joint planning. Based upon the further analysis performed by TransGrid on the Sydney West transformer overloads, it would appear that further joint planning with IE and EA may well result in the possible deferment of the needs from the 330/132kV transformer overloads.

The IE requirement for the 132 kV switching station at Holroyd to improve its supplies to Parramatta also appears to be at a preliminary stage of joint planning[33]. We would consider that the pudency of the construction of this stage of the project would have to be justified with respect to the likely date for the 330 kV works and other options available to IE.

With respect to the solutions considered, TransGrid appears to have only performed a preliminary assessment of the options. This is due to the timing of these projects near the end of the regulatory period. Some technical analysis has been performed but more detailed PV least cost analysis does not appear to have been performed to more critically assess the project and optimum staging. This analysis would also have to take into account IE and EA related developments and options.

As the EA solution may link to the IE solution it would also appear important to adequately assess both solutions together to ensure an appropriate least cost total TransGrid, IE and EA solution is obtained.

If the possible distribution works are also included, both projects would require significant levels of capital expenditure. Add to this the possible deferral benefits for the other transmission works for the supplies to the Sydney/Newcastle load centres, and there would appear to be significant commercial incentives for DSM or suitably located embedded generation in the Parramatta and inner Sydney area. Although large scale

[33] PB were supplied with a copy of a letter from IE to TransGrid dated 28 September 2004 requesting TransGrid to investigate the Holroyd project.

generation plants are unlikely to be able to sited in these areas, it does not appear unreasonable to assume that smaller plants (<50 MW) may be feasible in certain urban industrial locations. A plant of this size may defer the Holroyd works ($60 million) by up to 2 years.

Due to the above factors, PB considers it more appropriate to exclude both the Holroyd complex and Mason Park 330/132kV GIS substation developments as we consider the uncertainty of the timing of the need and the optimal solution to be significant.

The suggested assessment criteria for inclusion would be based upon the following:

- demonstration of the lack of appropriately located market driven committed generation projects;
- demonstration by TransGrid that they have sufficiently examined DSM options and grid support; and
- demonstration that TransGrid, through joint planning with IE and EA, has adequately assessed the needs, timings and solutions to determine the optimal total solution and timing.

It is important to note that dependant on the joint planning, the actual network developments and staging may be significantly different from the two projects detailed in the TransGrid application, particularly the Mason Park project.

6.5.3 Mid North Coast development

This section covers the Mid North Coast reinforcement in the major projects of the ex-ante cap.

TransGrid considers this complex project to be a load (reliability) project and independent of the background analysis.

Identification of need

The existing Mid North Coast region (Coffs Harbour to Port Macquarie) is supplied from a number of 132kV circuits from Armidale with 132kV links to Lismore in the North and a very weak 132kV connection to Newcastle in the south via Taree and Stroud.

Although TransGrid consider reinforcement of this network to be driven by load only issues, the connection from Armidale to Newcastle via the Mid North coast 132kV system and the 132kV connection to Lismore and Directlink do result in the Mid North Coast system transferring power between Queensland and central and southern NSW, although at a much reduced level from the main 330kV system.

The most immediate Mid North Coast needs relates to an outage of one of the existing 132kV lines to Coffs Harbour or Kempsey at times of peak demand in the Mid North Coast. This condition can result in low voltages at Coffs Harbour, Nambucca, Kempsey and Port Macquarie.

The other significant outage is that of the Kempsey to Port Macquarie 132kV line. This outage leaves the Port Macquarie load being supplied via the weak 132kV radial supply from Newcastle resulting in low voltage conditions at time of high demand at Port Macquarie.

Comments on backgrounds and review of studies of needs.

The Mid North Coast supply needs have not been studied as part of the background analysis. This is mainly due to these issues being considered predominantly load issues, and as such, independent of the likely generation locations assumed in the background

analysis. The issue of the QNI transfers through the 132kV system was considered within the main system review resulting in the requirement for a phase angle regulator on the Armidale to Kempsey 132kV line being proposed in the background analysis to reduce power flows on the 132kV network at times of high QNI import from Queensland. This augmentation is discussed further in Section 6.5.5.

TransGrid load flow studies indicate the contingent low voltage conditions to be occurring in Winter 2005. TransGrid is proposing to relieve the low voltage issue due to the outage of one of the 132kV supplies from Armidale by establishing a new 330/132kV connection at Coffs Harbour. This is a committed project with a service date of 2006/07. This project will also improve the supply to the far North Coast regions. TransGrid is also proposing to install a number of capacitor banks in this region to improve the voltage profile. These shunt capacitors are discussed further in the small augmentation Section6.6.

The new 330/132kV connection at Coffs Harbour can still be used to support the voltage at Coffs Harbour following the loss of the Armidale to Coffs 330kV line by use of a control scheme linking the existing SVC at Lismore and the taps on the Coffs 330/132kV transformer to achieve VAr support from Lismore via the 330kV line. Although this removes the need for large amounts of reactive support in the Mid North Coast region it increases the contingent loading on the remaining in service 132kV lines from Armidale. TransGrid studies indicate that the existing 132kV lines may become overloaded under this contingency and operation of the control scheme by summer 2006/07.

The new 330/132kV substation at Coffs will not relieve the low voltage at Port Macquarie for the outage of the Kempsey to Port Macquarie 132kV line.

Identification of solutions

The solution proposed by TransGrid to overcome the low voltage conditions following the loss of the Armidale to Coffs 330kV line or the Kempsey to Port Macquarie 132kV line is to establish a new 330/132kV substation at Port Macquarie. TransGrid has proposed this new connection to be in service for the winter of 2010.

To establish this new 330kV connection at Port Macquarie, TransGrid are proposing to rebuild the existing 132kV line from Armidale to Kempsey at 330kV and to construct a new 330kV line from Kempsey to Port Macquarie. Although these 330kV lines are due to be in service by 2010, TransGrid need to advance some of the re-build of the existing 132kV line to 2009 as the line must be taken out of service to re-build at 330kV and this can only be achieved during spring and autumn windows when minimum load conditions exist.

TransGrid has also advised that an existing 132kV line operating at 66kV between Coffs and Kempsey must be operated at 132kV prior to the rebuild of the Armidale to Kempsey 132kV line to ensure sufficient security of supply is maintained to the Port Macquarie and Kempsey loads when the Armidale to Kempsey 132kV circuit is out of service for the rebuild. TransGrid is proposing to upgrade the 66 kV line by summer 2007. These works will involve the establishment of a number of 132kV substations at Macksville, Raleigh, Nambucca and Sawtell which presently operate at 66 kV.

PB Associates comments

TransGrid has provided load flow studies indicating the needs and proving the solutions remove the low voltages and overloads. Following commissioning of Coffs Harbour 330/132 kV substation, it may be possible to implement a control scheme which coordinates operation of reactive plant and transformer tap changers at Coffs Harbour and Lismore 330/132 kV substations. The initial studies provided by TransGrid considered the situation where it is not possible to implement such a control scheme.

Further studies performed by TransGrid at the request of PB Associates indicate that, if it is possible to implement the control scheme, the contingent overloads and low voltages could be managed via dispatch of generation at Lismore or import from Queensland

through Directlink, and provision of some additional reactive support. At this stage, it is not certain that the control scheme will be able to be implemented although we do not see any significant technical difficulty with implementing a control scheme of this type.

The assumed location of new generation in the TransGrid backgrounds do not impact the needs for Mid North Coast as it is considered unlikely that significant new generation will connect in this area. It should be noted that the reactive capability of any generators in the Kempsey to Port Macquarie region, or even the ability to locate additional reactive plant in their substations may be a significant advantage to the security of supply in this region.

With respect to the solutions considered, TransGrid appears to have only performed a preliminary assessment of the options. This is possibly due to the timing of these projects near the end of the regulatory period. Some technical analysis has been performed but more detailed PV least cost analysis does not appear to have been performed to more critically assess the most appropriate optimum staging, the use of the generation at Lismore or Directlink and the economic worth of the risk of loss of load.

PB Associates considers that TransGrid have adequately demonstrated the need for the Mid North Coast developments as part of the long term plan for supply to this region. However, we do not consider that the timing of this project is sufficiently certain due to the issues discussed above, and there appears a reasonable likelihood that the project or parts thereof could be deferred.

To calculate a reasonable probability weighted capital expenditure to be allowed in the ex ante cap for the Mid North Coast project, PB Associates has assumed that the project could be deferred for up to two years with an equal probability[34].

The following tables summarises the TransGrid application capital expenditure and the PB Associates recommendation.

Table 6-2 Mid North Coast Reinforcement – TransGrid Application

	2005	2006	2007	2008	2009
Ex ante					
Mid North Coast reinforcement	$0	$483,336	$6,082,735	$22,623,805	$31,889,080
Excluded					
n/a	-	-	-	-	-

Table 6-3 Mid North Coast Reinforcement – PB Associates recommendation

	2005	2006	2007	2008	2009
Ex ante					
Mid North Coast reinforcement	$0	$150,156	$2,039,860	$9,068,322	$18,825,039
Excluded					
n/a	-	-	-	-	-

[34] PB Associates note that the probability weighting is only preliminary and further clarifications may be required to define the most appropriate weightings.

6.5.4 Canberra and Cooma supply

This section covers the Royalla 330kV substation stage 1 in the major projects.

TransGrid considers this project complex to be a load (reliability) project and independent of the background analysis.

Identification of need

Canberra and the far south coast are supplied from the 132kV network with connection to the main system at Canberra. The main TransGrid load centre of the far south is Cooma which is supplied from long 132kV lines. The section of these lines from Canberra to Royalla, although operating as double circuit 132kV, is strung on 330kV structures.

The south coast region of Bega is supplied via a Country Energy 132kV line from Cooma. TransGrid has advised that Country Energy is proposing to construct a second 132kV line from Cooma to Bega. TransGrid has a project in the small augmentation section relating to the establishment of a new Cooma 132kV substation to the North of the existing substation. TransGrid has advised that the existing Cooma substation does not have sufficient space to allow the connection of an additional 132kV circuit. This small augmentation project is discussed further in Section 6.6.

The Royalla project relates to two main needs:

1. Canberra is supplied via the 330/132kV Canberra substation[35]. This supply should not require reinforcement during this regulatory period.

2. Following an outage of one of the 132kV lines to Cooma, and also in the future under normal operation, the Cooma region will experience low voltages at times of peak demand, which may require load shedding to relieve.

Comment on backgrounds and review of studies of needs.

The Canberra and Far South Coast supply needs have not been studied as part of the background analysis. The Canberra and Far South Coast supply is effectively a radial supply from the main system. We consider this to be appropriate.

TransGrid load flow studies indicate the contingent low voltage conditions to be occurring in winter 2005. The studies indicate that up to 26MW may need to be shed to relieve the low voltage conditions at times of peak demand. By winter 2009 low voltage conditions may begin to occur under normal operation.

Identification of solutions

The Royalla project serves both needs. In 2007 TransGrid are proposing to establish a 132kV switching station at Royalla. This switching station will reduce the length of 132kV line between Canberra and Cooma that can be out of service thus improving the voltage under these contingent conditions.

In 2009 TransGrid are proposing to construct the Royalla to Gilmore 132kV line. This line will provide a second 132kV supply to Canberra.

The TransGrid studies also indicate that additional reactive plant may be required to relieve the low voltage conditions around Cooma, and reduce the amount of load shedding that may be required.

[35] Limited ability to supply Canberra is available through the Queanbeyan 132kV substation and the normally open 132kV connection from Queanbeyan back to the Yass 330/132kV substation.

A later stage of the project proposed for around 2012 is to establish the Royalla and Bungalore 330/132kV substations and construct a 330kV line between Royalla and Bungalore. This stage will significantly improve the security of supply to Canberra, whilst also giving some improvement to the contingent low voltages in the Cooma region.

PB Associates comments

TransGrid has provided load flow studies indicating the needs related to the low voltage conditions around the Cooma region. The studies also show that the new 132kV switching station will relieve the low voltages in the Cooma area.

Studies performed by TransGrid indicate that the low voltage conditions around Cooma and the levels of load at risk can be maintained at existing levels past winter 2009 without the Royalla 132 kV switching station with the installation of additional capacitor banks in this region plus the construction of the Country Energy 2nd 132kV line from Cooma to Bega.

Within some of the TransGrid planning reports related to this area, TransGrid discuss potential generation opportunities in the regions. These opportunities include gas via the Eastern Gas Pipeline, biomass from forestry activity and wind farms.

The most appropriate location for these plants would probably be such that it would offset the Cooma load. It should also be noted that although wind generation may not be able to be used to secure the MW load at times of peak demand due to the intermittent nature of the wind resource, appropriate developments could still provide reactive support even at low wind times. This ability may well be as important as the MW support for the Cooma/Bega areas.

With respect to the solutions considered, TransGrid appears to have only performed a preliminary assessment of the options. Some technical analysis has been performed but more detailed PV least cost analysis does not appear to have been performed to more critically assess the most appropriate optimum staging and the economic worth of the load at risk. PB Associates believe that it might also be appropriate to perform more extensive joint planning with Country Energy to assess the actual levels of load at risk – accounting for transfer abilities within the Country Energy network and the most appropriate location for further reactive plant in the Cooma/Bega region.

PB Associates considers that TransGrid have adequately demonstrated the need for the Royalla 132 kV switching station as part of the long term plan for supply to the Cooma region. However, we do not consider that the timing of this project is sufficiently certain due to the issues discussed above, and there appears a reasonable likelihood that the project could be deferred.

To calculate a reasonable probability weighted capital expenditure to be allowed in the ex ante cap for this stage of the Royalla project, PB Associates has assumed that the project could be deferred for up to two years with an equal probability[36].

The works associated with augmenting supply to the Canberra area are:

- Advancing establishment of Royalla 132 kV switching station (if it has not been established for supply to Cooma/Bega).
- Construction of a Royalla – Gilmore 132 kV line.
- Development of a 330 /132 kV substation at Royalla.
- Establishment of Bungendore 330/132 kV substation.

[36] PB Associates note that the probability weighting is only preliminary and further clarifications may be required to define the most appropriate weightings.

- Construction of a Bungendore – Royalla 330 kV line.

The solutions and timing of these works in the TransGrid application appears to be driven largely by the requirement for the increased security for the Canberra region. During this regulatory period, the Canberra load should be within the existing defined supply criteria which is effectively an N-1 criterion.

Due to the above factors, PB Associates considers it more appropriate to exclude the elements of the Royalla project related solely to the security of supply to the Canberra region. The expenditure related to these elements is currently proposed for the ex-ante cap. The suggested assessment criteria for inclusion would be based upon demonstration by TransGrid that the supply criteria for Canberra should be changed either via appropriate consultation and economic worth analysis, or via a statutory requirement.

The following tables summarises the TransGrid application capital expenditure and the PB Associates recommendation.

Table 6-4 Canberra and Cooma supply – TransGrid Application

	2005	2006	2007	2008	2009
Ex ante					
Royalla 330 kV substation Stage 1	$57,000	$610,702	$4,346,091	$8,358,761	$5,586,606
Excluded					
n/a	-	-	-	-	-

Table 6-5 Canberra and Cooma supply – PB Associates recommendation

	2005	2006	2007	2008	2009
Ex ante					
Royalla 132 kV substation	$17,864	$116,459	$1,233,650	$3,318,739	$3,220,144
Excluded					
Canberra Supply	$0	$293,333	$749,981	$1,589,602	$5,586,606

6.5.5 Interconnectors

This section covers the Yass – Wagga 330kV single circuit line and Series Compensation at Dumaresq in the excluded projects and the QNI upgrade project in the ex-ante cap. These projects relate to the main system backbone and background analysis.

The need for the QNI upgrade project is to maintain the QNI import capability from Queensland as the NSW demand grows. As discussed in the section on the Mid North Coast augmentation, the 132kV network supplying the Mid North Coast from Armidale and connecting down to Newcastle provides a parallel path to the main 330kV backbone for the QNI import power. Due to the natural impedance of the 132kV path and 330kV path only a small portion of the import power is transferred through the 132kV network, TransGrid has advised this ratio is presently approximately 20:1. At times of high Mid North Coast demand and high import from QNI, the 132kV circuit from Armidale to Kempsey can become overloaded. The existing solution to this it to either constrain QNI

import, or open the 132kV system reducing the security of supply to the Mid North Coast region.

In the TransGrid supporting analysis, the upgrade is assumed to be required by 2007/08 in all backgrounds. The TransGrid QNI upgrade project involves installing a phase angle regulator on the Armidale to Kempsey 132kV line at Armidale to control the power flow on this 132kV line.

The Yass – Wagga 330kV line relates to an approximately 200MW increase of the capability of the NSW import from the Victoria / Snowy regions. The series compensation at Dumaresq will provide approximately a 150MW increase in the capability of the NSW import through QNI. These major upgrades may be required if there was limited generation development in NSW and more significant generation development south of Wagga or in Victoria, and/or Queensland. Both of these upgrades would require joint planning with the appropriate connecting regions planning body (VenCorp in Victoria and Powerlink in Queensland). Depending on the levels and location of generation developments, the upgrades could be required through the reliability criterion of the regulatory test or via the market benefits criterion.

In the background analysis the Yass-Wagga upgrade was required in most medium growth backgrounds just outside of this regulatory period around 2010/11. For the high growth backgrounds the requirement was brought forward to 2009/10.

The series compensation at Dumaresq is required in 2008/09 for all medium growth backgrounds. The high growth scenarios bring this requirement forward one year, and the low load growth background defers the requirement by one year.

As well as the uncertainty in the timing of the requirement for the major upgrades of the interconnectors, TransGrid also advised that at this stage of the planning there is uncertainty in the preferred solutions, and it is presently considering a number of options. More extensive joint planning and consultation would be required on both the Yass-Wagga 330kV line and the series compensation at Dumaresq projects to determine the timing and scope of works.

With respect to the series compensation at Dumaresq, TransGrid considers that due to the proximity of generation in Queensland the possibility of sub-synchronous resonance due to the series compensation is significant. Detailed studies have not at this stage been performed, however, if sub-synchronous resonance is found then the scope of this project could change significantly.

PB Associates comments

The need for the QNI upgrade (132kV Armidale to Kempsey phase angle regulator) in 2007/08 appears reasonable, although it would have to pass the regulatory test. In the backgrounds assumed by TransGrid only existing generator upgrades at Mount Piper and Eraring were considered to have occurred by this date. It would appear that if relatively low levels of new generation commit to connecting in NSW by 2007/08 then this project could be deferred by a year or more, noting that the capability of QNI may have to be reduced at times of peak Mid North Coast demand.

PB Associates considers that TransGrid have adequately demonstrated the need for the QNI upgrade. However, we do not consider that the timing of this project is sufficiently certain due to the issues discussed above, and there appears a reasonable likelihood that the project could be deferred.

To calculate a reasonable probability weighted capital expenditure to be allowed in the ex ante cap for the QNI upgrade project, PB Associates has assumed that the project could be deferred for up to two years with an equal probability[37].

With respect to the Yass-Wagga 330kV line, the need for this project is most likely outside of this regulatory period, although TransGrid is proposing that the major part of the construction may be required in 2008/09 if high growth occurs.

It would appear that the timing of the need for the major upgrades of the interconnectors is partly driven by the base assumption in the TransGrid backgrounds that generation is only added to meet the minimum reserve requirement and only 660MW of new generation connects onto the NSW network. Under these assumptions, the interconnector capabilities are required to be increased to ensure the NSW demand can be met with appropriate reserve levels. If greater levels of generation connect into the NSW network then these interconnector major upgrades could be deferred. Depending on the levels and location of generation developments the upgrades could be required through the reliability criterion of the regulatory test or via market benefits criterion.

PB Associates concurs with the TransGrid assessment of the uncertainty in the scope of these projects at this stage of planning. PB Associates does not consider that sufficient planning and assessment has occurred to reliably define the scope of works of the major interconnector upgrade projects.

Due to the above factors, PB Associates considers it more appropriate to exclude the major interconnector developments as we consider the uncertainty of the timing of the need of all developments and the optimal solution for the major upgrades to be large.

The suggested assessment criteria for inclusion would be based upon the following:

- demonstration of the lack of appropriately located market driven committed generation projects; and
- demonstration that TransGrid have appropriately evaluated the optimal timing and development.

The excluded projects would be the Series Compensation at Dumaresq and the Yass-Wagga 330kV SC TL projects which are included as proposed excluded investments in the TransGrid expenditure submission.

The probability of requiring the major upgrades is less likely if sufficient generation connects into NSW. If sufficient generation in NSW does not occur in time, it is most likely only one development would be required during this regulatory period rather than both.

The interconnector projects could be grouped into two categories for ACCC definition: Vic/Snowy interconnection; and Queensland interconnection.

The following tables summarises the TransGrid application capital expenditure and the PB Associates recommendation.

[37] PB Associates note that the probability weighting is only preliminary and further clarifications may be required to define the most appropriate weightings.

Table 6-6 Interconnection – TransGrid Application

	2005	2006	2007	2008	2009
Ex ante					
QNI upgrade proposal	$0	$0	$2,001,900	$3,002,850	$0
Excluded					
Series Compensation at Dumarseq	$0	$0	$0	$50,000,000	$30,000,000
Yass-Wagga 330 kV SC TL	$0	$440,000	$2,721,271	$6,123,620	$39,301,609

Table 6-7 Interconnection – PB Associates recommendation

	2005	2006	2007	2008	2009
Ex ante					
QNI upgrade proposal	$0	$0	$621,924	$1,554,809	$1,554,809
Excluded					
Series Compensation at Dumarseq	$0	$0	$0	$50,000,000	$30,000,000
Yass-Wagga 330 kV SC TL	$0	$440,000	$2,721,271	$6,123,620	$39,301,609

6.6 SMALL AUGMENTATIONS

6.6.1 Overview of Small Augmentations

PB Associates has reviewed each of the projects contained in the TransGrid Revised Transmission Capital Investment Program 2004/05 – 2008/09 Small and Committed Augmentations. This section contains a brief commentary on each project outlining the need for the work, a description of the scope of the preferred TransGrid option to resolve the constraint/issue, the timing of the project as determined by the Planning Group, the commissioning date contained in TransGrid's Application as determined by the Engineering Group and the TransGrid estimate for the work.

Several of the projects spread across a number sub categories as some projects contain a line, substation or asset replacement component. In order to determine the total TransGrid project estimate the costs in each sub category need to be summed. PB Associates has cross referenced projects that appear in more than one category.

In general, it is either load growth or customer requirements/requests determine the need for these projects. Where the driver is load growth (resulting in a claim of unacceptable service standards), PB Associates has reviewed the load projections and planning studies and in all cases confirmed whether or not the need exists. Where the need is customer related, PB Associates has identified the customer requirement and noted this in the commentary relating to the project.

In many instances the need for various projects has arisen from joint planning studies with the relevant DNSP, but many of the projects in this category have not yet been requested in writing by the Distributor. Where a written request exists it is noted in this report but where there is presently no firm commitment PB Associates has used engineering judgment to determine the probability of the project proceeding. This is also noted in the report.

The TransGrid estimates for all of these projects have been developed by their Engineering Group and PB Associates has reviewed this process in detail. PB Associates has recommended efficiency factors to be applied to the TransGrid estimates in some instances and these are discussed in conjunction with those projects to which they apply.

6.6.2 New Lines

Glen Innes - Inverell Supply. The supply to the north western area of NSW consists of a network of 132kV lines emanating for TransGrid's Tamworth and Armidale substations. There is the prospect of low voltages occurring from 2005 onwards on the Inverell and Moree substation bus bars due to single contingencies. The preferred option selected by TransGrid to address these issues initially involves the installation of additional capacitor banks. This work delays the construction of a new 132kV line from Inverell to Glen Innes utilising the route of the existing Country Energy 66kV line 733, and associated 132kV switchbays at both Inverell and Glen Innes substations. Refer to. The TransGrid planning report38, which incorporates the impact of the local generation supplied by Eastern Star, indicates that the project is required by 2008/09 and the Engineering Department has scheduled the project for commissioning by 01 April 2004.

The project was commenced as a result of low voltages caused by outages of either 96N Armidale - Inverell line or 96M Moree – Narrabri line. TransGrid's estimate of expenditure to be incurred during this current regulatory period is $17,441,744.

PB Associates has reviewed the planning studies and has formed the view that this project should be included in the current capital works program. PB Associates notes that the planning report recommended the installation of an additional 66kV capacitor bank at Narrabri by 2005/06 and this project is reviewed in section 6.6.4

Upgrade 966 Armidale – Koolkhan 132kV Line. Supply to the far north coast of NSW consists of a 330kV line from Armidale to Lismore and a network of 132kV lines emanating from the Armidale substation. Unacceptable low voltages and the thermal rating of 966 are exceeded on the outage of 89 Armidale – Koolkhan 330kV line. The preferred option selected by TransGrid for this project consists of initially installing two 10 MVAr capacitors at Koolkhan substation followed by uprating the thermal capacity of 966 Armidale – Koolkhan line. This line was constructed in the early 1960s and was designed for a lower operating temperature. The work involves increasing the ground clearances on critical spans that currently limit the thermal rating and the work can be scheduled in conjunction with other maintenance works.[39]

The Planning report indicates that the project is required by 2004/05 but will be deferred until 2006/07 by the installation of additional capacitors at Koolkhan substation. These have been included in the Submission under Small Augmentations – Reactive Plant. The Engineering Department has scheduled the project for commissioning by 1 October 2007. The project was commenced as a result of low voltages on the 132kV busbar at Koolkhan substation on the outage of 89 Armidale – Lismore 330kV line. TransGrid's estimate of expenditure to be incurred during this current regulatory period is $10,911,700.

38 Planning Report PLR 218.

39 Planning Report PLR 212.

PB Associates has reviewed the information provided and has formed the view that this project can be deferred by Directlink well past the present regulatory period and hence should not be included in the current capital works program.

Mulwala 132kV Supply. Supply to the south west of NSW consists of 132kV ring supplying Coleambally, Deniliquin and Finley as well as Country Energy's 132kV line Albury – Mulwala and a 66kV line Mulwala – Finley. The main network limitations are unacceptable voltages at Finley and Deniliquin primarily on the outage of the 132kV line Darlington Point – Coleambally and the load growth at Mulwala reaching a stage where a firm 132kV supply is warranted. The preferred option selected by TransGrid to address these issues consists of the installation of a 10MVAr 132kV capacitor bank at Deniliquin by 2006/07 and the installation of a second 132/66kV transformer at Finley to provide firm construction to the Finley substation. This will allow the construction of the new Finley to Mulwala 132kV line along the route of the existing Country Energy 66kV line which is required by 2011. Refer to Planning Report PLR 217.

The project was commenced as a result of low voltages at the Coleambally, Deniliquin and Finley substations following the outage of the Darlington Point – Coleambally 132kV line. TransGrid's Planning report indicates that the capacitor banks are required by 2006/07 but the Engineering Department has omitted this project from the Submission. TransGrid's estimate of expenditure to be incurred during this current regulatory period is $1,375,951. This is preliminary expenditure associated with the construction of the 132kV line Finley – Mulwala which is not scheduled for commissioning until 1 October 2011.

PB Associates has reviewed the planning studies and has formed the view that preliminary expenditure associated with this project should be included in the current capital works program.

Parkes, Forbes and Cowra Supply. The Cowra/Parkes/Forbes area is supplied via a 350km long 132kV system between the Yass and Wellington 330/132kV substations. The network limitations are low voltages at Forbes and Parkes substations and the overloading of 999 on an outage of 94K Wellington – Parkes line, overloading of Country Energy's 895 on the outage of the single transformer at Parkes, and the overloading of the Cowra transformer if one is out of service. The preferred option selected by TransGrid to address these issues, including the timing of each component, consists of the installation of capacitors at the Cowra, Forbes, and Parkes substations (2005/06), installation of a second transformer at Parkes substation (2006/07), construction of a Manildra – Parkes 132kV line (2007/08) and replacement of the Cowra transformers by larger units (2009/10). Refer to Planning Report PLR 209.

The reactive plant details are contained in the Submission under Small Augmentations – Reactive Plant, and the transformer upgrades are detailed in the Submission under Small Augmentations – Transformers, only the estimates for the line component are contained in this section.

The project was commenced because of the unacceptably low voltages at Forbes and Parkes and the overloading of 999 Cowra – Yass on the outage of 94K Wellington – Parkes. The Engineering Department has scheduled the line component for commissioning by 1 December 2009. TransGrid's estimate of expenditure to be incurred during this current regulatory period for the line component is $15,839,293.

PB Associates has reviewed PLR 209 including the planning studies and has formed the view that this project should be included in the current capital works program.

Upgrade Lines 64, 65, and 66 – Snowy Asset Rehabilitation. Lines 64, 65 and 66 were transferred to TransGrid in 2002 and were all constructed during the late 1950s to mid 1960s. They were designed to operate at 49°C (120°F) and TransGrid has serious concerns regarding existing ground clearances under current operating conditions. TransGrid have carried out major investigations into both the condition of these lines and also the condition and ratings of the Murray and Upper Tumut Switching Stations. The

rating of these lines is placing constraints on the import capacity into NSW from Victoria and Snowy. This project involves the upgrading of lines 64, 65, and 66 to operate at 85°C. The Engineering Department has scheduled the project for commissioning by 1 December 2008.

TransGrid's estimate of expenditure to be incurred during this current regulatory period is $17,695,378. PB Associates has formed the view that this project should included in the current capital works program

Cable 41 Series Reactor Replacement. This project involves the replacement of the 330kV cable 41 existing series reactor due to condition, and an estimate of $4,800,000 has been allowed for the work in this section. An amount of $4,825,860 has also been for this project in Asset Replacement – Reactors and it appears as the project has been double counted. PB Associates has formed the opinion that the replacement of the reactor is condition based and therefore should be included in the Asset Replacement category and hence have removed $4,800,000 from TransGrid total estimate for Small Augmentation – New Lines.

Reconstruction of 875 at 132kV. This project was not included in the current capital works program as an allowance was made in Asset Replacement of approximately $4.79m for maintenance works on the existing 66kV line. In addition an allowance has also been included for the installation of capacitors at Narrabri to provide voltage support until the reconstruction of 875 at 132kV is ultimately required in 2009/10 provided the gas generation in the area proves reliable. If the gas generation cannot be relied upon for network support then the reconstruction of 875 to 132kV would be required as early as 2007/08.

PB Associates has requested TransGrid to carry our further planning studies and as a result of these studies recommends that the reconstruction of 875 to a 132kV feeder be initiated as soon as practicable. This would avert the need to maintain the existing 66kV line producing an immediate estimated saving of $4,788,341 and an additional saving of $193,500.by delaying the need to install the Narrabri capacitor bank by 3 years.

The estimate to reconstruct the line at 132kV is $18.32m. Easement costs associated with widening the easement out to 45m are estimated to be $7.92m and these would be incurred at least one year prior to construction

6.6.3 New Substations

Boggabri 132kV Substation. Boggabri is currently supplied via Country Energy's 66kV network between Gunnedah and Narrabri. This network is over 50years old and approaching full capacity. The preferred option selected by a Joint Planning Committee meeting comprising TransGrid and Country Energy to address this issue is for Country Energy to request a new 132/66kV bulk supply point near Boggabri. Refer to Planning Report PLR 205.

The Planning report indicates that the project is required because the thermal capacity of both 88K Gunnedah TG – Gunnedah CE and 88L Gunnedah TG – Gunnedah CE and low voltage at Boggabri due to and outage of either line. The Engineering Department has scheduled the project for commissioning by 1 March 2010 and hence TransGrid's estimate of expenditure to be incurred during this current regulatory period of $1,085,981, relates primarily to pre-construction design, construction approvals and site acquisition costs.

PB Associates has formed the view that this project is highly likely to proceed and hence should be included in the current capital works program.

Buladelah 132kv Substation. The Buladelah area is currently supplied by the Country Energy 33kV network which originates in the Stroud substation. Both Country Energy and TransGrid have identified constraints in the area which affect voltage levels in the

Buladelah area. These constraints include low 33kV voltages on the outage of Country Energy feeders 6 Stroud – Buladelah via Booral or 7 Stroud – Buladelah or Salt Ash – Tea Gardens. The 33kV voltages at Stroud busbar may also drop below acceptable levels on the outage of TransGrid line 96F Kurri – Stroud. The preferred option selected by a Joint Planning Committee – comprising TransGrid and Country Energy – is the establishment of a new bulk supply point at Buladelah by the construction of a new 132/33kV substation. Refer to Planning Report PLR 206.

The Planning report indicates that the project will be deferred by the installation of 7.5MVAr of capacitors in the Country Energy network and hence TransGrid have scheduled the project for commissioning by 1 August 2008 when the deferral period gained by the installation of the capacitor bank expires. TransGrid's estimate of expenditure to be incurred during this current regulatory period is $6,706,023.

PB Associates has reviewed planning report PLR 206 and formed the view that this project is highly likely to proceed and hence should be included in the current capital works program.

Glen Innes Supply. This project comprises the technical services component of the rebuild of the TransGrid Glen Innes substation and includes the provision of communication and data services to the site and terminal equipment. Full details of the need for the project and network constraints are detailed in Small Augmentations – Substations – Glen Innes Rebuild. TransGrid's estimate of expenditure to be incurred during the current regulatory period for this project is $641,300.

PB Associates has formed the view that this project should be included in the current capital works program as there is a request on file from Country Energy for the establishment of the new connection point.

Wagga North 132kV Substation. Wagga is currently supplied via a 330/132kV substation connected to a 132/66kV substation via two 132kV circuits and a long 132kV line from Yass. In addition Country Energy's 132/66kV Temora substation is supplied from the Wagga substation 132kV bus. The load supplied by the 132/66 kV substation will exceed the firm capacity of the existing transformers in 2005/06. Furthermore, this substation was established in the early 1950s and the substation is operating close to its equipment fault ratings and any further increase in capacity will require the fault rating limitation to be addressed.

In addition, the two 132kV circuits supplying the substation are also operating close to full capacity and the additional capacity required from the substation means that these feeders will also require uprating. A new gold mine is proposed to be commissioned in the first half of 2005 at Lake Cowal and this will be supplied from Country Energy's 132kV system from Temora substation further increasing the load on the two 132kV feeders supplying the existing Wagga substation for the TransGrid 330/132kV system.

Country Energy has also requested an additional bulk supply point to address 66kV reticulation issues in their network and the least cost solution to all of these issues is the construction of a new Wagga North substation. Refer to Planning Report PLR 227.

The Engineering Group has scheduled the project for commissioning in 1 August 2008 and TransGrid's estimate of expenditure to be incurred during this current regulatory period is $11,165,091.

PB Associates has reviewed the information supplied in Planning Reports 226 and 226 and has formed the view that the project should be included in the current capital works program.

Cooma North 132kV Switching Station. The far south coast of NSW is supplied via two 132kV lines emanating from Canberra substation terminating in the Cooma 132/66/11/kV substation. Supply to Bega is via a Country Energy 132kV line and Country Energy is considering constructing a second 132kV line to Bega and installing 66kV capacitors at

their Bega substation. In order to avoid further congestion of lines at the Cooma substation, the existing substation is located in a light industrial area where space is limited. TransGrid's preferred option is to construct a new 132kV switching station in the Cooma area to connect the new Country Energy line. This switching station would be incorporated into a future 330/132kV substation, when load growth warrants, supplying the Cooma/Bega area at 330kV.

The planning report indicates that the provision of additional capacitor banks is beneficial for voltage support in the area and as space would prohibit the installation of more that one additional bank in the existing substation, TransGrid propose to install additional capacitor banks in the proposed switching station. Refer Planning Report PLR 208. TransGrid omitted to include these capacitor banks in their estimate for the proposed switching station but PB Associates have included their installation costs in its recommendations.

Also, the installation of the additional capacitor bank at the existing Cooma substation was also omitted from the Application but PB Associates has included it in its recommendations in the Small Augmentation – Reactive Power category. Refer Planning Report PLR 208.

The Engineering Group has scheduled commissioning of the 132kV switching station for 1 December 2007. TransGrid's estimate of expenditure to be incurred during this current regulatory period for the 132kV switching station is $8,058,377.

PB Associates has reviewed the planning report and concurs with TransGrid that the constraints need to be addressed and hence have recommended that the project be included in the current capital works program.

6.6.4 Reactive Plant

Canberra 132kV Capacitor Bank. This 120MVAr capacitor bank is required to support the voltage at the Canberra substation when the 330kV lines into the substation are operated up to their full thermal ratings – importing power from Snowy/Victoria. The voltage at Canberra substation drops during these operating conditions due to the impedance of the lines. The Planning Group have indicated that the banks are required by 2005/06 and the Engineering group has scheduled the project for commissioning by 1 December 2005.

TransGrid's estimate of expenditure to be incurred during this current regulatory period is $2,154,797.

PB Associates has reviewed the information supplied by TransGrid and has formed the recommendation that the project should be included in the current capital works program in order to allow maximum import into NSW during high load conditions.

Cowra, Parkes and Forbes Capacitor Banks. Reference is made to PB Associates Report on Small Augmentation – New Lines, Parkes, Forbes and Cowra Supply. The capacitors at these locations are used to defer the commissioning of a second transformer at Parkes substation (2006/07); construction of a Manildra – Parkes 132kV line (2007/08) and replacement of the Cowra transformers by larger units (2009/10). The capacitor banks at Forbes are 132kV 12MVAr, at Cowra two 8MVAr banks and at Parkes an 8MVAr bank The capacitors are recommended for installation by the Planning Group in 2005/06 and the Engineering Group has programmed the capacitors to be commissioned by 1 December 2006.

TransGrid's estimate of expenditure to be incurred during this current regulatory period is $3,154,651.

PB Associates has reviewed the Planning Report 209 supplied by TransGrid and recommend that the project be included in the current capital works program.

Panorama 66kV Capacitor Bank. Panorama 132/66kV Substation is supplied via two 132kV lines from Wallerawang and Orange. Unacceptably low volts occur at the Panorama substation on the outage of the 132kV Wallerawang – Panorama line. This limitation can be removed by the installation of two 10MVAr 66kV capacitors at Panorama Substation.

TransGrid's estimate of expenditure to be incurred during this current regulatory period is $1,188,287, and the Engineering group has scheduled the project for commissioning by 1 April 2008.

PB Associates has reviewed the information supplied by TransGrid, in particular the planning studies Figure 3 and 4 attached to PLR 229, and has formed the view that the project should be included in the current capital works program.

Dapto Capacitor Banks. The existing 80MVAr capacitor banks at Dapto substation have special current limiting fuses that require replacement. Rather than just replace the fuses, TransGrid has decided to increase the capacity of the capacitor bank to 120MVAr and also to tune the banks to avoid harmonic amplification. TransGrid has recommended that the capacitor bank be augmented as the existing capacitor requires replacement due to the condition. TransGrid has advised that the additional reactive support is required to maintain voltage control under conditions of high import from Snowy/Victoria.

TransGrid's estimate of expenditure to be incurred during this current regulatory period is $3,397,390, and the Engineering Group has scheduled the project to be finalized by 1 December 2005.

PB Associates has reviewed the information supplied by TransGrid and has formed the view that the project should be included in the current capital works program.

Darlington Point 132kV Capacitor Banks. On the outage of the 330kV Wagga – Darlington Point line TransGrid has installed a network control scheme to segregate the 132kV system from the 220kV system in order to remove the impact of the Victorian import from the 132kV system. However, under periods of high load the voltage will collapse at Darlington Point. TransGrid proposes to address this issue in two ways. Firstly, by the installation of 40MVAr of capacitor banks and secondly by discussing with Country Energy the installation of under voltage load shedding at a number of sites. This project relates to the installation of the capacitor banks only. The planning studies have indicated that additional reactive support represents about the limit of support that can be provided to this system.

The planning studies indicate that reactive support is required from summer 2004 and the Engineering Group has scheduled the commissioning of this project by 1 December 2005.

TransGrid's estimate of expenditure to be incurred during this current regulatory period is $4.584,598.

PB Associates has reviewed the information provided and formed the view that this project should be included in the current capital works program.

Koolkhan 66kV Capacitor Bank. This project is related to the augmentation of the Koolkhan transformers which is discussed in PB Associates Report on Small Augmentations – Transformers. Planning Report, PLR 212, indicates that the augmentation of Koolkhan transformers can be deferred until 2009/10 by the installation of additional capacitors at Koolkhan substation. The Engineering Department has indicated that the capacitor banks will be commissioned by 1 December 2006.

TransGrid has included an estimate of $1,202,566 for expenditure on this project during the control period.

PB Associates has reviewed the information provided for this project, in particular the load forecast graph on page 4 of PLR 212, and has formed the view that it should be included in the current capital works program.

Nambucca 66kV Capacitor Bank. The capacitor bank detailed in planning report PLR 216 was requested to be commissioned by 2006. The Engineering Group has scheduled the capacitor bank to be commissioned by 1 December 2006 and has included an estimate of $1,202,566 to be expended during the control period. The two 10MVAr capacitor banks were intended to alleviate unacceptable low voltages on the outage of either 965 Armidale – Kempsey or 96C Armidale – Coffs Harbour prior to the commissioning of the Coffs Harbour 330/132kV substation..

PB Associates notes that the new 330/132kV Coffs Harbour substation is also scheduled for construction in 2006 and this will also provide additional support to the area. The deferment benefits of the capacitor banks are therefore negated.

TransGrid has provided additional planning studies that indicate the capacitor banks would provide voltage support on the combined outages of both 89 line Armidale – Coffs Harbour and the control scheme proposed for the area but PB Associates considers this to be a N-2 situation and providing a level of service in excess of the regulatory N-1 standard.

Accordingly PB Associates has formed the view that this project should not be included in the current capital works program.

Main System Capacitor Banks. TransGrid proposed to commission capacitor banks at the following locations.

- Regentville 80MVAr
- Sydney West 2ooMVAr
- Vales Point 2x 200MVAr
- Bayswater/Liddell 150MVAr
- Eraring 150MVAr
- Mt Piper 150MVAr; and
- three other locations to be identified.

PB Associates has reviewed the shunt capacitor bank commissioning schedule and also requested additional planning studies to confirm the need for the projects. These studies, refer Transmission Development File 2003/3466, have confirmed that the capacitor banks are required and that the three additional banks requested in the application will be required to be commissioned during the regulatory period.

PB Associates therefore recommends that the projects be included in the current capital works program.

Tamworth Reactors Stage 2. PB Associates has reviewed the information supplied regarding the replacement of a 50MVAr capacitor bank at Tamworth that was scrapped last year after being out of service for several years beforehand. TransGrid has supplied information that the installation of the reactor would provide the capability to progressively restore supply to the Hunter Valley, western and central coast power stations from Queensland. This would facilitate more rapid restoration of supply to the state, particularly the area north of Sydney.

TransGrid have stated that the lack of black start sources for New South Wales is of concern to both itself and the New South Wales government. However NEMMCO has contracted only two sources of black start generation within New South Wales, both in the south of the state. By way of comparison, five sources have been contracted in

Queensland and the ability to restore supply to sensitive loads to the north of Sydney is of particular concern.

TransGrid have also stated that this reactor would serve as an "in service spare" to cater for the failure of any of the six other 50 MVAr 330 kV shunt reactors in the state.

PB Associates notes that TransGrid have also supplied a legal opinion in relation to this project. PB Associates has formed the view that at this point in time NEMMCO has not altered its black start arrangements in New South Wales and therefore has not included this project in the recommended capital works program for the current regulatory period. However, the benefits outlined by TransGrid, particularly relating to increased speed of restoration of supply from Queensland, provided it was available, are not at issue.

PB Associates would recommend that in forming its opinion on the prudency and efficiency of this project the ACCC obtain additional information from NEMMCO and independent legal advice on the need for this project,

132 Narrabri Capacitor Bank. This project involves the installation of two 66kV 10MVAr capacitor banks at the Narrabri substation in order to maintain acceptable voltage levels at Narrabri on the outage of 968 Tamworth – Narrabri. Planning report PLR 218 indicates that the installation of one of the capacitor banks at Narrabri is required by 2005/06 and the second by 2007. The Engineering Group has scheduled the capacitor banks for commissioning by 1 December 2006 and allowed an estimated $645,064 for expenditure in the current control period.

PB Associates has also noted that TransGrid have allowed approximately $4.8m for urgent maintenance on the 66kV line 875 Tamworth – Gunnedah. Further planning studies were requested from TransGrid which indicate that the capacitor banks at Narrabri can be deferred until the winter of 2009 if this line is reconstructed at 132kV.

Hence PB Associates has formed the view that this project should be deferred until the beginning of 2009/10 and has recommended that 875 be reconstructed at 132kV as soon as the work can be scheduled.

Cooma Capacitor Bank. This project involves the installation of a 132kV 10MVAr capacitor bank at Cooma substation to support the voltage in the area. The construction of the proposed 132kV Cooma North Switching Station will allow additional capacitor banks to be installed to further support the voltage in the area. Refer to PB Associates Report Small Augmentations – New Substations and planning report PLR 205 for details.

PB Associates has reviewed the planning studies attached to PLR208 and recommends that the capacitor bank be installed. TransGrid omitted this project from their submission but PB Associates recommends that it be included in the current capital works program and scheduled for commissioning by 1 December 2005. TransGrid has provided an estimate for the project of $1.01m.

Deniliquin Capacitor Bank. This 132kV 10MVAr capacitor bank proposed for the Deniliquin substation will delay the need to complete the 132kV ring form Mulwala to Finley for a period of approximately two years. Refer to PLR 217 and PB Associates report, Small Augmentations – New Lines Mulwala 132kV Supply for details.

TransGrid omitted this project from their application but PB Associates recommends that it be included to defer the construction of the Mulwala to Finley 132kV line for two years. The Capacitor bank should be commissioned by 2006/07, and TransGrid have provided an estimate of $1.539m for expenditure during the current regulatory period.

6.6.5 Substations

33kV Supply for EnergyAustralia –Vales Point. The existing transformer at Vales Point has a 33kV tertiary winding which is currently used to provide 33kV to

EnergyAustralia. This Transformer is extremely noisy and currently has an EPA Prevention Notice in force requiring replacement of the transformer. TransGrid intend to replace this transformer with a standard 330/132kV transformer, for which spares are held, and then re-establish a 33kV supply for Energy Australia. The project is scheduled for completion by 1 June 2007 and will need to be co-ordinated with the replacement of the 330/132kV transformer.

TransGrid have allowed an estimate of $4,608,361 for this project during the current regulatory period.

PB Associates agrees that the transformer has to be replaced and that the use of transformers for which spares are held is accepted good industry practice. Hence PB Associates recommends that this project should be included in the current capital works program.

Buladelah 132kV Substation. This project is related to the provision of technical services to the proposed new 132kV substation at Buladelah to create a new bulk supply point for Country Energy to supply the Buladelah area. Details of this new 132/33kV substation are contained in PB Associates Report on Small Augmentations – New Substations. The project involves the provision of data and communications links to the new substation and the necessary terminal equipment.

TransGrid has allowed an estimated expenditure of $508,800 during the control period for this project and the Engineering Group has scheduled the project for completion by 1 August 2008. This aligns with the commissioning date for the substation.

PB Associates would therefore recommend that the project be included in the current capital works program.

Central Coast 330kV Line Re-arrangements. This project has been reviewed by PB Associates when reviewing TransGrid's main system planning studies. These studies indicate that this project will facilitate greater support for the Newcastle area voltage using the reactive power generation capability of Eraring Power Station and also overcome loading limitations on the Vales Point – Munmorah line. Refer to PB Associates' Report for details and also TransGrid's 2004 APR Sections 5.3.5 and 5.3.6.

The project consists of turning in Line 24 Newcastle – Vales point into Eraring and some 330kV line re-arrangements on the central Coast.

PB Associates has reviewed the information supplied regarding this project and also the additional planning studies requested for the TransGrid main system that confirm the benefits obtained by instigating the project. Accordingly PB Associates recommends that the project be included in the current capital works program.

89 Line – Connection at Armidale. This project involves the installation of a second breaker on line 89 which is the 330kV line which will supply both the new Coffs Harbour and the existing Lismore 330/132kV substations. The installation of a second breaker will result in a substantially higher reliability of supply to the far north coast of NSW, and will also facilitate programmed maintenance to be scheduled as and when required.. TransGrid have included an expenditure allowance of $2,535,669 and the Engineering group has scheduled the work for commissioning by 1 October 2006.

PB Associates has formed the view, based on reliability considerations, that this project should be included in the capital works program for the current control period.

Dapto Substation. This project is related to other small augmentation projects included in the Submission; including PB Associates Report Small Augmentations – Reactive Plant and Small Augmentations – Transformers. In this category TransGrid have included the establishment of additional feeder bays for Integral Energy to terminate a new feeder to their Mount Terry 132/33kV substation and the replacement of 330kV switchgear to accommodate the increasing fault level at the substation that was constructed in 1962.

TransGrid have included a total estimated expenditure of $8,715,688 during the current control period and the Engineering Group has scheduled the project for commissioning by 1 December 2006.

PB Associates has reviewed the information supplied by TransGrid for this project and agree that there is a high probability that Integral Energy will proceed with the construction of an additional line to their Mount Terry substation. In addition the increased fault level requires switchgear to be uprated and hence PB Associates recommends that the project be included in the capital works program for the current control period.

Finley 132kV Transformer Capacity Limits. The Finley Substation presently has a single 30MVA transformer which is programmed to be replaced 2008 due to the deterioration of the paper insulation. In addition due to increasing loads in the area it is also proposed to uprate the transformer to 60MVA. Some of the costs for this combined project are contained in the Asset Replacement Section relating to condition based transformer replacements. The uprated portions of the costs for the replacement of the existing 30MVA transformer are contained in this section.

Furthermore, due to the need to construct a new 132kV line to Mulwala as detailed in PB Associates Report Small Augmentations – New Lines, utilising the route of the existing Country Energy 66kV line Finley – Mulwala, Finley substation will lose the backup 66kV supply. Accordingly it will be necessary to install a second 60MVA transformer at Finley substation to provide firm supply. The full cost of this second transformer is contained in this project.

TransGrid have included an estimate of $4,395,422 for the total project and the Engineering Group has scheduled commissioning by 1 October 2007.

PB Associates notes that the transformer replacement has been scheduled for 2008 and the construction of the new 132kV line to Mulwala for 2011 with construction commencing in 2010. Accordingly whilst PB Associates has formed the view that the project should be included in TransGrid Capital works program it would recommend that the installation of the first transformer be scheduled for 2008 and that the second transformer be for 2010. This would result in an estimated expenditure for this project of $1,702,696 in 2008 and a further estimated expenditure of $2,692,726 in 2010.

Frequency Injection Points Kempsey, Port Macquarie and Taree Substations. These projects involve the establishment of 33kV frequency injection points at these TransGrid substations for Country Energy to inject load control signals into their respective networks. Country Energy require these injection points due the efficiencies involved with single point injection at higher voltage levels. These Country Energy areas have a very high penetration of off peak switched load.

TransGrid have allowed a total estimated expenditure of $1,225,000 during the control period and the commissioning dates of 1 June 2005 scheduled by the Engineering Group would, we believe, have been agreed in negotiation with Country Energy.

PB Associates has formed the view that these works have a high probability of proceeding, and hence should be included in the current capital works program.

Glen Innes Substation Rebuild. This substation was established as a temporary substation in 1970 and was tee connected onto the 96T Armidale – Lismore 132kV line. It supplies a single 66kV line to Country Energy's Glen Innes 66/11kV substation. The load in the area will exceed 20MVA in 2006 at which time planning requirements indicate firm capacity is required. This involves the construction of a second 132kV feeder into the substation and on-load changeover capability for the two transformers.

In addition Country Energy has requested an additional feeder bay at the substation[40] and that connection is required before summer 2005/06. As the existing substation was constructed as a temporary substation, TransGrid have proposed that the lowest cost option is to construct a new substation adjacent to the temporary substation. This will include the additional feeder bay, two incoming 132kV lines and on-load changeover facility for the two transformers.

The project is scheduled for commissioning by the Engineering Group by 1 April 2007 and the estimated expenditure through the current control period is $7,942,584.

PB Associates has formed the view that the project should be included in the current capital works program due the load at Glen Innes exceeding the 20MVA threshold for the provision of firm supply and the request for an additional feeder bay received from Country Energy.

Line Terminal Upratings. This project consists of uprating a number of line terminal bays on 330kV feeders in order to allow operation of the line at their full capacity. The Lines involved are 33 and 34 Bayswater – Liddell, 37 Kemps Creek – Avon, 23 Munmorah to Vales Point, 01 UTSS to Canberra, 02 UTSS to Yass, 24 Vales Point to Newcastle, 9 Yass to Canberra, 4 Yass to Marulan, and 5 Yass to Marulan. The work primarily involves the replacement of wave traps and in some locations CTs and disconnectors.

TransGrid have carried out detailed investigations into the scope of the work at each location and have included an estimate of $3,448,919 for expenditure during the control period and have scheduled the work for completion by 1 December 2005.

PB Associates has formed the view that as this work removes a constraint limiting the capacity of these lines it should be included in the capital works program.

Orange Substation 132kV Augmentation. The existing Orange substation was constructed by the NSW Government Railways and is hence located adjacent to the rail infrastructure. The site is constricted and it is not possible to substantially uprate the substation. There are currently three 30MVA transformers on site and it is proposed to replace them with two 120MVA transformers due to load growth requiring a firm capacity greater than the current 60MVA.

Due to the limitation on the existing site TransGrid propose to construct a 132kV bus bar and install the two new transformers on a new site located approximately 500 metres from the existing substation. They intend to retain the existing site for the 66kV busbar, which will be rebuilt, alleviating the need for Country energy to rearrange their 66kV feeders. The construction of a new 132kV bus will allow a two sections of 132kV bus to be installed which is more appropriate for a 132kV bus load of 140MW including the Cadia Mine load. In addition Feeder 947, Mt Piper – Wellington which is currently tee connected into the 132kV bus, will be looped in and out. This removes a constraint of low voltage on the 66kV orange bus bar in 2007 when the Mt Piper to Orange section of the line is out of service.

Two of the existing 30MVA transformers will be replaced 2008 due to their condition. Both transformers are English Electric units manufactured in the 1949 to 1953 period. They are both gassing, indicating the presence of hot spots, and are showing signs of advanced oil degradation and indicating a high moisture content in the insulating paper. The portion of the costs associated with the condition based replacements has been allocated to Asset Replacement – Transformer Replacements and upgrade portion is contained in this section.

40 Reference Country Energy letter dated 28 September 2004.

The Engineering Group has scheduled the project for completion by 1 April 2008 and has allowed an estimate of $15,968,854 for the project, excluding the condition based component, for the current regulatory period.

PB Associates has reviewed all the information supplied relating to this project and formed the view that it represents the best option to address the issues and constraints identified at Orange.

Murray and Upper Tumut Switching Station Refurbishments. These switching stations were transferred to TransGrid in 2002 and detailed investigations have been carried out into both the technical and physical condition of the electrical assets at both sites. At Murray switching station the investigations have revealed that the CT isolation and earth switches require replacement and that protection upgrades are urgently required. For example there are mismatches on the CTs requiring interposing CTs to be used to provide bus bar protection.

At Upper Tumut there are fault level limitations and a complicated jack bus bar arrangement. Work has been identified to substantially reduce the number of bus isolators by introducing the standard 'breaker and a half' configuration, and replace the isolators and earth switches and CTs.

TransGrid has scheduled this work for commissioning by 1 December 2007 and included an estimated expenditure of $15,099,052 for the regulatory period.

PB Associates has sighted the detailed engineering and condition reports produced as a result of the investigation into the condition of the assets and have formed the view that due to the criticality of these switching stations the projects should be included in the current capital works program.

Mount Annan 330kV Substation. This project involves the construction of a new dual voltage 330/132/66kV substation in the Mount Annan area to provide secure electricity supply to the Campbelltown/ Macarthur areas. Integral Energy has requested the establishment of the new bulk supply point[41]. The Campbelltown/Macarthur and South West Sector release area are experiencing very high load and customer growth.

Initially, TransGrid intend to install a single 375MVA 330/132kV transformer and a single 250MVA 330/66kV transformer. When required, an additional 330/132kV and an additional 330/66kV Transformer will be installed. 330kV supply will be provided by looping the existing 330kV Kemps Creek – Avon line into the next substation.

Integral Energy plan to connect four 132kV circuits and four 66kV circuits in the Mt Annan substation.

TransGrid have allowed an estimate of $24,083,742 for expenditure in the control period and the Engineering Group has scheduled the project for completion by 1 December 2008.

PB Associates has reviewed the supplied and requested information associated with this project and has formed the view that the project has a high probability of proceeding during the current regulatory period and hence should be included in the current capital works program.

Sydney North 132kV Fault Level Upgrade. This project involves the replacement of 132kV isolators and earth switches in order to improve the fault level at the 132kV bus bars at Sydney North substation. The driver for this project is the slowly decreasing network impedances as additional transformers and additional lines and cables are installed and commissioned.

41 By letter dated 2 September 2004.

TransGrid have allowed an estimate of $4,878,749 and the Engineering Group has scheduled the work for commissioning by 1 December 2006.

PB Associates has formed the view that this work should be included in the current capital works program.

Sydney East, Sydney North and Sydney West Duplicate Breakers. Currently at these substations, duplicate line breakers are used to provide bus coupling capability between the duplicate bus bars. Last summer bushfires caused concurrent outages on the two feeders from Sydney West which were fitted with the duplicate breakers and the bus coupling capability was lost until a feeder was restored.

TransGrid allowed an estimate of $5,467,759 and the Engineering Group has scheduled the project for commissioning by 1 December 2007.

PB Associates has reviewed the need for this project and considers that it involves increasing the reliability standard above the statutory requirement of N-1 and hence recommends that this project should not be included in the capital works program for the current control period.

Sydney West 132kV Switchbays. This project involves the establishment of two additional 132kV switchbays for Integral Energy. Integral Energy is commissioning two additional 132kV feeders to supply the increasing industrial load in the area including the old Australia Wonderland site.

TransGrid have allowed expenditure of $1,709,685 during the current period and the Engineering Group has scheduled the project for commissioning by 1 December 2006.

PB Associates has formed the view that there is a high probability of this project proceeding and hence recommend that the project be included in the current capital works program.

Sydney West Substation 132kV Fault Level Upgrade. This project involves the replacement of the existing disconnectors in order to facilitate an increase in fault level at the 132kV bus bar to 15,000MVA. The driver for this project is the slowly decreasing network impedances as additional transformers and additional lines and cables are installed and commissioned.

TransGrid has allowed an estimate of $2,312,914 for expenditure during the control period and the Engineering Group has scheduled the project for commissioning by 1 December 2007.

PB Associates has reviewed the information provided by TransGrid and has formed the view that the project should be included in the current capital works program.

Tomago 330/132kV Supply Point. This project involves the establishment of a new 132kV supply point on the northern side of the Hunter River for EnergyAustralia. The load at the EnergyAustralia 132/33kV substation has reached the stage where additional 132kV capacity is required. Establishment of this additional 132kV capacity also delays the need to replace the banks of 330/132kV single phase transformers located in the Newcastle substation. One of these banks is scheduled for replacement in 2005 due to the condition of the transformer.

TransGrid has allowed an estimate of $10,332,745 for expenditure on the project during the current control period and has scheduled the project for commissioning by 1 March 2008.

Although there are a number of options currently under consideration, PB Associates has formed the view that this project has a high probability of proceeding during the current regulatory period. Therefore, PB Associates recommends that the costs for the

establishment of the additional bulk supply point at Tomago be included in the capital works program..

Tuggerah 132kV Augmentations. This project involves the establishment of an additional 132kV switch bay and a 132kV bus section switch bay at Tuggerah substation so that EnergyAustralia can convert their Berkley Vale substation to a 132/33kV substation. This project is planned in conjunction with other related projects and is required to maintain reliable supply to the increasing loads on the Central Coast, refer to PB Associates Report Section 12 Small Augmentations –Transformers.

TransGrid have allowed an estimate of $2,823,376, including the provision of technical services, for expenditure on the project during the current regulatory period and has scheduled the project for commissioning by 1 October 2008. This aligns with the commissioning date for the installation of the second transformer at Tuggerah substation.

PB Associates has reviewed the information supplied regarding this project, refer planning report PLR 207, and accepts that there is a high probability of the work proceeding and therefore recommends that the project be included in the current capital works program.

Vineyard 132kV Line Switchbays. This project involves the construction of two additional 132kV switch bays for Integral Energy at the Vineyard substation. Integral Energy is currently constructing a new dual circuit 132kV line from Vineyard to their Rouse Hill substation.

TransGrid have included an estimate of $1,613,517 for expenditure on the project during the current regulatory period and has scheduled the project for commissioning by 1 December 2006.

PB Associates has formed the view that this project will be required during the current regulatory period and therefore recommends that it be included in the current capital works program.

6.6.6 Transformers

Armidale 132kV Transformer Augmentation. The two 132/66kV transformers at Armidale substation are 38 years old and approaching the end of their service life. In addition the firm capacity of the Armidale substation has been exceeded since 2004. In an emergency Country Energy has been able to reduce load by modifying their load control system. Load growth projections indicate that the firm capacity of the existing transformers will be exceeded by 2006 even allowing for the County Energy load control strategy. Refer to actual and forecast maximum winter demands in planning report PLR 201.

TransGrid propose to replace the two 30MVA 132/66kV transformers with 60MVA transformers and have scheduled the work for commissioning by 1 March 2006. An estimate of $2,026,556 has been allowed for the project during the current control period.

PB Associates has reviewed the load growth projections and has formed the view that the project should be included in the current capital works program.

Armidale 330KV Transformer Augmentation. This project involves the replacement and augmentation of No.1 and No.3 330/132kV 150MVA transformers at Armidale substation. Refer to 2004 APR section 6.3.1 Armidale, Vales Point, Vineyard, Wellington, Marulan and Yass 330/132kV Transformers. Currently there are three transformers at the substation two 150 MVA units and a one 200MVA unit. TransGrid's preferred option is to replace the two 150MVA units with 375 MVA units and scrap the two 150MVA units and then transfer the 200MVA unit to Marulan as a spare transformer. This option results in a standard two transformer arrangement at Armidale substation with standard system spares being available for both transformers.

The portion of the project relating to asset replacement has been accounted for in Asset Replacement – Major and Committed Projects – Transformer Replacements, and the augmentation portion of the estimated expenditure is contained in this section.

TransGrid have scheduled the project for commissioning by 1 June 2007 and this corresponds with the expenditure timing in the Asset Replacement category. The estimated expenditure for the augmentation portion of the project is $7,189,274.

PB Associates has formed the view that this project should be included in the current capital works program.

Marulan 330kV Transformer. This project involves the relocation of the 200MVA transformer from Armidale substation to Marulan to act as a system spare transformer. Refer to 2004 APR section 6.3.1 Armidale, Vales Point, Vineyard, Wellington, Marulan and Yass 330/132kV Transformers. Currently Marulan has a 42 year old 160MVA 330/132kV transformer identical to the 160 MVA units being replaced at Vales Point; and on replacement of the Vales Point units this transformer will be the last of its type in service. Refer planning report PLR 234. Due to the age and condition of the in-service transformer TransGrid propose to install additional switchgear so the spare transformer can be placed in service quickly if required. This work has been included in the estimate.

TransGrid have estimated that the transformer relocation will cost $1,918,031 and the Engineering group has scheduled the project for commissioning by 1 October 2007.

PB Associates considers this project to be prudent as it is maximising the life of the existing Marulan Transformer whilst managing the risk associated with this strategy, and hence recommends that the project be included in the current capital works program.

Vineyard 330 Transformer. The firm transformer capacity at the Vineyard substation will be exceed in 2005/06. Refer to the load growth projection in planning report PLR 224 and the 2004 APR section 6.3.1 Armidale, Vales Point, Vineyard, Wellington, Marulan and Yass 330/132kV Transformers. One of the existing 200MVA 330/132kV transformers was recently replaced with a 375MVA 330/132kV transformer and was relocated to the Yass substation which is undergoing refurbishment.

This project involves the replacement of the second 200MVA transformer at Vineyard substation with a new 375MVA unit. The 200MVA unit released by this project will be relocated to Vales Point substation to replace the 160MVA unit which has an EPA Prevention Notice requiring action to reduce noise levels. Refer to Section 1 of Small Augmentation – Substations for maintenance of the 33kV supply for EnergyAustralia at Vales Point substation and Asset Replacement – Regulatory Projects for the transformer replacement at Vales Point substation.

TransGrid has scheduled the project for commissioning by 1 November 2005 and has allowed an estimate of $6,073,160 for expenditure during the current regulatory period.

PB Associates has formed the view that this transformer replacement and subsequent re-arrangement of the existing transformer optimises the use of the transformer population, and recommends that the project be included in the current capital works program.

Wellington 330kV Transformer Augmentation. This project involves the replacement of the 200MVA transformer at Wellington Substation with a 375MVA unit. Refer to 2004 APR section 6.3.1 Armidale, Vales Point, Vineyard, Wellington, Marulan and Yass 330/132kV Transformers. Currently Wellington substation has two transformers, a 200MVA unit and a 190MVA unit and on the outage of either transformer the other is overloaded.

It is planned to relocate the 200MVA transformer to Vales Point to replace the system spare recently installed from Dapto substation which has a known fault. TransGrid have scheduled the replacement of the 190MVA transformer at Wellington in 2006 under Asset

Replacement – Major and Committed Projects – Transformer Replacements and the 190MVA transformer will be scrapped.

TransGrid have scheduled the project for commissioning by 1 May 2006 and has included an estimate of $5,944,374 for expenditure during the current control period.

PB Associates has reviewed the information supplied including the planning studies attached to planning report, PLR 228 and concurs with the need for the project and therefore recommends that it be included in the current capital works program.

Cowra Transformer Replacement. This project involves the initial expenditure associated with the replacement of the existing two 30MVA 132/66kV transformers at the Cowra substation with 60MVA units scheduled for commissioning during the next regulatory period. The actual and forecast summer maximum demands indicate that the firm capacity of the substation will be exceeded by 2009/10 at which time the higher capacity transformers will be required to be in service. Refer to planning report PLR 209 for details.

TransGrid have scheduled this project for completion by 1 October 2009 and has included an estimate of $1,082,628 for preliminary expenditure during this current period.

PB Associates has formed the view that the project is not required until 2010/11 and does not need to be commenced till 2009/10. We recommend that it should not be included in the current capital works program based on the load growth projection in the relevant planning report.

Dapto Substation, additional 375MVA Transformer. Dapto substation currently has three 375MVA 330/132kV transformers in situ and meets the statutory N-1 reliability standard. TransGrid has advised that the load factor at Dapto is high and propose to install an additional transformer to allow programmed maintenance of the existing transformers.

TransGrid has included an estimate of $7,177,297 for this project during the current control period and has scheduled the work for commissioning by 1 December 2008.

PB Associates has reviewed the information supplied by TransGrid and as the statutory reliability standards are currently being met does not recommend that this project be included in the current capital works program.

Kempsey 132kV Transformer Limitation. This project involves the replacement of the two existing 30MVA 132/33kV transformers at the Kempsey substation due to firm capacity of the transformers being exceeded by load growth. TransGrid propose to replace the existing transformers with 60MVA units and has scheduled the project for commissioning by 1 April 2009.

The Engineering Group has included an estimate of $4,000,745 for expenditure during the current control period.

PB Associates has reviewed the load growth forecasts and have formed the view that the project is not required until winter of 2010 and hence does not need to be commenced until the second half of 2009 and therefore can be deferred until the next regulatory period.

Koolkhan 132kV Transformer Augmentation. This project involves either the installation of a third 60MVA 132/66kV transformer or the replacement of the existing two 60MVA transformers. TransGrid have scheduled the project for completion in 2009/10 and hence only preliminary project expenditure of $325,156 has been included current regulatory period.

PB Associates has reviewed the information supplied regarding the load growth in the Koolkhan area, refer planning report PLR 212, and has formed the view that this project

is not required until the summer of 2010/11 and hence does not need to be commenced till the beginning of 2010 and therefore any expenditure can be deferred until the next regulatory period.

Parkes Second Transformer. The Parkes substation currently has a single 60MVA 132/66kV transformer and backup is provided via the Country Energy 66kV line 895 Forbes – Parkes. The load at Forbes is experiencing steady growth which is expected to continue growing at approximately the same rate. The load at Forbes has exceeded that ability of the Country Energy 66kV feeder to provide full backup and TransGrid have proposed to install a second 60MVA 132/66kV transformer to restore the statutory N-1 reliability standard.

TransGrid has scheduled the project for commissioning by 1 December 2007 and has allowed an estimate of $3,152,652 for the project during the current control period.

PB Associates has reviewed the information provided, in particular the load growth information in planning report PLR 209, and considers the timing of the project appropriate considering the magnitude of the load at risk. We therefore recommend that the project be included in the current regulatory period.

Port Macquarie 132/33 Transformer Replacement. Port Macquarie Substation currently has three 30MVA 132/66kV transformers supplying Country Energy's network. These transformers are fifty years old and are scheduled for replacement due to their condition. In addition the load at Port Macquarie continues to grow due to new and redevelopment in the area and hence the firm capacity of the existing 30MVA transformers will be exceeded by winter of 2007.

To address both these issues TransGrid proposes to install three 60MVA 132/33kV transformers to replace the existing units. Two of the transformers will be replaced under the Asset Replacement – Major and Committed Projects – Transformer Replacements category and the third transformer which is being installed due to load growth is included in this category.

TransGrid have included an estimate of $3,175,490 for the augmentation component of the project in the current regulatory period and have scheduled the project for commissioning by 1 April 2006.

PB Associates has reviewed the information contained in planning report PLR 214 relating to the load growth forecasts for the winter maximum demands in Port Macquarie and has formed the view that the third transformer is not required to be commissioned prior to winter of 2008 and therefore recommends that the project be included in the current capital works program but that the commissioning date be extended by 12 months until 1 April 2007.

Sydney South Transformers Nos. 1 & 2 Replacement. Sydney South substation currently has two 375MVA 330/132kV transformers and four 250MVA 330/132kV transformers in service. On the outage of either cable 41 or cable 42 the rating of transformers 2, 5 and 6 are exceeded. TransGrid propose to replace the 250MVA transformers No.1 and No.2 with 375MVA units so that all transformers connected to the 132kV bus bar have the same capacity. Transformers No.3 and No.4 are tail ended to 132kV transmission lines.

The planning studies detailing the overload situations are attached to planning report PLR 223. These planning studies indicate that the modified N – 2 reliability standard adopted jointly by TransGrid and EnergyAustralia and exceeded on an outage of either cable 41 or 42 and one of the four 330kV transformers connected to the bus bars at Sydney South substation. TransGrid has included an estimate of $12,146,322 for expenditure during the current control period for this project and has scheduled the project to be commissioned by 1 December 2007.

PB Associates has reviewed the information provided and requested additional planning studies to confirm that the overload situation is removed by TransGrid's preferred option. These studies cannot be provided prior to publication of this report due to the dependence on the EnergyAustralia network projects such as the installation of phase shifters on the Kurnell – Bunnerong cables and retiring the Canterbury – Bunnerong cables.

PB Associates has relied on the TransGrid planning studies alone and has formed the view that the project should be included in the current capital works program because load growth indicates that it is unlikely that this project could be deferred and more probable that the replacement of the remaining 250MVA transformers would be advanced.

Tuggerah second 330kV Transformer and Switchgear. By summer of 2008/9 the load on the Central Coast is projected to exceed the capacity of 132kV systems from Munmorah, Vales Point and Sydney East to supply the load on the outage of either the 330kV line Sterland – Tuggerah or the 330/132kV transformer at Tuggerah. The single circuit line between Sterland and Tuggerah was recently reconstructed as a double circuit line and TransGrid propose to overcome this contingency by completing the 330kV mesh bus bar at Tuggerah, operating the Sterland – Tuggerak 330kV line as a dual circuit and installing a second 375MVA transformer at Tuggerah substation. This will provide firm supply at Tuggerah substation.

This project was commenced during the last regulatory period with the reconstruction of the existing single circuit 330kV Sterland – Tuggerah line as a double circuit line.

TransGrid have included an estimate of $12,650,409 for expenditure on the project during the current regulatory period and have scheduled the project for commissioning by 01/10/2008.

PB Associates has reviewed the planning report PLR 207 and noted that the timing of the project correlates with the EnergyAustralia planning study indicating the inability of the 132kV network to maintain voltage levels on the loss of the 132kV supply from the existing Tuggerah substation. PB Associates therefore recommends that the project be included in the current capital works program.

6.6.7 Committed Projects

Coffs Harbour 330/132kV Substation. This Project consisted of the construction of a new 330/132kV substation adjacent to the existing 330kV Line Armidale to Lismore. It was commenced during the last regulatory period but the majority of the expenditure will occur during this current control period. Refer to Planning Report PLR 216. It is scheduled for commissioning by winter of 2006. The project was commenced as a result of unacceptably low voltages on the outage of either 965 Armidale – Kempsey or 96C Armidale – Coffs Harbour, and the project has a positive cost benefits due to the savings in system losses. TransGrid's estimate of expenditure to be incurred in this regulatory period is $24,256,000.

Coleambally 132kV Substation. This Project comprised of a small amount of outstanding work relating to the installation of the second transformer at Colleambally 132kV Substation, which was substantially completed during the last regulatory period. TransGrid's estimate of expenditure to be incurred during this current regulatory period is $40,000.

Darlington Point Communications. This Project consists of the construction of a new microwave radio link from Wagga to Darlington Point. It was commenced during the last regulatory period but the majority of the expenditure will occur during this current control period. Refer to Outline Plan OLP10 for details. The project was commenced as a result of the need to meet the NEMMCO Standard for Power System Data Communications

and for SCADA . TransGrid's estimate of outstanding expenditure to be incurred during this current regulatory period is $528,000.

Inner City Substation and Cable Works. The MetroGrid project was commissioned on 10/10/2004 and this project incorporates two components. The first is the final contract payments for the project and the second relates to remedial works instigated after the project was completed. TransGrid have not included any allowance for the settlement of any contractor disputes in this project.

Final contract payments totalling $4,199,000 including:

- TransGrid supervision costs for repairs by Toshiba on diverter under defects liability - $44k
- Determination of final claims and payments, claims consultant and TransGrid administration -$184k
- TransGrid's Haymarket Commissioning Costs - $428k
- Cable Contract Completion Costs – other Utilities - $821k
- Cable Contract Completion Costs – Mitsui Contract Defects - additional and outstanding works to optimise cable capacity - $2.621k
- MetroGrid Post Project Reviews - $101k

Remedial Works totalling $13,635,000 including

- Haymarket Civil Works – Ultimo Road works and building Finishes - $313k
- Haymarket SF6 Gas Management – Design and construction of gas containment walls around transformers and reactor and purchase of gas vacuum compression cart - $732k
- Haymarket Defects – Resolve issues to obtain BCA certificate and resolve outstanding Siemens Defects and minor additional works - $433k
- Haymarket Contract – Determine outstanding Siemens Claims - $1,190k
- Tunnel Surface Building Works – Urban design Treatment of structures - $545k
- Ultimo Pedestrian Network Landscaping - $1,352k
- Sydney South Control/Protection Commissioning - $119k
- Cable 42 Contract Completion Costs – Restoration and Georges River National Park regeneration costs - $673k
- Tunnel Contract Finalisation and Arbitration - $2,709k
- Tunnel Defects and Omissions Works – including resolution of remaining defects, additional tunnel support to improve maintenance intervals, additional water control - $4,713k
- Tunnel Security Works – including high level security at entry points, intruder alarms and security fencing - $856k

TransGrid's estimate of outstanding expenditure to be incurred during this current regulatory period is $17,700,000 but the details provided to PB Associates total $17,834,000. The MetroGrid project is the subject of separate discussions between the ACCC and TransGrid and therefore PB Associates has not included any recommendations regarding this expenditure.

Koolkhan 132kV Substation. This Project consisted of the uprating of the existing transformers to 60 MVA transformers and the installation of two additional 66kV feeder bays for Country Energy. It was commenced during the last regulatory period and the majority of the expenditure has already been incurred. Refer to Planning Report PLR 212 for details. The load at the Koolkhan substation is growing rapidly and the transformer capacity will require uprating again by 2009/10. The project was commenced as a result of the firm capacity of the existing transformers being exceeded due to the rapid load growth in the area. TransGrid's estimate of expenditure to be incurred during this current regulatory period is $400,000.

Liverpool Third Transformer. This Project consisted of the installation of a third 375MVA 330/132 kV transformer in the Liverpool Substation. The high load growth in the Liverpool/Camden/Campbelltown areas has resulted in the load exceeding the firm capacity of the existing two transformers in summer 2002/03 and 2003/04. The project was commenced during the last regulatory period but the majority of the expenditure will occur during this current control period. Refer to Planning Report PLR 215. TransGrid's estimate of outstanding expenditure to be incurred during this current regulatory period is $4,161,000.

Newcastle 330kV Substation. This Project relates to the work required at the Newcastle substation to facilitate operation of Lines 95 and 9W at 330kV in order to supply the additional load at the Tomago smelter. The project consisted of the construction of an additional 330kV switchbay at the Newcastle substation. TransGrid's estimate of expenditure to be incurred during this current regulatory period is $901,000.

Southern Communications Upgrade. This Project consisted of the upgrading of the PLCs and other obsolete communication equipment in the South of the state. Construction was commenced during the last regulatory period but the majority of the expenditure will occur during this current control period. Refer to section 5.5.40 of the TransGrid Submission. TransGrid's estimate of expenditure to be incurred during this current regulatory period is $1,793,000.

Sydney West New 132kV Switchbay. This Project consisted of the construction of switchbay for Integral Energy. The Project was commenced during the last regulatory period and TransGrid's estimate of outstanding expenditure to be incurred during this current regulatory period to complete the works is $100,000.

Tomago 330kV Switching Station. This Project relates to work associated with the operation of Lines 95 and 9W at 330kV in order to supply the additional load to the Tomago smelter. The project consisted of alterations to the feeder switchbays at Tomago Switching Compound and the 330kV Tomago substation to facilitate lines 95 and 9W to operate at 330kv. Construction was commenced during the last regulatory period and TransGrid's estimate of expenditure to be incurred during this current regulatory period is $440,000.

Tuggerah Sterland Upgrade. This Project consisted of the construction of a new double circuit 330kV line along the route of an existing single circuit 330kV line. The work was commenced during the last regulatory period to take advantage of windows of opportunity that allowed the single 330kV line to be taken out of service. The project is a preliminary part of a larger project designed to increase capacity to the Central Coast, refer to Planning Report PLR 207. TransGrid's estimate of expenditure to be incurred during this current regulatory period is $250,000 and this relates to removal of sections of the decommissioned single circuit line and restorations works associated with the easement.

Vales Point and Munmorah Switchyard Uprating. This Project consisted of uprating terminal equipment at both Vales Point and Munmorah as a result of the uprating of Line 23. It includes the uprating of CTs and Line Traps etc and construction was completed during the last regulatory period. TransGrid's estimate of expenditure to be incurred during this current regulatory period is $100,000.

Vineyard No.1 Transformer Replacement. This Project consisted of the upgrading of No.1 transformer to 375MVA and the relocation of the existing 200MVA transformer to the Yass substation. Construction was commenced during the last regulatory period but the majority of the expenditure will occur during this current control period. Refer to Planning Report PLR 225. The project was commenced as load growth in the area would result in the firm capacity of the Vineyard substation being exceeded by 2005/06. TransGrid's estimate of expenditure to be incurred during this current regulatory period is $4,385,000.

Vineyard No.2 Transformer Replacement. This Project consisted of the upgrading of No.2 transformer to 375MVA and the relocation of the existing 200MVA transformer to the Vales Point substation. Construction was commenced during the last regulatory period but the majority of the expenditure will occur during this current control period. Refer to Planning Report PLR 225. The project was commenced as load growth in the area would result in the firm capacity of the Vineyard substation being exceeded by 2005/06. TransGrid's estimate of expenditure to be incurred during this current regulatory period is $3,808,000.

Waratah West 330kV Substation. This Project consisted of the installation of a 375 MVA 330/132 kV transformer at Waratah West Substation. The load growth in the Newcastle area will be met initially by providing additional 132kV capacity at Waratah West. However additional transformation reliability will be required in the Newcastle area and is subject to EnergyAustralia's requirements. Establishing additional 132kV capacity at Waratah West avoids the need for EnergyAustralia to install additional circuits across the Hunter River. Construction was commenced during the last regulatory period but substantial additional expenditure will be incurred during this current control period. Refer to Planning Report PLR 219 for details. It is required to be commissioned by 2006/07. TransGrid's estimate of expenditure to be incurred during this current regulatory period is $3,773,000.

Wollar –Wellington 330kV Augmentation This project consists of the construction of a new 330 kV line from the proposed Wollar switching station to the Wellington substation, including an additional landing bay at Wellington Substation and associated communication works. Only minor works were included in the last regulatory period and most of the expenditures will be incurred during the current period.

The project was commenced for the following reasons:

- The underlying 132 kV network cannot supply the load at times of peak demand, if the existing 330 kV line 72 experiences an outage.

- Planning studies carried out show that during summer 2004/2005 if line 72 is out of service the voltage at Wellington substation busbars falls to 0.8 per unit at times of peak demand. In addition, loading of the four 132 KV feeders from Wallerawang/Mt Piper exceed their sustained emergency rating.

- During winter 2005 if line 72 is out of service during times of peak demand than the voltage at the Wellington Substation busbar falls to 0.78 per unit and the loading on the four 132 KV feeders from Wallerawang/Mt Piper exceed their sustained emergency rating.

This situation is unacceptable as the Country Energy 132 kV network extends approximately 400 km further west of Wellington supplying the western area of the State out to Cobar. TransGrid's total estimate of expenditure to be incurred during the current regulatory period is $73,991,000.

The ACCC has also received correspondence from an interested party in relation to this project and subsequently discussions were held between ACCC, PB Associates and the interested party. The interested party made the following assertions:

- The exiting 330 kV line is extremely reliable and therefore another line is not required.
- The probability of an outage on the existing line is very low due to the inherent liability of the individual components of the existing line.
- TransGrid purportedly stated that the new line should have been commissioned some time ago and as it had not been needed for some time why is it required now.
- Based on outage frequency the money being spent on the Wollar-Wellington line could be more effectively spent on the Country Energy Network.
- Adoption of the N-1 planning standards by transmission and distribution businesses in NSW was resulting in excessive expenditure on infrastructure.
- The load forecast used by TransGrid were too high and did not take into account issues such as remaining mine lives which could reduce load if the operation ceased.
- TransGrid did not factor appropriate generation options into its analysis before proceeding with the construction of the new 330 kV transmission line.

PB Associates raised the following points:

- The acceptable voltage level at the Wellington Substation busbars was 1.0 per unit and that if line 72 was out of service at peak times then the planning studies indicated that load would have to be shed to maintain acceptable voltage levels and to reduce the loading on 132 kV feeders.
- It appears that TransGrid had appropriately applied the statutory N-1 reliability standard considering the magnitude of the connected load and the large geographical area supplied by these network elements.
- That determination and application of the appropriate planning standards was a State issue and any variation from the statutory N-1 standard had to be agreed between the transmission and distribution operators

Committed Condition Based Projects. These projects, Yass Substation and Sydney West SVC, have been addressed in the Asset Replacement section of this report under the Committed Asset Replacement Projects category.

TransGrid's total estimate for committed projects in the current regulatory period is $136,626,000 including the MetroGrid project.

6.6.8 Technical Services – Miscellaneous (Communications)

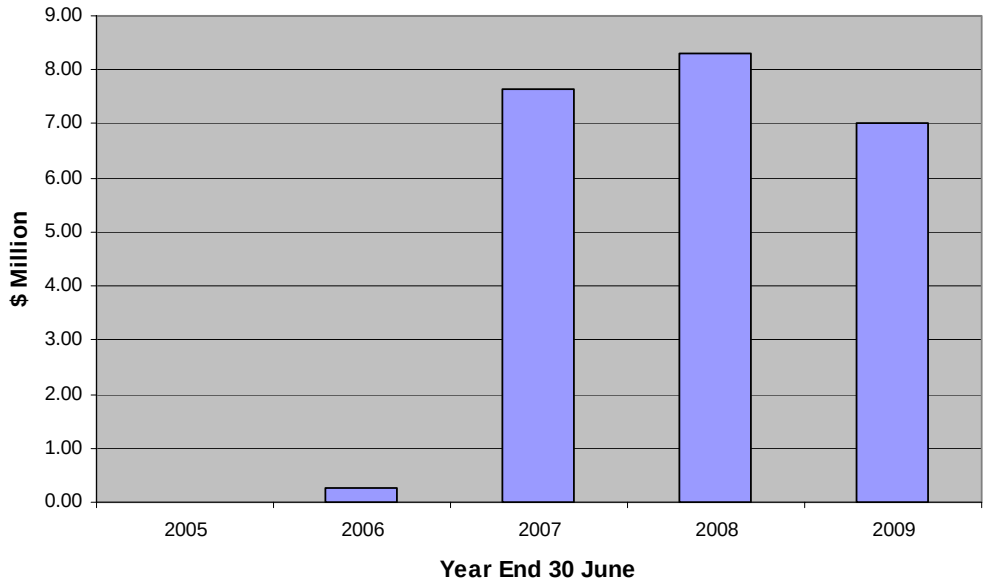
This category of expenditures relates to the augmentation of communication systems for protection and SCADA. TransGrid's electricity network relies heavily on communication systems for system automation and control, as well as continual feedback on supply and voltage throughout the grid. Maintaining these communication links is fundamental to security of supply and operation of the NEM.

TransGrid has submitted a proposed capital expenditure program for the augmentation of these communication systems. This is given in Table 6-8.

Table 6-8 – Communication Capital Expenditure Program ($2004) – ($M)

Year End 30 June	2005	2006	2007	2008	2009	Total
Darlington Pt Radio Development SCADA	0.00	0.00	2.75	0.00	0.00	**2.75**
Darlington Pt Radio Development Subs	0.00	0.11	0.17	0.00	0.00	**0.28**
Hume SCADA	0.00	0.00	0.00	0.00	0.88	**0.88**
Hume Subs	0.00	0.00	0.00	0.04	0.05	**0.09**
Lismore to Dumaresq SCADA	0.00	0.00	0.00	4.84	0.00	**4.84**
Lismore to Dumaresq Subs	0.00	0.00	0.19	0.29	0.00	**0.48**
Minor Technical Services Projects	0.00	0.00	0.00	0.00	0.22	**0.22**
New England SCADA	0.00	0.00	0.00	0.00	0.04	**0.04**
North Coast SCADA	0.00	0.00	4.18	0.00	0.00	**4.18**
North Coast SCADA	0.00	0.17	0.25	0.00	0.00	**0.42**
OPGW Backup: Southern	0.00	0.00	0.00	0.00	0.13	**0.13**
OPGW Backup: Western SCADA	0.00	0.00	0.00	0.00	2.31	**2.31**
OPGW Backup: Western Subs	0.00	0.00	0.00	0.09	0.14	**0.23**
Radio Replacement SCADA	0.00	0.00	0.00	2.75	0.00	**2.75**
Radio Replacement Subs	0.00	0.00	0.11	0.17	0.00	**0.28**
Snowy OPGW Augmentation SCADA	0.00	0.00	0.00	0.00	2.97	**2.97**
Snowy OPGW Augmentation Subs	0.00	0.00	0.00	0.12	0.18	**0.30**
South Western NSW Development Subs	0.00	0.00	0.00	0.00	0.10	**0.10**
Total	**0.00**	**0.28**	**7.65**	**8.29**	**7.01**	**23.23**

Figure 6-2 –Projected Technical Services Capital Expenditures



The expenditures in this category of Technical Services relates substantially to the need to upgrade communications systems to enable compliance with changes to the NEC standards. In their submission, TransGrid make the following statement:

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

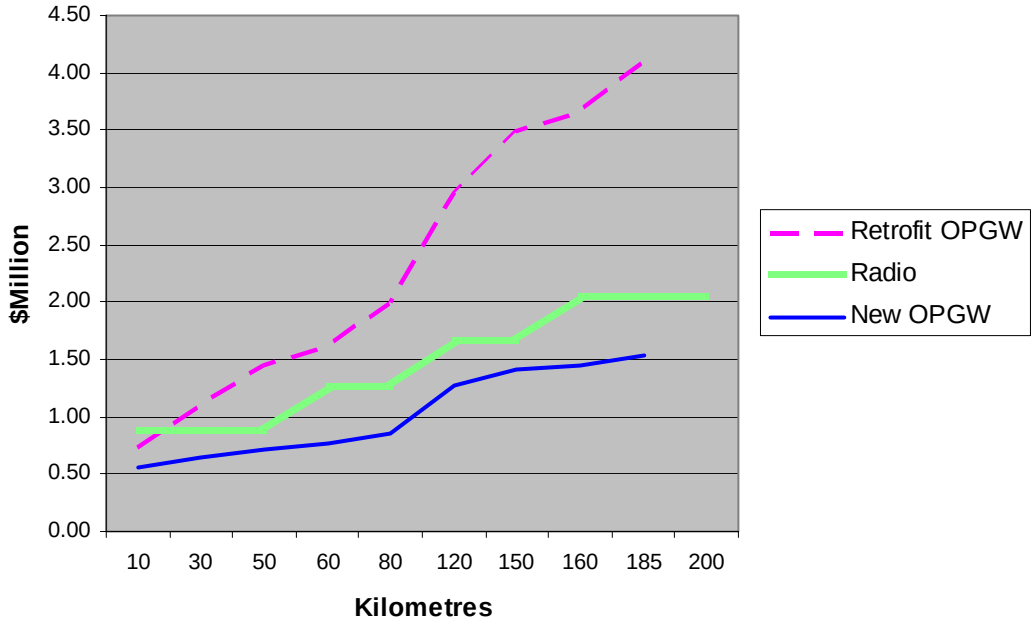
via microwave radio links with some sections of new OPGW links. It is intended that a number of strategically formed "broad loops" (as shown in the diagram in this Section) will be developed to provide the increased communication security as required by the NEC.

The projects highlighted in Table 3-1 identify those projects which relate specifically to compliance with the new standard. This amounts to $15.6m or 67% of the total proposed amount. Other proposed expenditures are based on upgrading facilities in line existing code requirements and standards.

The TransGrid application includes $23m for these investments over the next 4 years (note that no amounts were entered for costs during 2004/05). PB Associates is therefore required to provide an opinion as to the bona fide nature of the arguments for these projects and, the efficiency of the proposed alternatives and expenditures.

PB Associates has reviewed the National Electricity Code (NEC) requirements and acknowledges that alternative communication rings provide a reasonable long term solution for improving the security of communications and associated monitoring and control of the NSW transmission network. In reviewing the alternative approaches to achieving these ring services, PB Associates has looked at the underlying costs for the various approaches and discussed these in detail with TransGrid. PB Associates also reviewed calculations underpinning reliability estimates and deficiencies relative to NEC requirements as well as costing information relating to the feasible alternatives. PB associates believe the calculations have been reasonably based and that in general the approaches proposed are likely to be the most cost effective. Proposed projects cover those areas where TransGrid cannot reasonably expect to meet reliability requirements under the Code and applicable standards. TransGrid and PB Associates have based their assessments to some extent on the following diagram in applying "rule of thumb" estimates for the likely alternatives.

Figure 6-3 – Estimated Costs by kilometres for OPGW and Radio Communications



As Figure 6-3 shows, including OPGW onto lines during construction generally provides the least cost option for communications. However, to include OPGW on existing lines can be expensive and in some cases problematic.

During discussions with PB Associates, TransGrid advised that OPGW on transmission towers has a slightly higher exposure to the risks of outages than microwave radio

systems due to the additional support towers involved. TransGrid also advised that OPGW technology *"has difficulty reaching distances greater than about 160km, and the current practical limit is around 180km,"*

PB Associates has reviewed the proposed communication solutions for each of the sites and generally concurs with TransGrid on the preferred options. However, PB Associates has three main concerns with the proposed expenditures:

1. the costs include an amount for engineering scoping factors which were double counted in the final application table;

2. TransGrid has not provided details regarding opportunities to use existing communication carrier services that might be available in some regions; and

3. the use of readily available equipment throughout the TransGrid system has resulted in some portions of the communications network with unused capacity that may be able to be used for non-regulated income.

In relation to the engineering scoping factor, a flat 10% has been removed by PB Associates from each project.

In relation to using external communications carriers, it is difficult to establish whether these services could be secured at lower cost and within the reliability levels required for the electricity system security. PB Associates has formed the view that this is an area where TransGrid should explore in more detail for future expenditure submissions. However, we share TransGrid's concerns regarding reliability and therefore at this time generally support TransGrid's proposed approach.

In relation to the excess capacity in some areas, PB Associated believes that, as with the previous issues, there is scope for TransGrid to offer communications capacity to the market as well as to electricity distributors. An example of this is the north coast where TransGrid acquired Macrocom as a base for its microwave systems in that region. This appears to have been an efficient partial solution, as the technology works well with the existing TransGrid network to provide route diversity for mission-critical applications like SCADA and protection signalling. The unused capacity within the network can be made available for unregulated purposes if a need arises or can be identified. In the case of OPGW it would be reasonable to assign the cost of "lighting up" currently unused fibre capacity to the external business development segment of the business, where that capacity is not required for internal services.

PB Associates was also advised during the review that TransGrid had not incorporated expenditures relating to minor communications works. Their original costing information had these expenditures timed for the next regulatory period, however they indicated that they should have applied an amount to each year of the period. In a revised submission TransGrid provided an estimate of $2.8m for 5 years. In considering whether this amount is reasonable PB Associates notes that the program is insufficient in the early stages of the regulatory period. PB Associates has therefore allowed for an amount of $0.5m p.a. for the regulatory period.

A final area where PB Associates believes TransGrid's proposed expenditures could be revised is in relation to the communication link between Lismore and Dumaresq. TransGrid has made the following statement in their Application.

"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."

In discussions with TransGrid, it has been acknowledged that it should be technically feasible to use the Powerlink network to provide a communication link from the north coast Macrocom system to the existing service at Dumaresq. It is envisaged that Powerlink would have sufficient available capability to meet TransGrid's requirements,

however, this service would be on commercially negotiated terms. It is therefore likely in our view that the terms would be less than the full cost of the Lismore to Dumaresq link ($5.5m).

In determining whether the amount for inclusion in TransGrid's capital expenditure proposal PB Associates is concerned firstly, that the amount could range between zero and $5.5m, and secondly, that the ACCC is responsible for revenue decisions relating to Powerlink which would incorporate communication costs. This raises the issue of deriving an appropriate sharing of costs between Queensland and NSW customers which reflects optimal joint planning similar to that applied for the electricity network interconnection. If Powerlink's system is available for use, the costs would also be incurred as operating expenses, rather than capital. On this basis, PB Associates recommends that this project not be included in the proposed capital program for TransGrid as it does not represent in our view the most efficient solution.

Summary – Technical Services (Communications)

Based on the findings presented in this section, PB Associates recommends the following capital expenditure allowances for Technical Services for the current regulatory period.

Table 6-9 – Technical Services Recommended Capital Program ($m[42])

Year End 30 June	2005	2006	2007	2008	2009	Total
Darlington Pt Radio Development SCADA	0.00	0.00	2.48	0.00	0.00	**2.48**
Darlington Pt Radio Development Subs	0.00	0.10	0.15	0.00	0.00	**0.25**
Hume SCADA	0.00	0.00	0.00	0.00	0.79	**0.79**
Hume Subs	0.00	0.00	0.00	0.03	0.05	**0.08**
Lismore to Dumaresq SCADA	0.00	0.00	0.00	0.00	0.00	**0.00**
Lismore to Dumaresq Subs	0.00	0.00	0.00	0.00	0.00	**0.00**
Minor Technical Services Projects	0.50	0.50	0.50	0.50	0.50	**2.50**
New England SCADA	0.00	0.00	0.00	0.00	0.04	**0.04**
North Coast SCADA	0.00	0.00	3.76	0.00	0.00	**3.76**
North Coast SCADA	0.00	0.15	0.23	0.00	0.00	**0.38**
OPGW Backup: Southern	0.00	0.00	0.00	0.00	0.11	**0.11**
OPGW Backup: Western SCADA	0.00	0.00	0.00	0.00	1.98	**1.98**
OPGW Backup: Western Subs	0.00	0.00	0.00	0.08	0.12	**0.20**
Radio Replacement SCADA	0.00	0.00	0.00	2.48	0.00	**2.48**
Radio Replacement Subs	0.00	0.00	0.10	0.15	0.00	**0.25**
Snowy OPGW Augmentation SCADA	0.00	0.00	0.00	0.00	2.54	**2.54**
Snowy OPGW Augmentation Subs	0.00	0.00	0.00	0.10	0.15	**0.25**
South Western NSW Development Subs	0.00	0.00	0.00	0.00	0.09	**0.09**
Total	**0.50**	**0.75**	**7.21**	**3.34**	**6.36**	**18.15**

In making these recommendations PB Associates notes that there were discrepancies identified in the review process which must also be taken into consideration when drawing conclusions regarding the overall integrity of the data. Nevertheless, PB Associates believes that, in general, the processes employed by TransGrid in preparing these estimates were reasonable and that staff had been cooperative and transparent in providing information for the review. It is therefore believed that the figures included above are a sound representation of TransGrid's underlying Technical Services expenditure requirements.

42 2004 dollars.

6.6.9 Summary of Findings and Recommendations for Small Augmentations

One of the main issues identified by PB Associates in reviewing the small augmentation projects is that TransGrid omitted several capacitor banks which were included in the planning studies assessed during the review process. These capacitor banks were located at the proposed Cooma switching station, Cooma substation and Deniliquin substation and have subsequently been included in PB Associates recommendations.

PB Associates has recommended that Line 966 upgrade be deferred by using network support from Directlink, and Line 875 be upgraded to 132kV operation as soon as possible and that the work be included as a small augmentation project. In addition, the replacement of the series reactor in Cable No. 41 has been included in both asset replacement and small augmentation and PB Associates has recommended that the project be removed from the small augmentation category.

PB Associates has also recommended that the reactive power projects at Narrabri substation be deferred until the next period, the Nambucca substation capacitor bank be removed from the submission and the replacement of the second Tamworth reactor not be included in the current capital works program. Other projects not recommended for inclusion in the capital works program include duplicate breakers at Sydney East, West and North substations, and transformer replacements at Cowra, Dapto, Kempsey and Koolkhan substations. PB Associates also noted the inclusion of additional Technical Services costs which have been removed in formulating its recommendations.

In relation to Technical Services expenditure, PB Associates has made three adjustments.

- removal of a 10% engineering factor already included in the base cost estimates;
- an additional allowance of $0.5m p.a. for minor communications expenditures overlooked in TransGrid's Application; and
- the Lismore to Dumaresq line has been removed pending negotiations with Powerlink to link communications from Brisbane to QNI. The amount removed is $5.5m.

The PB Associates recommended expenditures for small augmentations over the period compared with TransGrid's estimates in their Application and PB Associates recommended variations costed using TransGrid's estimates are shown in Figure 6-4.

Figure 6-4 – Small Augmentation Proposed Capital Expenditures ($2004)

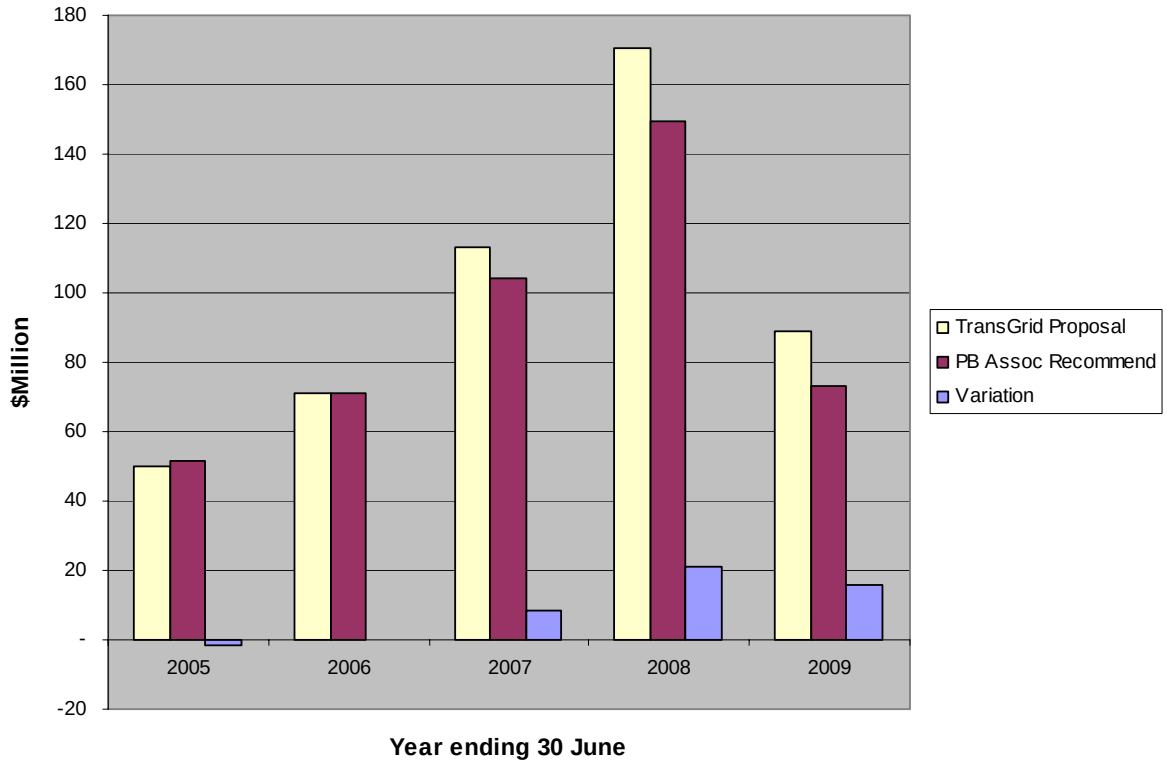
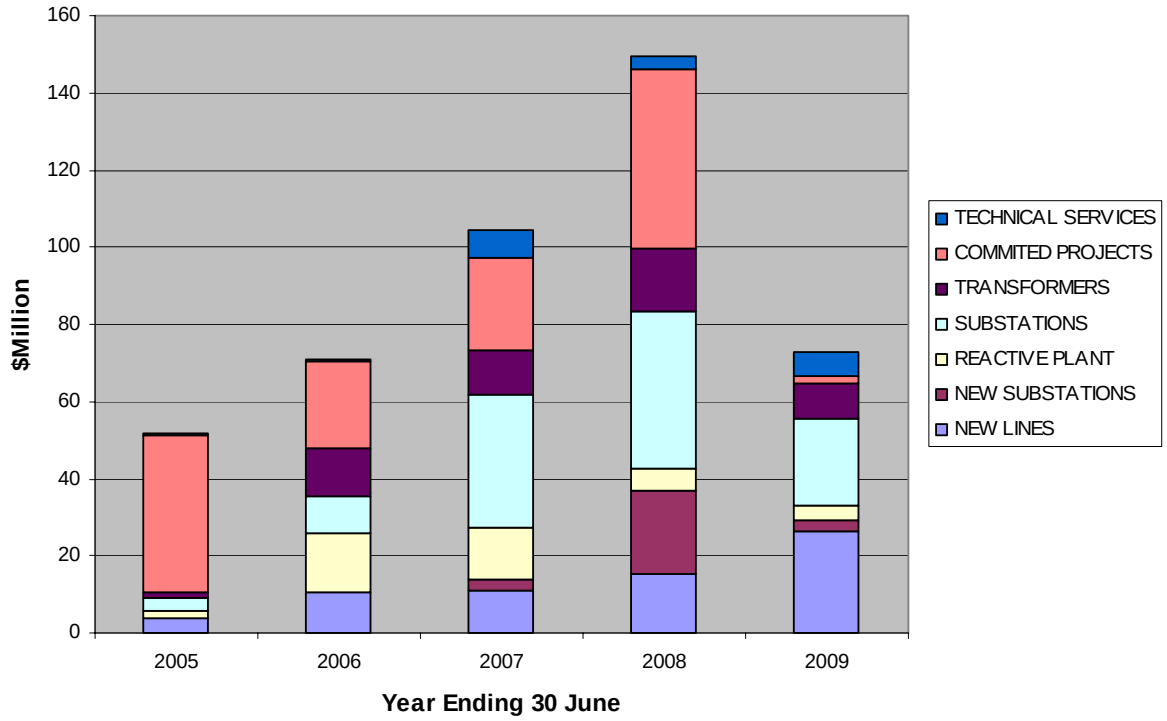


Figure 6-5 indicates the breakdown by category of the PB Associates recommended yearly expenditures.

Figure 6-5 – PB Associates Recommended Small Augmentation Capital Expenditures by Category ($2004)



6.7 PROPERTY ACQUISITIONS AND SURVEYS (INCLUDING EASEMENTS)

The costs of easements and the increasing challenges of land and easement acquisitions required to facilitate augmentations of the transmission network have placed considerable emphasis on ensuring rigorous project evaluations and route selections well in advance of the need to accommodate load requirements.

The lead times for land and easement acquisitions along with environmental impact assessments and surveys can be up to four or five years depending on the route length and geographic area. As a result, PB Associates has placed considerable importance on the review of property expenditures, particularly in relation to the governance arrangements employed (which can significantly affect the levels of litigation and ease of negotiations for TransGrid), and the expenditure levels projected for each project under consideration.

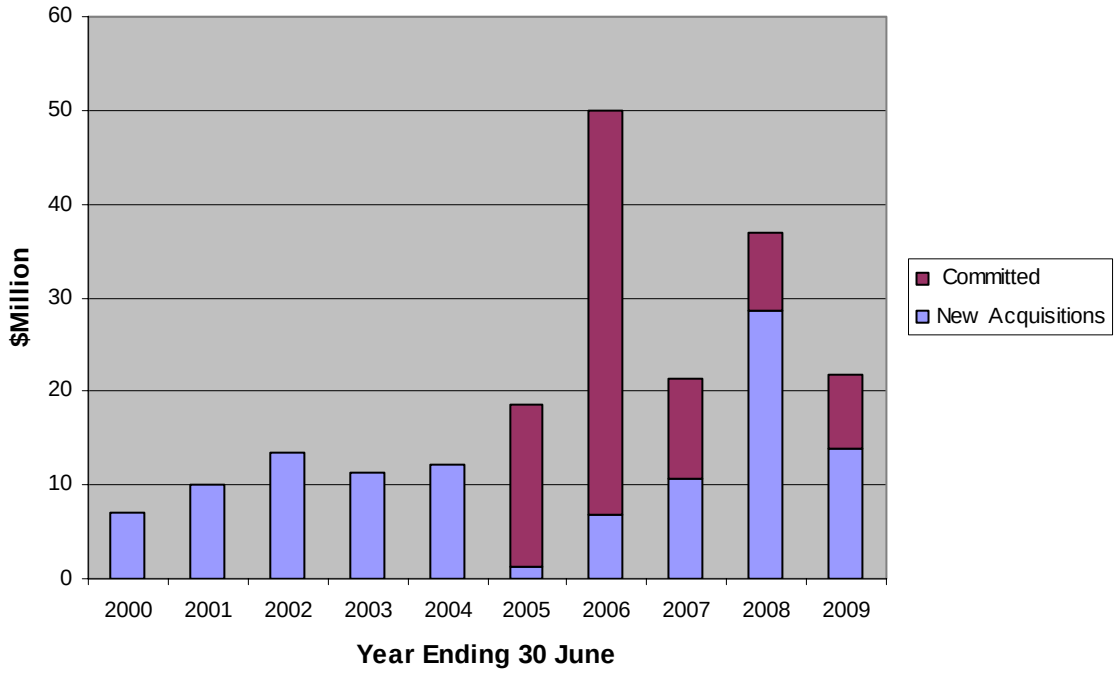
PB Associates has separately identified the required timing of load requirements for augmentation projects as discussed earlier in Section 6. Where PB Associates has recommended that projects be deferred or not undertaken at this time the associated property costs have been adjusted.

TransGrid has proposed a total of $149m over the regulatory period for property acquisitions and surveys made up of $87m for "Committed and On-going Works" and $61m for new "Augmentation Projects". TransGrid provided a detailed schedule of all property costs relating to each project on an annual basis and this is summarised in Table 6-10.

Table 6-10 – Property Capital Expenditure History and Projections ($2004) – ($M)

Year Ending 30th June	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
New Acquisitions	7	10	13.4	11.4	12.2	1.32	6.79	10.58	28.69	13.98
Committed						17.33	43.27	10.76	8.29	7.74
Total Property	**7.00**	**10.00**	**13.40**	**11.40**	**12.20**	**18.65**	**50.06**	**21.34**	**36.98**	**21.72**

Figure 6-6 – Property Capital Expenditure History and Projections ($2004)



The dramatic increase in proposed new acquisitions/easements reflects TransGrid's proposed and potential (Excluded Projects) augmentation program in 2008 and 2009. Figure 6-6 also shows that committed projects continue to represent a substantial component of the program throughout the regulatory period. The following discussion identifies the key drivers for these increases and provides PB Associates' views on these proposed expenditures.

6.7.1 Property Group Structure

The significance of the property budget is reflected in the governance arrangements and resourcing of property acquisitions within TransGrid. PB Associates devoted considerable time to the investigation of TransGrid's property management and cost estimation processes to ensure that the figures presented to the ACCC were appropriate.

The Property Group within TransGrid currently consists of 5 key areas reporting to the Property Manager. These are:

- Survey;
- Property Information Enquiry Service;
- Acquisitions and Valuation;
- Administrative Services; and
- Property Services and Sales.

This structure is traditional and functionally based, however it is proposed that the group will move to a new structure in the near future to reflect the need for full integration with network planning to ensure congruence between proposed augmentation works and property investigations and acquisitions. The proposed structure focuses upon four key areas:

- Property Planning;
- Survey and Property Information;
- Land Access; and
- Property Asset Management.

It is planned that this new structure will facilitate governance procedures for efficient property management. PB Associates has reviewed the key property procedures documents including:

- Acquisitions of Property (AD LA G3 706);
- Compensation Offers and Payments (AD LA G3 704); and
- Valuation Reports (AD LA G3 703).

These procedures describe the key process relating to incurring property expenditures. PB Associates believes the underlying procedures for managing the costs of property acquisitions and easements are reasonable.

6.7.2 Property Cost Projections

As shown in Figure 6-6 property costs for TransGrid are projected to increase substantially over the coming regulatory period. The main reasons for this increase relate to costs for committed projects as shown in Table 6-11.

Table 6-11 – Property Capital Expenditure Program ($m)

Year Ending 30th June	2005	2006	2007	2008	2009	Total
Easement Acquisition	0.73	1.47	9.38	28.37	13.80	**53.75**
Site Acquisition – Substations	0.59	5.32	1.20	0.32	0.18	**7.61**
Committed Projects	17.33	43.27	10.76	8.29	7.74	**87.38**
Total Property	**18.65**	**50.06**	**21.34**	**36.98**	**21.72**	**148.74**

Table 6-11 shows the increase in 2006 projected expenditures relating to committed projects, as well as the increases for Easement Acquisitions. A more detailed review of the specific projects contributing to these amounts is shown in Table 6-12 and Table 6-13.

Table 6-12 – Easement Acquisitions ($m)

Year Ending 30th June	2005	2006	2007	2008	2009	Total
Royalla 132kV SS - Line Outlets	0.00	0.00	0.05	0.00	0.00	**0.05**
Royalla - Gilmore	0.73	1.47	0.00	0.00	0.00	**2.20**
Sydney West to Reedy Creek 330kV	0.00	0.00	7.00	0.00	0.00	**7.00**
Glen Innes to Inverell 132kV Line	0.00	0.00	2.33	4.67	0.00	**7.00**
Manildra to Parkes 132kV Line	0.00	0.00	0.00	6.70	0.00	**6.70**
Armidale to Kempsey 330kV Line	0.00	0.00	0.00	17.00	0.00	**17.00**
Kempsey to Port Macquarie 330kV Line	0.00	0.00	0.00	0.00	13.80	**13.80**
Total	**0.73**	**1.47**	**9.33**	**28.37**	**13.80**	**53.70**

The highlighted projects have been identified by PB Associates in Section 6 as recommended for treatment as Excluded Projects and therefore not included in the ex-ante proposed works program for this regulatory period. This amounts to $40.05m over the period.

Table 6-13 – Site Acquisitions ($m)

Year Ending 30th June	2005	2006	2007	2008	2009	Total
Royalla 132kV Switching Station	0.45	0.00	0.00	0.00	0.00	**0.45**
Bayswater 500kV Substation	0.14	0.00	0.00	0.00	0.00	**0.14**
Cooma North 132 Switching Station	0.00	0.32	0.00	0.00	0.00	**0.32**
Macksville 132kV Substation	0.00	0.40	0.00	0.00	0.00	**0.40**
Raleigh 132kV Substation	0.00	0.40	0.00	0.00	0.00	**0.40**
Sawtell 132kV Substation	0.00	0.40	0.00	0.00	0.00	**0.40**
Wagga North 132kV Substation	0.00	0.34	0.00	0.00	0.00	**0.34**
Bulladelah 132kV Substation	0.00	0.50	0.00	0.00	0.00	**0.50**
Mt Piper 500kV Substation	0.00	0.32	0.00	0.00	0.00	**0.32**
Bannaby 500kV substation	0.00	0.47	0.00	0.00	0.00	**0.47**
Mount Annan 330kV Substation	0.00	2.18	0.00	0.00	0.00	**2.18**
Boggabri 132kV Substation	0.00	0.00	0.00	0.32	0.00	**0.32**
Port Macquarie 330kV Substation	0.00	0.00	1.20	0.00	0.00	**1.20**
Bungendore 330kV Substation	0.00	0.00	0.00	0.00	0.18	**0.18**
Total	**0.59**	**5.32**	**1.20**	**0.32**	**0.18**	**7.61**

The highlighted projects have been identified by PB Associates as recommended for treatment as Excluded Projects and therefore not included in the ex-ante proposed works program for this regulatory period. This amounts to $3.96m over the period. (The total for both site and easement acquisitions was $44.01m over the period).

PB Associates undertook a number of more detailed reviews of specific projects relating to easement acquisitions (which represents the vast majority of uncommitted property expenditures). The intention of these reviews was largely to gain greater insights into the formulation of cost estimates and thereby ascertain a level of confidence in the accuracy of those estimates.

Due to the sensitivity of some aspects of easement and acquisition processes and costs the details of these reviews has not been presented in this report. However, PB Associates has formed the view that the procedures applied by TransGrid in formulating these estimates and the basis for underlying cost assumptions are generally reasonable. In most cases the costs and experiences of past projects have been applied to projected works. Considerable external contracting services are also applied for estimating legal and property services costs based on competitive tendering and these prices were shown to PB Associates.

One issue which has been considered further is TransGrid's adoption of an "options fee" approach to reduce the risk of being refused access to properties during the Environmental Impact Statement (EIS) process and perhaps to facilitate better easement negotiations to avoid the need for compulsory acquisitions. In the past, considerable expenses have been incurred in circumstances where the property owner has refused access to workers even though these arrangements had been agreed. TransGrid has provided documentation supporting the use of option fees at a fixed percentage of the compensation amount up to a maximum value per property. This amount has been added to many projects in the property easement acquisition estimates with the exception

of small projects or those where projections have been developed based on high level estimates and details are not available at this stage of the planning process.

TransGrid has advised that[43]:

"For the projects included in the ACCC submission with option fees the total of estimated compensation costs is $38,181,400. Transaction costs for these projects are estimated at $25,742,792. This results in a transaction cost to compensation cost ratio of 0.674. The total of the option fee amounts is $2.15M.

Actual historical property costs for the period 1999 to 2004 show total transaction costs of $25,485,700 and compensation costs of $27,537,400. This shows a transaction cost to compensation cost ratio of 0.925."

TransGrid has argued that the benefits included in projected compensation costs outweigh the additional costs incurred in relation to the option fees. In addition, TransGrid has assumed that the option fee payments will *"result in good relationships being developed with landowners assisting the negotiation process and resulting in less compulsory acquisition and disputes over compensation assessments."*

PB Associates recognises that TransGrid has incorporated savings resulting from the implementation of the option fee approach and that the cost estimates are based on a reasonable methodology.

However, TransGrid has acknowledged that they have *"changed the apportioning of property costs for future projects in a manner that is likely to exaggerate the expenditure requirements for this period. The proposed property capital expenditure program contains significant costs relating to past projects (Coffs Harbour Site Acquisition, Darlington Pt Buronga Augmentation, Koolkhan Coffs Harbour 132kV Line, MetroGrid 330kV Cable Acquisition – approximately $15.6m). However, property costs for future projects have been assumed to occur prior to commencement of construction."*

PB Associates has reviewed these changes and whilst TransGrid are planning to incur property costs at earlier stages of project delivery, it has not been clearly demonstrated that the profile offered by TransGrid is likely to eventuate. In addition to the changes in project commissioning dates relating to the review of augmentation projects discussed in Section 6 it is our view that some property expenditure will be deferred and that this may move expenditures into the subsequent regulatory period as has been the case historically. A revised profile of expenditures has therefore been formulated by PB Associates for easement and site acquisition costs which are discussed further in the summary of our findings in Section 6.7.3.

Table 6-14 – Committed Projects ($m)

Year Ending 30th June	**2005**	**2006**	**2007**	**2008**	**2009**	**Total**
Coffs Harbour Site Acquisition	1.27	0.07	0.00	0.00	0.00	**1.34**
Coffs Harbour Site Survey	0.02	0.02	0.00	0.00	0.00	**0.04**
Darlington Pt Buronga Augmentation	3.72	2.39	0.00	0.00	0.00	**6.11**
Darlington Pt to Buronga 220kV Line	0.00	0.10	0.00	0.00	0.00	**0.10**
Gadara SS Acquisition	0.02	0.00	0.00	0.00	0.00	**0.02**
Gadara SS Survey	0.02	0.00	0.00	0.00	0.00	**0.02**
Ivanhoe Coal - Easement	0.10	0.50	0.00	0.00	0.00	**0.60**
Kempsey Coffs 132kV Line	6.62	0.00	0.60	0.00	0.00	**7.22**
Koolkhan Coffs Harbour 132kV Line	0.00	0.22	0.35	0.15	0.00	**0.72**
Marulan Substation	0.05	0.00	0.00	0.00	0.00	**0.05**
MetroGrid 330kV Cable Acquisition	0.70	0.00	0.00	0.00	0.00	**0.70**

[43] Supplementary information provided by TransGrid during the PB Associates review.

MetroGrid 330kV Cable Survey	0.05	0.00	0.00	0.00	0.00	**0.05**
Misc Radio Repeater Sites Acquisition	0.06	0.05	0.06	0.16	0.00	**0.33**
Misc Radio Repeater Sites Survey	0.05	0.06	0.06	0.06	0.04	**0.27**
Molong - Manildra 132kV Line	0.06	0.00	0.00	0.00	0.00	**0.06**
Outstanding Easements	0.70	3.60	3.60	3.60	3.60	**15.10**
State Forests	0.15	0.60	0.60	0.00	0.00	**1.35**
Statewide NP&WS	0.15	3.00	3.00	3.00	3.00	**12.15**
Sydney Catchment	0.10	1.10	1.10	1.10	1.10	**4.50**
Tuggerah - Sterland 330kV Line	0.06	0.00	0.00	0.00	0.00	**0.06**
Wallgrove SS Acquisition	0.03	18.69	0.00	0.00	0.00	**18.72**
Wallgrove SS Survey	0.05	0.00	0.00	0.00	0.00	**0.05**
Waratah West 330kV Site Acquisition	0.20	0.10	0.00	0.00	0.00	**0.30**
Waratah West 330kV Site Survey	0.01	0.00	0.00	0.00	0.00	**0.01**
Wollar Switching Station	0.05	0.19	0.01	0.00	0.00	**0.25**
Wollar to Wellington 330kV Line Acquisition	2.65	12.40	1.16	0.22	0.00	**16.43**
Wollar to Wellington 330kV Line Survey	0.12	0.12	0.16	0.00	0.00	**0.40**
Wollar Wellington Transmitter Site Acquisition	0.00	0.06	0.06	0.00	0.00	**0.12**
Wollar Wellington Transmitter Site Survey	0.05	0.00	0.00	0.00	0.00	**0.05**
Yass - Wagga SS Rebuild	0.28	0.00	0.00	0.00	0.00	**0.28**
Total Committed	**17.33**	**43.27**	**10.76**	**8.29**	**7.74**	**87.38**

PB Associates are of the view that the levels of committed expenditure are comparatively high in 2005 and 2006 and remain significant throughout the period. Also, as noted in relation to easement acquisitions, TransGrid advised that the cost allocation for proposed expenditures is different to the historical experiences due to the proposed changes to property procedures. It is expected that in the future TransGrid will seek to manage property issues at earlier stages of project development.

In terms of the effect on the expenditure requirements for the current regulatory period, there are therefore considerable remaining levels of committed expenditures reflecting legacies from previous projects and increases in new acquisition costs reflecting the introduction of new arrangements and the significant proposed augmentation program. PB Associates is recommending changes to the cost allocation profiles for new projects to provide greater consistency.

There are three main contributors to the levels of committed property expenditures in the proposed program which have been highlighted on Table 6-14 and are discussed below:

Outstanding Easements (Including State Forests, NP&WS & SC)

TransGrid is planning to formalise relationships for property interests throughout the state where gaps in easements and land holdings exist. The program involves establishing agreements for these sites in order to increase protection of the network and to formalise occupancy relationships with landowners. PB Associates appreciates the issues associated with the arrangements, but acknowledges that they have been outstanding for many years and is concerned that the timing and nature of the proposed spending needs much broader consideration. Whilst there may be significant legal and cost implications for TransGrid if these outstanding easement gaps are not resolved, PB Associates is of the view that it difficult to assess the relative efficiency of the proposed expenditures and program. The fact that these easements were not acquired at the time of the line construction and that current (more efficient) practice is to acquire easement rights before or during construction, challenges whether these costs can reasonably be considered efficient.

Nevertheless, TransGrid has applied the same costing methodology in determining the expenditures required to address these outstanding easements as that applied to new augmentation projects and this approach is considered reasonable by PB Associates. TransGrid also provided substantial correspondence relating to the identification and negotiations surrounding many of these outstanding easements which indicate the likelihood that TransGrid will be required to incur costs during the regulatory period to resolve many of these issues. On this basis PB Associates proposes that these expenditures be incorporated into the ex-ante capital expenditure program for this regulatory period and TransGrid assume responsibility for managing the risks associated with the outstanding easements. Care will need to be taken to ensure that any gaps remaining at the end of this regulatory period are not inadvertently incorporated into future capital expenditure allowances. This amounts to $33.1m. In making this recommendation we believe it may be useful for the ACCC to work with TransGrid in quantifying the risks and costs of this program and the appropriate timeframe for resolving the issues.

Wallgrove Substation

An amount of $18.7m has been included in the capital expenditure program for purchase of land to the west of the existing Wallgrove substation. TransGrid has advised that this land is under considerable development pressure and has potential for a range of commercial uses. Although no specific augmentation projects have been planned for this site, TransGrid expressed a strong belief that the land will be required for future new lines into and expansion of this substation. PB Associates recognises that acquiring sites for augmentations, particularly around the Sydney region are becoming increasing difficult and expensive. The Wallgrove site does represent a possible hub for future transmission supply and that over the next 20 years it is likely that TransGrid will look to this site as a possible augmentation alternative for future load growth. However, it is important that such speculative investments are adequately balanced against the needs of existing customers. TransGrid has not advised PB Associates of other options that may exist that may serve the future augmentation requirements for this site. It is possible that options over the land or integrated planning using other network or non-network solutions may satisfy TransGrid's requirements. It is therefore proposed that this expenditure not be included in the allowable capital program pending more detailed assessments of the need for this site. Options over the land could be explored pending more definitive identification of the requirements for the site.

Kempsey Coffs 132kV Line (Bonville Golf Course Litigation)

During PB Associates' review the Land & Environment Court awarded the landowner of the Boneville Golf Course $1.2m in compensation, plus interest. TransGrid had previous allowed for an amount of $6.6m in its 2004/05 property cost estimate. It is still uncertain as to whether further appeals will be lodged, however, at this time TransGrid are liable only for costs (approximately $2m) and compensation and interest ($1.3m). In terms of

this review, therefore, PB Associates considers it appropriate to allow only the known and best estimate for these costs of $3.3m.

6.7.3 Summary of PB Associates Findings for Property Investments

The following table shows the recommended property investments proposed by PB Associates:

Table 6-15 – Total Property Recommended Capital Expenditure ($m)

Year Ending 30th June	2005	2006	2007	2008	2009	Total
Easement Acquisitions	3.75	3.75	0.78	4.57	4.57	**17.40**
Site Acquisitions	0.00	1.11	1.11	1.22	0.11	**3.55**
Committed Property	13.96	24.58	10.16	8.29	7.74	**64.72**
Total	**17.71**	**29.44**	**12.05**	**14.08**	**12.41**	**85.67**

The tables include adjustments for:

- Addition of easement costs relating to the recommendation in section 6.6.2 for line 875 to be included as an additional small augmentation project. The costs of easements included for this project total $7.92 million.
- excluded augmentation projects;
- timing of expenditures based on a balance of proposed arrangements and historical experience;
- revised estimates for the Bonville Golf Course litigation costs; and
- deferral of the Wallgrove site acquisition.

It is noted by PB Associates, however, that the process for reviewing Excluded Projects will often involve the incurring of property related costs and that timing for these assessments needs to allow for efficient easement and site acquisitions.

7. SUPPORT THE BUSINESS

TransGrid has submitted capital expenditure projections for business support requirements which total $121.7m over the 5 year period. Included in these projections are costs relating to:

- Information Technology ($73m);
- motor vehicles and mobile plant ($39.5m); and
- miscellaneous assets, office equipment and State Records Security Upgrade ($9.2m).

Business Support capital expenditures are identified and separately recorded in TransGrid's accounts from other capital investments. Business support costs of labour, materials and expenses associated with specific projects are directly assigned to those capital projects. However, general investments in IT, motor vehicles, plant, and office equipment are captured separately due to the depreciable lives of those investments. The ring fencing of these accounts is discussed in Section 7. In considering business support expenditures discussions were held with staff from each of the functional areas to ascertain the nature of the drivers for the expenditures, the processes followed for identification and estimation of the proposed expenditures and the reasonableness of timing and levels of the proposed investments.

Business Support costs have been allocated by TransGrid at $24 million per annum for this period as described in Table 7-1.

The expenditure categories above have been provided in total costs and PB Associates has assumed an even distribution of the total costs across the regulatory period in creating the following table.

Table 7-1 – Support the Business Capital Expenditure Submission ($m)

Year Ending 30th June	**2005**	**2006**	**2007**	**2008**	**2009**	**Total**
Information Technology	11.80	14.22	15.56	14.11	15.58	**71.27**
Motor Vehicles	9.51	8.22	7.34	7.42	7.13	**39.62**
Miscellaneous Assets	2.69	1.56	1.10	2.47	1.29	**9.11**
Total	**24.00**	**24.00**	**24.00**	**24.00**	**24.00**	**120.00**

7.1.1 Information Technology

7.1.1.1 Comparison with Historical Expenditures

TransGrid is forecasting a capital expenditure IT program of approximately $73m for the next regulatory period. This compares with capital expenditures during the previous period of $55.5m[44]. The significant step in expenditure levels is partially explained by two major projects that were not previously captured within the scope of IT activities;

- SCADA Upgrade – $5.2m; and
- Corporate Development Planning Systems – $1.5m

[44] Note that due to rounding differences, the sum of individual year expenditures shown in Table 7-1 is only $71.3m.

Although the step change in expenditures remains significant in the area of Business Performance Improvement. The following table provides an approximate overview of the historical and forecast expenditures.

Table 7-2 – IT Expenditure Comparison

	Previous Regulatory Period	Forecast Regulatory Period
Cyclical Replacement	$47.7m	$51.7m
Business Performance Improvement	$7.8m	$14.6m
Different Scope	-	$6.7m
Total	**$55.5m**	**$73.0m**

Approximately $47.7m of TransGrid's historical expenditure relates to the replacement and upgrade of IT infrastructure (i.e. cyclical replacement). The ACCC application requests $58.4m for the cyclical upgrade and replacement of IT assets. With the adjustment to scope this amount is $51.7m compared to $47.7m in the previous five years. This comparison indicates a continuation of the same level of expenditure in this category.

TransGrid has described the last regulatory period as one of "rapid change" with significant alterations to IT business operations including the:

- development of Service Based outsourcing contacts, tender and transition to new outsourcers;
- implementation of structured service delivery processes;
- replacement of legacy servers and operating systems;
- upgrade and expansion of the data network;
- implementation of new IT governance;
- restructure and change of ISG role; and
- development of the 2005 – 2007 IT Strategy.

PB Associates has sighted external reviews and benchmarks of TransGrid IT operations and notes that many of the changes described above have been out-workings of these and/or similar reviews. TransGrid does not appear as a best performer in the information sighted by PB Associates. This indicate that TransGrid has areas of expenditure that may be able to be reduced, although we note that it would not necessarily be prudent for TransGrid to adopt an aggressive stance in relation to the early adoption of IT systems and IT cost cutting. PB associates also appreciates that work has been undertaken by TransGrid over the last two years to address some of the shortcomings raised in the reviews

7.1.1.2 IT Governance

TransGrid has provided PB Associates with information that describes the IT governance and management processes that are currently in place.

TransGrid has provided a significant level of information relating to the replacement/refurbishment of current information technology systems. The major systems described by TransGrid in their submission and supporting information include;

- Maintenance Management;
- Real Time System Control;
- Human Resources and Payroll;
- Supply Management;
- Financial Management;
- Messaging and Document Management;
- Electronic Drawing and Drawing;
- Geographical Information System – Network Analysis and Planning; and
- Environmental Management.

The above systems are deployed across a corporate-wide area network connected to 58 sites that includes 1,200 desktop and laptop computers, 120 NT Servers, 10 Unix Servers and 6 VMS Servers.

The governance and management processes described by TransGrid appear to be robust and well structured. PB Associates notes that the current governance systems have only recently been installed and that valid direct comparison across period may therefore be limited.

TransGrid appears to be actively addressing earlier[45] criticisms made by Business Catalyst International including the following;

- *TransGrid currently does not track the total IT costs by major application. The cost analysis suggests that these costs are considerable. TransGrid should examine the cost effectiveness of TAMIS. In addition TransGrid should review the cost effectiveness of having two major ERP platforms MIMS and Oracle.*
- *The high level benchmarking from this study suggests that the IT costs are on the higher side of industry average. TransGrid needs to undertake a regular and detailed benchmarking exercise on key IT service components.*
- *In future project and support expenditure, TransGrid needs to include the total costs in the business case – project, operating and support costs.*

PB Associates has discussed the issue of dual Enterprise Resource Planning[46] (ERP) platforms with TransGrid management and is in general agreement with the TransGrid position that the current situation is not optimal and that the move to a single ERP platform (e.g. Oracle, MIMS, SAP, etc) would be preferable. TransGrid has not provided PB Associates with a business case for the move to a single ERP. As the costs and benefits of a move to a single ERP are not known, PB Associates has allowed for the simple replacement cost of the existing dual ERPs. On this basis, TransGrid will retain the benefits of any business improvements and efficiencies gained through the move to a single ERP.

[45] September 2002.

[46] An IT system that attempts to integrate all departments and functions across a company onto a single computer system that can serve all those different departments' particular needs.

7.1.1.3 Cyclical Replacement

The detailed information provided by TransGrid identified almost 200 individual IT asset/cost groups that are scheduled for replacement during the forecast regulatory period. Many of these assets are scheduled for replacement more than once in the period. This is in accordance with TransGrid's procedures for replacement of assets that reflects their support lives which are generally between 3-5 years.

PB Associates notes that depreciated life does not necessarily correlate to actual life and that depreciation schedules do not necessitate the need to replace or retire an asset. Based on this, PB Associates asked TransGrid to confirm the current replacement cycles for TransGrid IT systems and applications. TransGrid responded that "all current systems and applications (are) replaced within 3-5 years with SCADA maybe extended to 6 years".

PB Associates has reviewed the replacement allocations applied by TransGrid and notes that the majority of assets that are listed for a three year replacement program are programmed for two replacements in the forecast period (i.e. over 5 years). PB Associates considers that it is likely that one-third of the second cycle replacements would fall outside of the regulatory period (i.e. in year 6) and has adjusted the capital expenditure forecasts accordingly. PB Associates has been advised by TransGrid that the Exchange and Unix system replacements have already been undertaken in the regulatory period under review and therefore the likely secondary replacement would also fall within this period. Based on this the dual replacements for these systems have been accepted within the 5 year period.

PB Associates has reviewed the unit costs for items that can be benchmarked in the public domain (e.g. standard office software and hardware). The results of this review indicate a number of areas where PB Associates considers that the costs put forward by TransGrid are below what PB Associates would consider a market price. Examples of this include desktop and laptop computers where PB Associates developed market rates of $2,100 and $3,200 respectively compared with TransGrid estimates of $1,353 and $2,920 respectively[47]. There are other areas where PB Associates consider the unit rates to be higher than the current market average and have adjusted the TransGrid figures accordingly.

TransGrid commissioned a report by Business Catalyst International entitled "*TransGrid IT Strategy and Governance Review*", a copy of which was provided to PB Associates. The report details the improvements made by TransGrid and the next steps required to move to a more efficient base.

Comments by TransGrid management and within the Catalyst report indicate a need to review and reduce the numbers of PCs operating within TransGrid. The catalyst report notes that:

> *"TransGrid should audit current PC and laptop numbers and develop guidelines for the ongoing acquisition of both PCs and laptops. All project related costs should be transparent and monitored against specific budgets and metrics, with clear individual accountability."*

In the original submission documentation provided to PB Associates, the combined numbers of laptops and desktops required to be replaced for the forecast period was 1000. PB Associates considers this figure to be reasonable.

47 PB Associates estimates include Operating System purchase costs resulting in the removal of this line item to avoid double-counting.

7.1.1.4 Business Performance Improvements

In supplementary information provided to PB Associates, TransGrid has identified a number of business performance improvements and IT initiatives. These are listed in Table 7-3.

Table 7-3 – Business Performance Improvements and Infrastructure Initiatives

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 Resource 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	
Initiative: Provide one accurate and accessible data source	Define data requirements for key processes and assign responsibility for ongoing management
Initiative: Provide simplified and standard corporate reporting	Provide tools to streamline corporate reporting and analysis from multiple sources
System rationalisation	
Initiative: Adopt a single Enterprise Resource Planning (ERP) solution	Review ERP options and select a preferred platform
Initiative: Adopt a single Project Management solution	Review Project Management tools and select a preferred platform
Initiative: 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	
Initiative: Implement application development standard tools	Identify a standard application development toolkit
Initiative: Ensure corporate data resides in corporate systems	Identify and plan the migration of corporate data in non-corporate systems
Supporting Strategies	
Continue implementation of ITIL	
Review compliance with AS8018 and implement as appropriate	
Sourcing review of all IT requirements in 2005	
Development of standard Architecture	
Asset Management Plan	

TransGrid has provided substantial material in support of its proposed business improvement IT expenditure plan. The material indicates the high level of uncertainty in the external IT environment, particularly as it relates to the mergers and acquisitions of IT companies, the future development of new systems and the rapid obsolescence of existing software and associated support. Based on this information, and the views of external consultants[48], TransGrid has estimated that around 20% of additional capital expenditure will be required for investments in business improvement related IT projects. This totals $14.6m over the current regulatory period.

PB Associates has reviewed these estimates in detail and held lengthy discussions with TransGrid regarding historical business improvement investments and the basis of the 20% estimate. Whilst it is agreed that general IT developments are likely to lead to opportunities for effective IT investments by TransGrid, there are two factors which PB Associates believes mitigate against allowing fully for these amounts in the current regulatory period:

1. Historical expenditures are well below the levels estimated by TransGrid for future business improvement projections. Historical expenditures (indexed to 2004 dollars) show that the combined IT investment has averaged around $12.4m p.a. Historical figures for business improvement indicate an amount of around $1.65m p.a. (2004 dollars) compared to the projected level of $2.9m p.a.

2. Business improvement investments are intended to provide tangible benefits for the organisation. TransGrid undertakes a project evaluation process for IT investments that includes net benefit studies which largely underpin the prioritisation and selection of projects. On this basis the benefits of business improvement expenditures should generally exceed costs in order for them to be approved internally.

In reviewing the appropriate level of investment to be included in the TransGrid forward capital expenditure program for IT, PB Associates role is largely confined to determining the need for and efficiency of the proposed expenditures. In this regard TransGrid has demonstrated a reasonable approach to identifying, costing and assessing its IT projects. Whilst adjustments have been recommended in this review for certain aspects of the TransGrid IT proposal, PB Associates has not found material deficiencies in the costing of proposed business improvement projects assessed.

However, PB Associates does not believe TransGrid has adequately justified the 20% estimation of business improvement expenditure requirements. As is the case for other aspects of this review, PB Associates has focussed on assessing the identified need and efficiency of proposed IT investments. Whilst it is recognised that the developments in IT may lead to the identification of new opportunities to enhance existing systems during the regulatory period, it is not, in most cases, possible to identify those areas or describe those systems as necessary at this time. It is therefore the view of PB Associates that the recommended capital expenditure for IT business improvement investments should be linked to more to historical levels. It is therefore recommended that a figure of $7.8m for the current regulatory period be applied.

7.1.1.5 Project Reviews

In reviewing TransGrid's IT capital expenditure, PB Associates has undertaken detailed reviews of a representative group of sample projects. The sample projects were selected by PB Associates and represent a cross-section of business applications and expenditures. TransGrid has supported this review and provided a high-level of co-operation and supporting materials to enable the sample reviews.

PB Associates has received confirmation from TransGrid that specific "pass through" projects are not included in the IT projects described in this section. TransGrid has also

[48] TransGrid advised in its application that it has held discussions with IT consulting company Gartner.

confirmed that no provision for the expansion of the corporate data network to accommodate new site has been provided in the expenditure forecasts in this area.

A brief description of the sample projects is provided below.

Exchange

The cyclical upgrade of the exchange service has been identified by TransGrid as being necessary based the current version becoming unsupported. This is consistent with TransGrid's stated policy of avoiding de-supported applications.

The exchange project is ranked 6th on the TransGrid priority listing with a total forecast total capital expenditure of $0.564m.

PB Associates has sighted quotes for the recent works and is satisfied that the forecast costs are in line with the historical costs.

Storage Area Network (SAN)

The replacement of the Storage Area Network is presently ranked 10th on the TransGrid priority listing. The works will be partially completed in the current regulatory period and fully complete and commissioned in the next. $0.450m capital expenditure is anticipated to be incurred in this regulatory period. The replacement capital expenditure forecast is $1.5m.

Included in the business case for the SAN project was justification for the replacement of 120 network drives (disks) that currently support the TransGrid servers. TransGrid has indicated that the justification for the project includes reduction in the costs of future server replacements for which it will not require to purchase storage. These savings have been included in future project estimates.

Asset Management System Improvement Project (AMSIP)

TransGrid has provided PB Associates with the business case and benefits realization plan for the Asset Management System Improvement Project. The project is already a committed project and therefore no priority is assigned.

TransGrid has stated that the project is targeted to deliver;

- *Initiatives to manage the increasing asset base while reducing the risk and liability arising from asset failures or accidents.*
- *Work Management process standardisation with automated data capture and transfer*
- *Development of additional reporting capability*
- *Improved budgeting tools*
- *Improvements to Property and Environment/Vegetation Management*
- *Improvement to Geographical Information System operating expenditure savings and better asset performance.*

PB Associates understands that the project is expected to deliver operating expenditure savings and that these savings are already factored into the TransGrid operating expenditure forecasts. This was not able to be verified by PB Associates.

The AMSIP project is anticipated to cost $3.7m to implement and have quantified annual benefits of $3.7m.

BSU1/2

The BSU2 project was reviewed predominantly in terms of the basis for costing estimates. This project follows from a previous business system upgrade covering MIMS and Oracle following the withdrawal of support for VMS. The final cost for BSU1 was $4.9m which included $0.8m for hardware. This was significantly more than the original budgeted figure of $3.9m.

A Post Implementation Review was undertaken by an independent consultant who provided some favourable feedback and indicated a number of areas where future implementations could be delivered more efficiently. TransGrid advised that those recommendations have been incorporated into the BSU2 implementation estimates. PB Associates believes the BSU1 historical costs in conjunctions with the recommended process improvements generally represent a reasonable basis for the cost estimates for BSU2.

7.1.1.6 Summary of IT Recommended Capital Expenditures

During the review of IT expenditure projections it was noted that in a number of instances specific projects were either not adequately provided for, or had been duplicated. This was due to the split of expenditures between replacement and business improvement categories which was intended to offer more insightful data presentation. However, in these instances the projects had either been included as both replacement and improvement, or had not been properly included in either section.

PB Associates accepts that the dissection of expenditures between replacement and improvement does add considerable value in understanding the nature of the expenditure drivers. The errors in data presentation, however, reflect the challenges that TransGrid still face in ensuring that the governance arrangements provide a sound quality assurance process in the formulation of capital requirements.

Based on the above discussion, PB Associates recommends the following variations for IT forecast capital expenditures as detailed in Table 7-4 and

Table 7-5.

Table 7-4 – IT Capital expenditure Variations ($m)

Year Ending 30 June	2005	2006	2007	2008	2009	Total
IT Replacement	1.06	1.06	1.06	1.06	1.06	**5.30**
IT Business Performance Improvement	1.36	1.36	1.36	1.36	1.36	**6.80**
Total Proposed Reductions	**2.42**	**2.42**	**2.42**	**2.42**	**2.42**	**12.10**

Table 7-5 – IT Capital Expenditure Recommendations ($m)

Year Ending 30 June	2005	2006	2007	2008	2009	Total
TransGrid Proposed	11.80	14.22	15.56	14.11	15.58	**71.27**
Adjustment	**-2.42**	**-2.42**	**-2.42**	**-2.42**	**-2.42**	**-12.10**
PB Assoc. Recommend	**9.38**	**11.80**	**13.14**	**11.69**	**13.16**	**59.17**

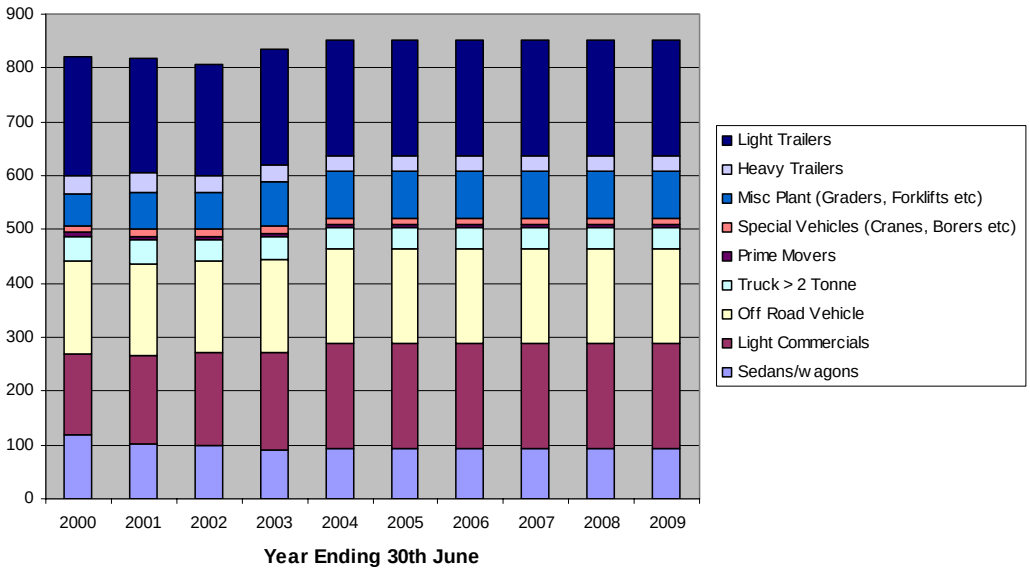
7.1.2 Motor Vehicles and Mobile Plant

Motor vehicle expenditures are coordinated through the Finance Division of TransGrid and expenditures on new vehicles are approved by the relevant manager under the

organisation's prescribed Motor Vehicle Allocation Policy (TransGrid Reference GD TR G1 004).

A dissection of the proposed motor vehicle fleet by type indicates that TransGrid has projected the total numbers to remain the same as for 2004. It is noted, however, that plant/vehicle numbers have increased slightly in 2004.

Figure 7-1 – Motor Vehicle and Mobile Plant Numbers



In terms of projected expenditures on plant and motor vehicles it is important to note that TransGrid applies a policy of disposal for sedans/station wagons and light commercials at the end of 2 years. In presenting the capital expenditures for plant and motor vehicles it is therefore necessary to separately show these amounts. In translating this information into tariff revenue requirements, ACCC will only need to allow for the net amount of these figures, i.e. capital expenditure less disposal value.

Figure 7-2 shows the historical and proposed capital expenditure and disposal values.

Figure 7-2 - Motor Vehicle and Mobile Plant - Net Capital Investment ($m)

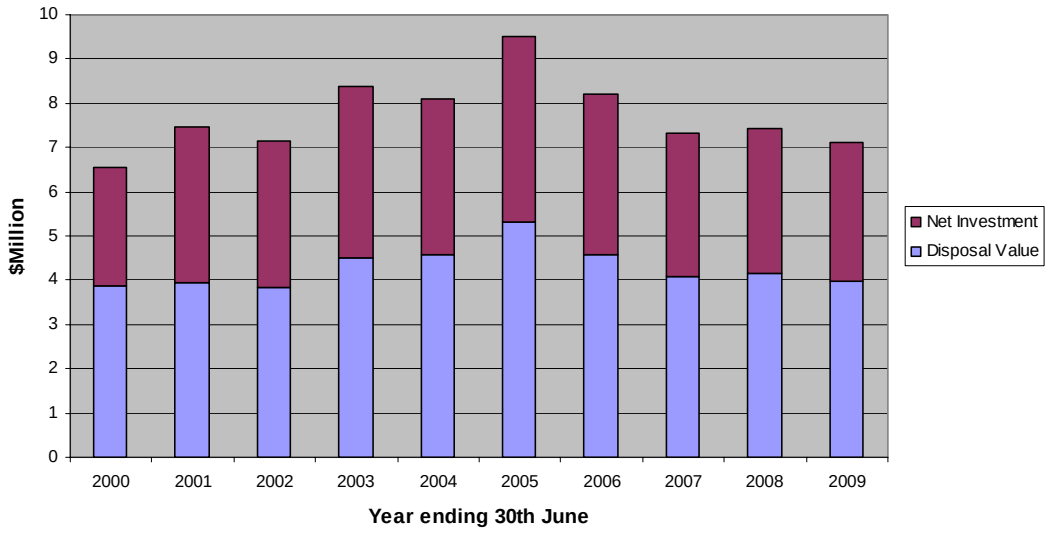


Table 7-6 summarises TransGrid's proposed capital expenditures for vehicles and mobile plant.

Table 7-6 – Motor Vehicle and Mobile Plant - Net Capital Investment ($2004)

Year End 30 June	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Capital Expenditure ($M)	6.35	7.46	7.14	8.37	8.09	9.51	8.22	7.34	7.42	7.13
Disposal Value ($M)	3.77	3.93	3.82	4.51	4.59	5.31	4.59	4.10	4.14	3.98
Net Investment ($M)	**2.59**	**3.54**	**3.32**	**3.86**	**3.50**	**4.20**	**3.63**	**3.24**	**3.28**	**3.15**
Average Net Investment per vehicle ($)	3,145	4,319	4,118	4,629	4,103	4,924	4,256	3,798	3,845	3,693

It is noted that the table shows an increase in average net capital investment in 2005 followed by reducing average amounts. Whilst vehicle numbers in all classes are projected to stay the same over the period, capital expenditure levels rise to $9.5m in 2005 and reduce to $7.1m in 2009. PB Associates made inquiries regarding this apparent anomaly and was advised that a number of the mobile plant fleet have reached the end of their economic life and are due for replacement. Though plant numbers do not change, the purchase costs incurred during 2004/05 are substantially above average. PB Associates was shown plant records which demonstrate the age of these vehicles and the cost of replacement which support the proposed expenditure program.

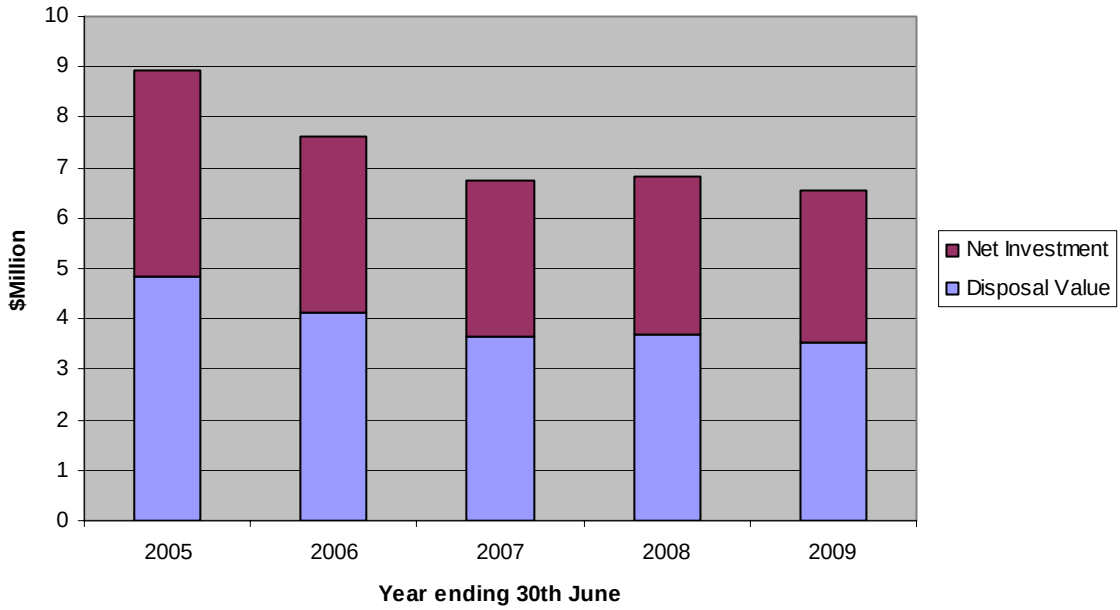
TransGrid advised that the figures provided in its application included motor vehicles relating to salary contracts which were 100% private use. Although these amounts are relatively small, it is not appropriate that they be included in the regulated asset base. As a result amounts of $0.6m p.a. for capital expenditure and $0.45m for disposals has been removed from the recommended expenditure level.

The approach adopted by TransGrid in determining motor vehicle and plant expenditures over the regulatory period is based on robust asset information and a sound process for vehicle turnovers. PB Associates therefore recommends no changes to the proposed capital program, other than to eliminate private motor vehicles as per Table 7-7.

Table 7-7 – Recommended Motor Vehicle and Mobile Plant Capital Investment ($m)

Year End 30 June	2005	2006	2007	2008	2009	Total
Capital Expenditure ($M)	8.91	7.62	6.74	6.82	6.53	36.62
Disposal Value ($M)	4.86	4.14	3.65	3.69	3.53	19.87
Net Investment ($M)	**4.05**	**3.48**	**3.09**	**3.13**	**3.00**	16.75
Average Net Investment per vehicle ($)	4,748	4,080	3,623	3,669	3,517	

Figure 7-3 - Recommended Motor Vehicle and Mobile Plant Capital Investment ($m)

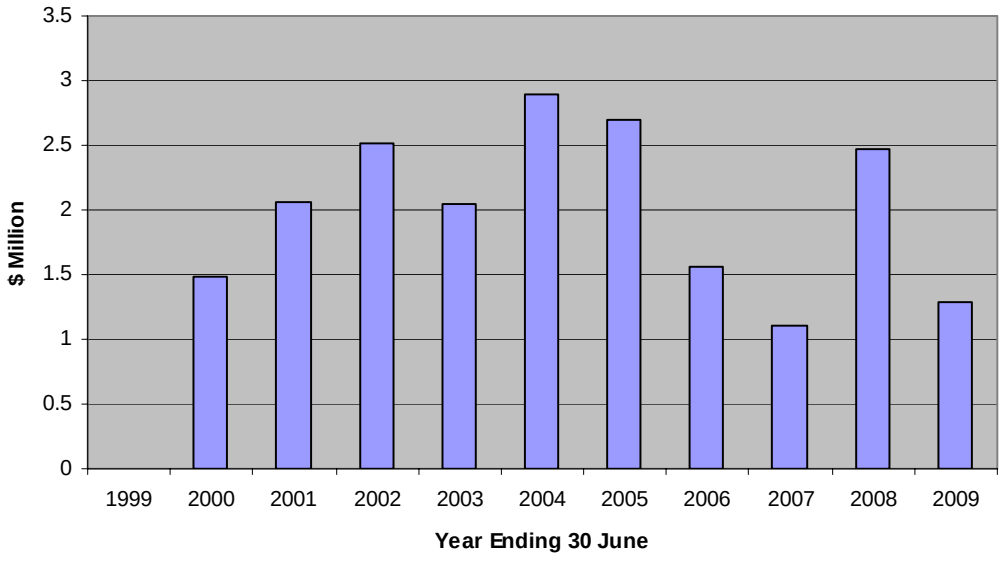


7.1.3 Miscellaneous Assets, Office Equipment

TransGrid has provided details of projected capital expenditure requirements for miscellaneous assets and office equipment. Projections are based approximately on existing equipment ages and anticipated replacement schedules which are therefore linked to historical expenditures. Any additional requirements are determined by section, division or regional needs and are subject to TransGrid's purchasing policy for small assets and the appropriate approvals process.

Historical and projected expenditures are shown in Figure 7-4.

Figure 7-4 – Miscellaneous Assets and Records



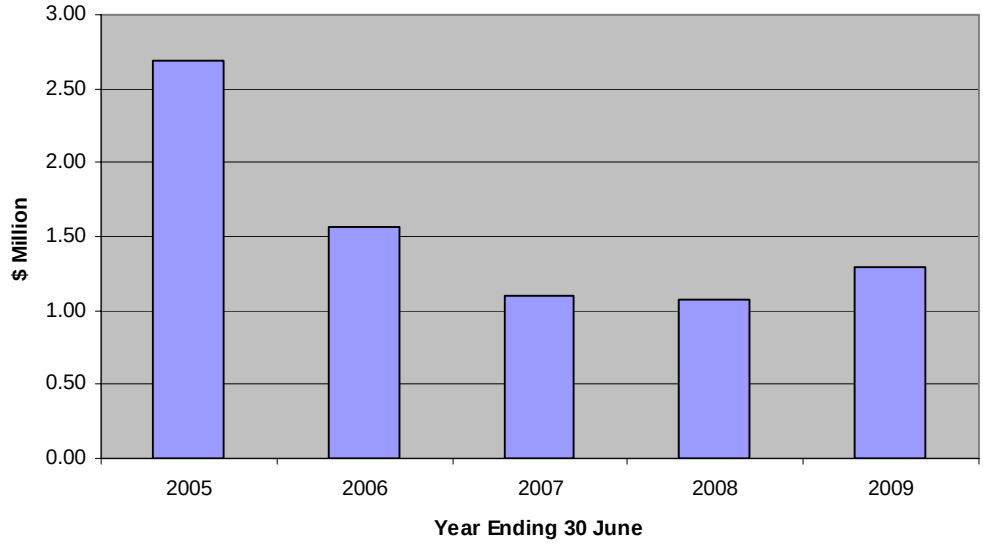
As Figure 7-4 shows, historical expenditures have generally been above those anticipated by TransGrid for the current regulatory period. The profile for projected expenditures is linked to detailed schedules for equipment replacements and also includes $1.4m for a State Records Security Upgrade.

PB Associates has reviewed the detailed schedules for equipment purchases and believes that the process for identification of anticipated expenditures and the levels proposed are reasonable. During the review, however, TransGrid advised that they had included expenditures for State Records upgrade in both the IT and Miscellaneous Assets sections. It was agreed that this amount of $1.4m would be removed from the Miscellaneous Assets projections. Table 7-8 provides the revised capital expenditure figures proposed by PB Associates.

Table 7-8 – Recommended Miscellaneous Assets and Records ($2004) – ($M)

Year End 30 June	2005	2006	2007	2008	2009	Total
Miscellaneous Assets ($M)	2.69	1.56	1.10	1.07	1.29	**7.71**

Figure 7-5 – Recommended Miscellaneous Assets and Records

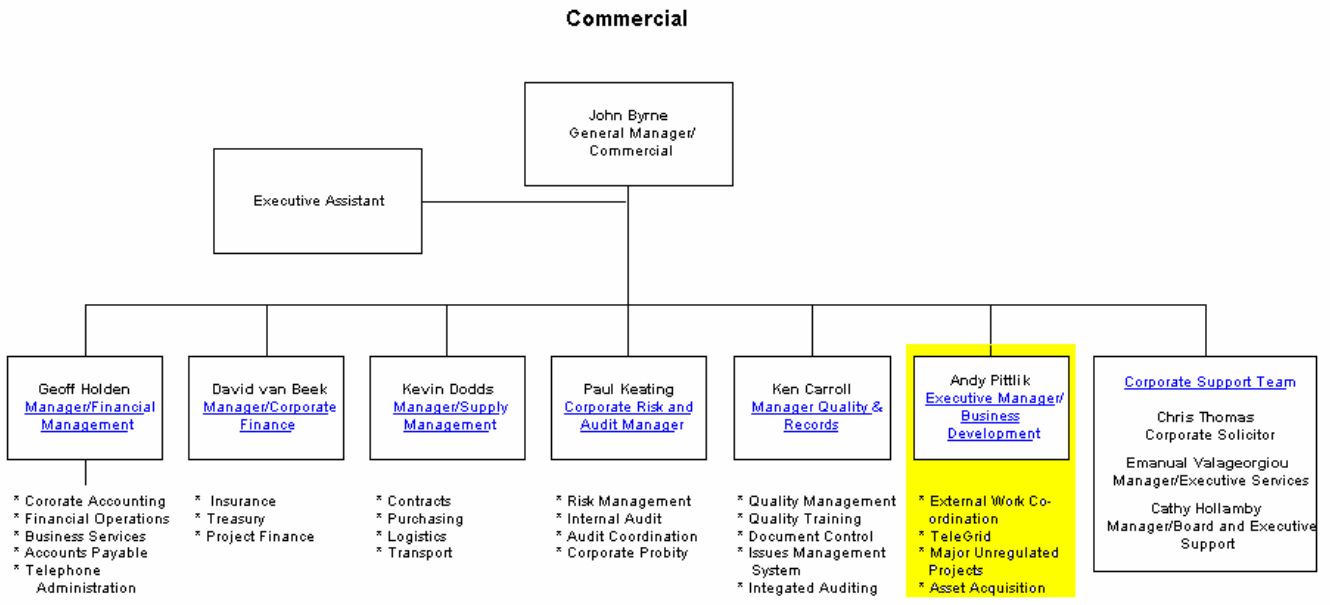


7.1.4 Ring Fencing of External Business

TransGrid derives approximately $20m (2003/04) from external business services. These services largely include contestable contracting and utility consulting services. Like all regulated utility businesses in the NEM, TransGrid is required to comply with ring fencing arrangements that are designed to prevent the use of monopoly market powers and revenues to support competitive business operations.

TransGrid has established an external business development function within the Commercial Division to oversee and foster external business ventures and grow external revenues and profits. This is shown in Figure 7-6.

Figure 7-6 – Organisational Structure for the Commercial Division of TransGrid



Although it is beyond the scope of this review to consider these ring fencing arrangements for TransGrid, in order to provide an appropriate capital expenditure allowance for monopoly transmission services it is necessary to determine the levels of capital expenditure proposed by TransGrid which should reasonably be assigned to the contestable business segment of the organisation.

TransGrid's contestable operations use many of the support functions of the business. In relation to capital expenditures, TransGrid has identified business support investments which are also shared with the contestable business operation. These include:

- motor vehicles and plant;
- administrative equipment (miscellaneous assets); and
- Information Technology.

In discussions with TransGrid it was acknowledged that some proportion of these capital expenditures should be allocated to the contestable segment of the business. The relatively small size of the contestable arm means that applying an appropriate basis for allocation is difficult and the organisation does not capture detailed costing information relating to these operations. A number of potential approaches were considered including proportion of:

- total revenues (2.9%);
- total operating expenditures (1.7%);
- labour hours (2.7%); and
- labour dollars (2.7%).

TransGrid is of the view that business support expenditures would not vary in the absence of the contestable business operations and that only a small amount could be attributed to this segment. They have advocated the use of the operating expenditures as a base for the allocation. PB Associates believes operating costs would be a reasonable basis for the allocation. However, it is noted that the above calculations are

based on adjusted figures which exclude a one off project provided to Energy Australia which substantially distorts the calculation. When 2003/04 and 2003/04 Annual Report figures are used the following proportions are derived:

- total revenues (2.4% 2002/03, 4.4% 2003/04); and
- total operating expenditures (3.3% 2002/03, 6.0% 2003/04);

Labour hours and dollars are not specifically reported in the Annual Report. PB Associates believes that publicly reported information provides a more appropriate basis for allocating business support investments. The substantial movements between 2002/03 and 2003/04 for unregulated business revenues and expenditures indicate that the one off project with Energy Australia materially affects the calculation. TransGrid are not projecting for this level of activity to be fully maintained. PB Associates believes that total revenues are a reasonable basis for the allocation and that 2002/03 proportions represents a more accurate representation of future external business operations. Table 7-9 shows the levels of Support the Business capital expenditures recommended for the regulated capital expenditure program applied by the ACCC in determining allowable network monopoly revenues after adjusting for the 2.4% allocation to external business.

Table 7-9 – Recommended Support the Business Capital Expenditures ($m)

Year Ending 30 June	2005	2006	2007	2008	2009	Total
Information Technology	9.15	11.52	12.82	11.41	12.84	**57.75**
Motor Vehicles and Plant	8.70	7.44	6.58	6.66	6.37	**35.74**
Miscellaneous Assets	2.63	1.52	1.07	1.04	1.26	**7.52**
Total Support the Business	**20.48**	**20.48**	**20.48**	**19.11**	**20.48**	**101.02**

7.1.5 Customer Contributions

PB Associates discussed the customer contribution policies applied by TransGrid for connections or augmentations requested by generators, distributors and other directly connected customers. The purpose of these discussions was to identify incomes that are anticipated to be received as direct payments from these network users outside the Transmission Use of System (TUOS) charges. Such payments would offset some of the proposed capital expenditures and therefore should not be incorporated into the ACCC's allowable revenue determination.

TransGrid applies a shallow connection capital contribution policy in line with the requirements of the NEC. In this regard, TransGrid has advised PB Associates that no direct funding for any of the capital projects proposed in their application are anticipated to be received from network users other than through TUOS charges.

PB Associates notes that whilst the formation of TUOS rates is outside the scope of this review, this an area where anomalies can occur and the incentives for prudent investment by TransGrid and distributors may require further consideration. In particular, since TUOS charges are deemed as "pass through" expenses by IPART in setting allowable distribution prices, it is possible that submissions to TransGrid for minor augmentation works based on distribution benefits are not subject to thorough regulatory scrutiny. In practice this issue is partially addressed through the joint planning process between distributors and TransGrid.

8. POOLED CONTINGENCY

TransGrid has included in its application, an amount to cover unforseen expenditures and the myriad of potential smaller projects that may arise which cannot be foreseen at this time. Under the ex-ante regulatory approach, there is no opportunity to recover these unforeseen expenditures unless they are incorporated into the costs of Excluded Projects and approved in subsequent assessments of those project costs by the ACCC. TransGrid has made the following comment in its Application:

"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".[49]

In a number of sections within its Application, TransGrid has identified areas where it cannot accurately predict the nature or scope of some smaller projects that may occur and other areas where projects may be foreseen, however they are particularly difficult to scope properly at this early stage of their consideration.

PB Associates recognises the challenges of an ex-ante approach in terms of needing to accurately identify all projects and estimate their costs. In reviewing the pooled contingency figures proposed by TransGrid, PB Associates has taken a number of factors into consideration. In particular:

- the requirements of the NEC for efficient costs only to be allowed in the revenue cap calculation;
- the levels of risk associated with unforseen expenditures and variations in project scopes;
- PB Associates' recommendations relating to replacement and augmentation projects, in particular, the recommendation for many major augmentation projects to be treated as excluded investments and addressed when specific triggers occur; and
- the basis of the contingency estimation proposed by TransGrid.

In relation to the NEC requirement for only efficient costs to be included in the revenue cap calculation, the Pooled Contingency allowance in our view does not qualify. It is not appropriate for PB Associates to endorse this allowance without more detailed information supporting the types of expenditures which TransGrid could reasonably expect to arise. TransGrid and PB Associates have explored all cost areas in detail to identify the basis for anticipated expenditures. In many cases PB Associates has recommended inclusion of costs where it believes TransGrid had not made sufficient provision. Costs within each of these areas therefore already incorporate some allowance for historical trends in expenditures that may not be easily attributable to specific projects. PB Associates has applied a bottom up detailed assessment of the individual projects proposed by TransGrid and the underlying efficient costs for these projects. An analysis of the costing and unit rates is provided in section 4.2.2.

In relation to commercial risks, it is noted by PB Associates that the rates of return applied under the NEC revenue determination model incorporates a risk factor. Whether this is adequate under the ex-ante approach is not within the scope of this review. It is also noted that the ACCC's revised ex-ante approach allows inclusion of all actual capital expenditures into the asset base at the end of the period. The only area of commercial risk for TransGrid, therefore, in terms of unforeseen capital expenditures, is that returns on those investments within the period would be lost. Given that there is now a relatively

[49] TransGrid's Revenue Cap Application, November 2004, Section 10.6.

symmetrical risk that TransGrid will also find opportunities to further defer some capital expenditures or efficiency gains beyond the industry comparisons reference in this review, the risks of additional contingency related works is considered small.

It is noted further that much of the uncertainty referred to by TransGrid relates to major augmentation projects, many of which PB Associates has recommended to be treated as Excluded Projects. Therefore these risks should be more easily managed at the time those projects are required for consideration.

On balance, therefore, PB Associates believes it would not be consistent with the concept of efficient costs to provide for a contingency allowance in the ex-ante capital expenditure program.

9. CONCLUSION AND SUMMARY OF RECOMMENDATIONS

PB Associates has been provided with detailed information by TransGrid in support of its capital expenditure application to the ACCC. In addition, PB Associates received full cooperation and support from all staff within TransGrid and it was clear the high level of importance placed on its submission and the ACCC review process at all levels.

In general, the information provided was of a high quality and strongly supported TransGrid's Application. There were areas where errors had occurred and adjustments were required, however given the size of the capital program, the complexity of the issues covered and the process necessary to be employed to accommodate the revised regulatory schedule, PB Associates believes TransGrid has achieved remarkable progress.

PB Associates found the level of cooperation from TransGrid in identifying the capital requirements and developing optimal cost and project solutions to be excellent. Discussions with staff were open, transparent and supportive and we have formed the view that TransGrid provided all available information in a timely and constructive manner. Whilst there were a number of areas where errors or deficiencies in the available information were identified, there was a general recognition that TransGrid has made a concerted effort to develop a solid investment program.

9.1 CAPITAL GOVERNANCE

The overall governance framework developed by TransGrid for capital expenditure identification, assessment and approval should provide a sound basis for future capital investment. In the case of this application, there are areas where the process has been accelerated to accommodate the timeframe and this led to some instances of inconsistencies in project requirements and costing. PB Associates does not believe these deficiencies are symptomatic of problems in the governance arrangements moving forward, but were peculiar to this particular review which relied more heavily on key individuals to coordinate and aggregate project evaluations.

The working group structure adopted by TransGrid for consideration of capital investments should enable cross functional input to investments and potentially to optimal project selections. The eventual outcomes will, however, be somewhat dependent on the key performance measures adopted by the company and the relative weightings placed on commercial, social, customer and staff related objectives. During this review the primary focus was on efficient commercial outcomes, however PB Associates included consideration of service, safety and environmental requirement in balancing its recommendations for the capital program.

9.2 REPLACEMENT PROJECTS

Generally PB Associates found that the assets identified in TransGrid's Application were at, or very near, the end of their effective service lives and required replacement in the short to medium term. In almost every instance PB Associates has agreed with the timetable for replacement of the assets included in the TransGrid application.

Where a large number of similar assets are proposed for replacement PB Associates has formed the view that the TransGrid estimates are based on one-off projects and there are, therefore, opportunities for scale efficiencies which PB Associates' have included in its recommendations.

PB Associates has noted that the excess land at Tamworth and at Orange can be disposed of and the proceeds used to offset the capital cost associated with these two projects. Furthermore, the contingency sums allowed for in the TransGrid depot

estimates have been removed as the estimates are based on current construction costs. During the review process TransGrid also removed the project to construct a new office building at their Wallgrove Depot site to house head office staff. This project was estimated at $20m

PB Associates has recommended that Line 875 be upgraded as soon as practicable to 132kV and hence has removed the allowance for maintenance of the existing line from this section and included the reconstruction costs in the relevant small augmentation section.

Variations have also been made to reduce labour rates by 8.5% based on benchmark comparisons, which results in a 1.5% reduction in total project estimates. In addition there is a reduction in the scoping factor for Taree substation which reduces the estimated cost for that project by $1.25m.

PB Associates has also recommended that only one transformer be replaced at Glen Innes during the current regulatory period and that the Port Macquarie transformer be deferred for another year and that the replacement of Sydney West No.4 transformer be deferred until its conditions dictates replacement is warranted.

PB Associates has also recommended that the poles on lines 96M and 94B continue to be monitored using ground line and pole inspection techniques and they be replaced on a as needs basis when they are condemned.

Over the five year period the PB Associates recommends a total replacement capital expenditure of $276m, this is $51m less than TransGrid proposed estimates. However, $20m of this amount comprises the removal of the proposed office building at Wallgrove Depot.

9.3 AUGMENTATIONS AND EXCLUDED PROJECTS

For major augmentations, PB Associates recommends that all projects be considered as excluded investments. This is due to the uncertainty surrounding the requirements for these projects and the lack of sufficient consideration of all feasible and potential solutions.

The PB Associates review of augmentation related capital expenditures included a review of the overall methodology for producing the capex forecasts, and more detailed reviews of the TransGrid backgrounds and individual proposed major projects.

Background development

Due to the uncertainty in generation developments, TransGrid has produced a number of load/generation/interconnection backgrounds from which to assess the augmentation needs of the main system backbone. The probabilities on key assumptions within the background development lead to a probability that each background would occur. The individual backgrounds essentially being mutually exclusive outcomes of which one outcome must occur (i.e. the probability of all backgrounds sum to 1).

The capital expenditures proposed by TransGrid in the ex ante cap are not probability weighted forecasts based upon the set of background probabilities. The studies conducted by TransGrid showed that the majority of projects and their timing were insensitive to the backgrounds and only a limited number of projects were sensitive to the backgrounds. These sensitive projects were considered the excluded projects.

The insensitivity of expenditure to the background was driven by two main factors. The first being that there is not a great difference between the low, medium and high growth rates and as such, it takes almost four years for high growth to advance one year from the medium growth or low growth to defer one year from the medium. For the majority of works in the first three to four years, the difference in peak demand is not sufficient to

warrant a change in timing from the medium forecast. Only a number of projects near the end of this regulatory period are impacted by the difference in demand growth.

The second factors is the assumption that generation developments are only enough to meet reserve requirements. This results in the main generation development occurring in the 2009/10 (in the medium growth background). The tightening of the supply demand balance results in an inability to use constrained generation to relieve network violations near the end of the period. In effect, projects may be required under the reliability clause of the regulatory test prior to the assumed generation developments.

The methodology applied by TransGrid in determining the background interconnection and generation developments and probabilities, and the assumptions applied in defining the set of generation locations does not appear unreasonable from a purely most likely least cost generation location point of view. However, certain assumptions within the development of these backgrounds are key in driving the needs for the network projects, particularly in the later years of the period.

The new generation development location, size and timing may well be partly driven by the forecast network limitations, and commercial benefit that may exist in placing the generation in appropriate locations to leverage this benefit. This impact does not appear to have been examined in the TransGrid background development.

Major project reviews

In general terms, PB Associates considers the technical studies conducted by TransGrid to assess the needs and timing of projects, and to confirm the projects address the needs, to be appropriate. We do consider however that for a number of the projects, alternative solutions may exist that have not been analysed suitably.

Although technical studies had been performed to assess the needs and solutions, no evidence of economic evaluation or least cost PV analysis of solutions has been provided. This may be expected for projects at this stage of planning. However, it is difficult to support such significant projects being included in an ex-ante cap without a more significant level of rigour in their evaluation.

The load only related projects, particularly those related to Sydney supply issues, require joint planning with the relevant distributor to evaluate the optimum solution to both the TransGrid and distributors needs. For the major projects, this joint planning appears to be at a fairly preliminary stage. PB Associates considers that more detailed joint planning is required to appropriately assess the optimum joint solution.

For the main system needs and projects, which are based upon analysis of the backgrounds, it appears that the base assumption in the background development that additional generation is only sufficient to meet the minimum reserve requirement is a primary driver of the need and timing of the major projects. This assumption results in new generation developments occurring after the need has arisen and as such a network solution becomes almost the only option. The NSW government in its recently released green paper is signalling its desire to see more NSW based generation. The 2004 SOO also indicated a number of significant “advanced and publicly announced” generation projects in NSW. Based upon this, and the market incentive of locating in a potentially “constrained on” location, PB considers that there may be a greater incentive to locate in the central coast region than accounted for in the TransGrid backgrounds, and possibly in advance of the date assuming in the TransGrid backgrounds. Based upon this there appears to be reasonable possibility that major network reinforcement could be deferred.

With respect to DSM or grid support by generators, TransGrid is proposing nearly $1bn between 2008 and 2012 in network investment to improve the supply paths to the Sydney load centre. This is matched by significant proposed investment by both IE and EA. If the market does not act to optimally locate new generation then some form of support payment may provide sufficient commercial incentive deferring the need for major network augmentation.

As the backgrounds do not include a range of generation developments in location, size and timing, only a limited number of the major projects near the end of the regulatory period are impacted. The TransGrid developed background probabilities are not appropriate to develop a probability weighted capital expenditure for the ex ante cap, and PB Associates does not consider it appropriate within the context of this review for PB Associates to assign its best estimate of the probabilities in order to produce an expected ex ante cap across all the projects. Neither do we consider it prudent to make a judgement on the most likely project outcomes to define the ex ante capital expenditure, due to the uncertainty at this stage of generation developments in NSW.

For the above reasons, with respect to the major projects in Table 1A of the TransGrid application, PB Associates proposes to exclude a number of the major projects and accept that all the excluded projects presently proposed by TransGrid should remain excluded. PB Associates considers that some projects are linked to other major projects, and these projects should be grouped and assessed together for inclusion to ensure the optimum solution is determined.

It is important to note that dependant on the generation/interconnector developments and more detailed analysis conducted by TransGrid, the actual network developments, staging and timing may be significantly different from the projects as defined within the TransGrid application. It can not be stated at this stage how many individual projects may be required for inclusion in this regulatory period. However, due to the greater certainty of generation developments and joint planning when a request for inclusion would occur, it may well be that a single request could be made across a number of projects. If greater levels of generation connect and at a slightly earlier time, and/or significant levels of DSM are obtained then it may well be that a number of the major projects could be deferred.

The need for some of the major projects (or parts thereof) has been demonstrated by TransGrid, although we consider that there is still some uncertainty in the optimal timing. In these cases PB Associates has assumed these projects could be deferred for up to two years with an equal probability to calculate the ex ante component. The major projects or project components that remain in the ex ante cap with a probability weighting adjustment are:

- Mid North Coast reinforcement
- QNI upgrade (phase angle regulator at Armadale)
- Royalla 132 kV switching station (part of Royalla 330 kV substation stage 1)

Table 9-1 indicates the excluded project groupings and suggested assessment criteria proposed by PB Associates for the projects defined in the TransGrid application.

Table 9-1 – Excluded Project groupings

Projects[50] and groupings	**Assessment criteria for inclusion**
Transfers to Sydney/Newcastle load centre and the 500 kV developments: • Western 550 kV system • Newcastle and Lower North Coast Supply • Bannaby – Sydney 500 kV • Kemps to Sydney South	• demonstration of the lack of appropriately located market driven committed generation projects; • demonstration by TG that they have sufficiently examined DSM options and grid support; and • demonstration that TG have appropriately evaluated both technically and economically the optimal project and staging of the network development.

[50] As defined in table 1A of TransGrid's application.

Projects[50] and groupings	Assessment criteria for inclusion
Supplies from Sydney West: • Holroyd Complex • Masons Park 330/132kV GIS substation	• demonstration of the lack of appropriately located market driven committed generation projects; • demonstration by TG that they have sufficiently examined DSM options and grid support; and • demonstration that TG, through joint planning with IE and EA has adequately assessed the needs, timings and solutions to determine the optimal total solution and timing.
Canberra and Cooma supply: • Royalla 330kV substation stage 1	• demonstration by TG that the change to the security of supply criteria for Canberra should be changed either via some form of consultation and economic worth analysis or via a statutory requirement.
Queensland Interconnection: • Series compensation at Dumaresq	• demonstration of the lack of appropriately located market driven committed generation projects; and • demonstration that TG have appropriately evaluated the optimal timing and development.
Vic/Snowy Interconnection: • Yass – Wagga 330kV single circuit line	• demonstration of the lack of appropriately located market driven committed generation projects; and • demonstration that TG have appropriately evaluated the optimal timing and development.

Small Augmentations

PB Associates has reviewed each of the projects contained in the TransGrid Revised Transmission Capital Investment Program 2004/05 – 2008/09 Small and Committed Augmentations. In general either load growth or customer requirements/requests determine the need for these projects. Where the need is load growth resulting in unacceptable service standards, PB Associates has reviewed the load projections and planning studies and in all cases confirmed that the need exists. Where the need is customer related PB Associates has identified the customer requirement. In many instances the need for various projects has arisen from joint planning studies with the relevant DNSP. Where a written request exists it is noted in this report but where there is currently no firm commitment PB Associates has used engineering judgment to determine the probability of the project proceeding, and this is also noted in the report.

In terms of TransGrid's estimates PB Associates has recommended efficiency factors to be applied in some instances. One of the main issues identified by PB Associates in reviewing the small augmentation projects is that TransGrid omitted several capacitor banks which were included in the planning studies assessed during the review process. These capacitor banks were located at the proposed Cooma switching station, the existing Cooma substation and the Deniliquin substation and have subsequently been included in PB Associates recommendations.

PB Associates has recommended that Line 966 upgrade be deferred by utilising network support from Directlink, and Line 875 be upgraded to 132kV operation. In addition the replacement of the series reactor in Cable No. 41 has been included in both asset replacement and small augmentation and PB Associates has recommended that the project be removed from the small augmentation category.

PB Associates has also recommended that the reactive power projects at Narrabri substation be deferred until the next period, the Nambucca substation capacitor bank be removed from the submission and the replacement of the second Tamworth reactor be

excluded from the regulated asset base. Other projects not recommended for inclusion in the capital works program include duplicating breakers at Sydney East, West and North substations, and transformer replacements at Cowra, Dapto, Kempsey and Koolkhan substations.

In relation to Technical Services expenditure, PB Associates has made three adjustments.

- A 10% engineering factor has been removed as this was already included in the base cost estimates;
- An additional allowance of $0.5m p.a. was included as the costs of minor communications expenditures had overlooked in TransGrid's Application;
- The Lismore to Dumaresq line has been removed pending negotiations with Powerlink to link communications from Brisbane to QNI. The amount removed was $5.5m.

Property Acquisitions and Easements

The costs of property easements and acquisitions are driven largely by the program for network augmentations. As a result of the proposed deferral of many augmentations and the classifying of many major augmentations as Excluded Projects, the provision recommended for Property costs in the ex-ante capital expenditure program has been reduced. The key factors contributing to the reductions are:

1. excluded augmentation projects;
2. timing of expenditures have been deferred in some cases to reflect a balance of proposed new practices with TransGrid's historical experience;
3. revised estimates for the Bonville Golf Course litigation costs; and
4. deferral of the Wallgrove site acquisition.

9.4 SUPPORT THE BUSINESS

IT

PB Associates found that the basis for developing cost estimates for replacement of IT systems, was in some cases at the high side of cost expectations or the timing of those expenditures was slightly premature.

TransGrid's application also identified expenditure requirements for IT business performance improvement investments. PB Associates reviewed these projections and concluded that the levels were not reflective of historical experiences and should in most cases be offset by efficiency gains.

During the review PB Associates also noted that in a number of instances specific projects were either not adequately provided for, or had been duplicated. This was due in part to the process of splitting expenditures between replacement and business improvement categories which led to transcription errors. These errors, however, reflect the challenges that TransGrid still face in ensuring that the governance arrangements provide a sound quality assurance process in the formulation of capital requirements for regulatory review.

PB Associates has recommended reductions of $12.1m for IT capital expenditures, for a total 5 year program expenditure of $59.17m less ring fencing allocations.

Motor Vehicle and Mobile Plant

The approach adopted by TransGrid in determining motor vehicle and plant expenditures over the regulatory period is based on robust asset information and a sound process for vehicle turnovers. PB Associates therefore recommends no changes to the proposed capital program, other than to eliminate private motor vehicles which had been included in TransGrid's Application. The total recommended 5 year capital expenditure program is $36.6m and $19.9m for disposals. These figures are further reduced for ring fencing allocations.

Miscellaneous Assets

PB Associates has reviewed the detailed schedules for equipment purchases and believes that the process for identification of anticipated expenditures and the levels proposed are reasonable. During the review, however, TransGrid identified that they had included expenditures for the State Records upgrade in both the IT and Miscellaneous Assets sections. It was agreed that this amount of $1.4m would be removed from the Miscellaneous Assets projections. The revised capital expenditure figures proposed for the 5 year program is therefore $7.7m.

Ring Fencing

PB Associates has recommended that a proportion of support the business capital expenditures should be excluded from the regulated network component of the capital expenditure program. The basis for the allocation was discussed with TransGrid and both parties agree that total revenues are a reasonable basis. It was also agreed that the 2002/03 proportion represents a more accurate representation of future external business operations. On this basis 2.4% of support the business capital expenditures is recommended to be excluded from TransGrid's regulated network capital expenditures. This amounts to approximately $2.5m. The resulting recommended 5 year capital expenditure for support the business is therefore $100.5m.

The following table shows the levels of Support the Business capital expenditures recommended for the regulated capital expenditure program applied by the ACCC in determining allowable network monopoly revenues after adjusting for the 2.4% allocation to external business.

Table 9-2 – Recommended Support the Business Capital Expenditures ($m)

Year Ending 30 June	2005	2006	2007	2008	2009	Total
Information Technology	9.15	11.52	12.82	11.41	12.84	**57.75**
Motor Vehicles and Plant	8.70	7.44	6.58	6.66	6.37	**35.74**
Miscellaneous Assets	2.63	1.52	1.07	1.04	1.26	**7.52**
Total Support the Business	**20.48**	**20.48**	**20.48**	**19.11**	**20.48**	**101.02**

9.5 POOLED CONTINGENCY

PB Associates has analysed TransGrid's submission for inclusion of a pooled contingency to allow for unforeseen minor capital expenditures and where the scope of some projects is difficult to ascertain. Although PB Associates appreciates the difficulties in providing accurate estimates for these projects and that it is difficult to identify all possible expenditures at this time, we do not consider it appropriate or necessary to incorporate an additional amount to cover such risks. Where necessary, PB Associates has tried to work with TransGrid to fully explore the various projects and categories of expenditure and to provide sufficient capital expenditure allowances in each case. PB Associates has formed the view that there is sufficient scope within the allowed expenditures to provide for reasonable and appropriate investments.

9.6 SUMMARY OF TOTAL RECOMMENDED CAPITAL EXPENDITURES

Based on the information reviewed during this assignment PB Associates has formulated the following recommended capital expenditure requirements for TransGrid's monopoly transmission network business over the regulatory period 2004/05 to 2008/09 as shown in Table 9-3, and Table 9-4.

Table 9-3 - Summary of TransGrid's Proposed Capital Expenditures ($m)

Year Ending 30 June	2005	2006	2007	2008	2009	Total
Asset Replacement	67	74	67	57	61	**326**
Augmentation	70	125	170	350	273	**988**
Support the Business	24	24	24	24	24	**120**
Excluded Projects	0	3	26	239	353	**621**
Pooled Contingency	10	14	17	29	23	**93**
Total	**171**	**240**	**304**	**699**	**734**	**2,148**

Table 9-4 – Recommended Changes to Capital Expenditures ($m)

Year Ending 30 June	2005	2006	2007	2008	2009	Total
Asset Replacement	-4	-21	-13	-7	-6	**-50**
Augmentation	-1	-24	-50	-172	-164	**-411**
Support the Business	-4	-4	-4	-5	-4	**-19**
Excluded Projects	1	6	32	127	145	**310**
Pooled Contingency	-10	-14	-17	-29	-23	**-93**
Total	**-17**	**-57**	**-51**	**-87**	**-52**	**-263**

Table 9-5 – Summary of PB Associates Recommended Capital Expenditures ($m)

Year Ending 30 June	2005	2006	2007	2008	2009	Total
Asset Replacement	63	53	54	50	55	**276**
Augmentation	69	101	120	178	109	**577**
Support the Business	20	20	20	19	20	**101**
Excluded Projects	1	9	58	366	498	**931**
Pooled Contingency	0	0	0	0	0	**0**
Total	**154**	**183**	**253**	**612**	**682**	**1,885**

APPENDIX A
Summary of Capital Expenditure Recommendations - In Format of Table 1A of TransGrid Application ($2004) - ($Millions)

	2005	2006	2007	2008	2009	5 Year Total
M Background Included Projects Summary Sheet	**153**	**175**	**195**	**247**	**184**	**954**
Asset Replacement						
Sub Total (Asset Replacement)	**63**	**53**	**54**	**50**	**55**	**276**
Sub-Total (Minor Projects)	**35**	**36**	**29**	**24**	**28**	**151**
Substation Projects	18	14	11	10	13	66
Mains Projects	5	5	3	3	3	19
Protection & Metering Projects	0	1	0	0	0	2
Communications Projects	2	2	3	2	1	10
Security Projects	10	15	11	9	10	55
Sub Total (Committed Asset Replacement Projects)	**18**	**1**	**0**	**0**	**0**	**19**
Committed Asset Replacement Projects	18	1	0	0	0	19
Sub Total (Major & Combined Projects)	**8**	**11**	**21**	**19**	**26**	**84**
Transformer Replacements	8	10	17	11	5	50
Transmission Line Reconstruction 990 (Yass-Wagga) & 875 (Tamworth-Gunnedah)	0	0	1	1	7	9
Control Room Replacement Taree Substation	0	0	2	3	2	6
Protection System Upgrades	1	1	1	1	1	5
Tunnel Board Replacement Canberra 330kV	0	0	0	1	0	1
Substation Replacement Queanbeyan Substation	0	0	0	1	11	12
Regional Depots Projects	**0**	**3**	**3**	**7**	**2**	**16**
Sub-Total (Regulatory Projects)	**1**	**2**	**2**	**0**	**0**	**6**
Transformers (Vales Point)	0	1	1	0	0	3
PCB	1	1	0	0	0	2
Mine Subsidence	0	0	0	0	0	0
Future Regulatory Projects	0	0	0	0	0	1
Support the Business						
Support the Business	**20**	**20**	**20**	**19**	**20**	**101**
Augmentation						
Sub Total (Augmentation)	**69**	**101**	**120**	**178**	**109**	**577**
Sub Total (Property Acquisition & Survey)	**18**	**29**	**12**	**14**	**12**	**86**
Business Resources - Property - Committed & Ongoing Works	14	25	10	8	8	65
Property - Augmentation Projects	4	5	2	6	5	21
Sub Total (Small and Committed Augmentations)	**52**	**71**	**104**	**150**	**73**	**450**
Committed	41	22	24	47	2	136
Small Augmentations - New Lines	4	10	11	15	26	67
Small Augmentations - New Substations	0	0	3	22	3	27
Small Augmentations - Reactive Plant	2	15	13	6	4	40
Small Augmentations - Substations	3	10	34	41	22	110
Small Augmentations - Transformers	1	12	11	17	9	51
Technical Services - Miscellaneous	1	1	7	3	6	18
Sub Total (Complex)	**0**	**0**	**4**	**14**	**24**	**42**
Royalla 330 kV Substation Stage 1 (132kV Substation)	0	0	1	3	3	8
Holroyd Complex	0	0	0	0	0	0
Mid North Coast Reinforcement	0	0	2	9	19	30
QNI Upgrade proposal	0	0	1	2	2	4
Western 500 kV System	0	0	0	0	0	0
Pooled Contingency	**0**	**0**	**0**	**0**	**0**	**0**

	2005	2006	2007	2008	2009	5 Year Total
M Background Excluded Projects Summary Sheet	**1**	**9**	**58**	**366**	**498**	**930**
Sub-Total (Excluded Projects)	**1**	**9**	**58**	**366**	**498**	**930**
Easements and Land	0	0	12	124	0	136
Newcastle and Lower North Coast Supply (Stage 1)	0	0	3	12	82	98
Bannaby - Sydney 500kV Development	0	1	5	16	104	125
Kemps - Sydney South Development	0	0	0	1	2	3
Mason Park 330/132kV GIS Substation	0	1	3	30	96	129
Series Compensation at Dumarseq	0	0	0	50	30	80
Yass - Wagga 330kV SC TL	0	0	3	6	39	49
Royalla 330 kV Substation Stage 1 (Canberra Supply)	0	0	1	2	6	8
Holroyd Complex	0	1	8	27	28	64
Mid North Coast Reinforcement	0	0	0	0	0	0
QNI Upgrade proposal	0	0	0	0	0	0
Western 500 kV System	0	2	15	81	97	194
Property - Augmentation Projects	1	3	8	17	14	44

APPENDIX B
Replacement Project – Comparison of Proposed and Recommended Expenditures ($2004)

Asset Replacement

TransGrid Proposal

	04/05	05/06	06/07	07/08	08/09	Total
Condition Based Line Replacement	332,988	546,410	3,007,474	3,384,489	7,603,652	**14,875,013**
Condition Based Transformer Replacement	9,820,497	18,873,476	15,238,874	12,091,458	4,917,080	**60,941,385**
Strategy Based Substation Replacement	0	0	0	1,553,223	12,221,220	**13,774,443**
Tunnel Board Replacement	0	0	350,000	700,000	350,000	**1,400,000**
Secondary Systems Replacement	0	0	2,025,000	4,050,000	2,025,000	**8,100,000**
Protection Systems Upgrade	640,000	870,000	1,490,000	1,600,000	1,250,000	**5,850,000**
Regulatory Projects	960,311	2,114,805	1,722,414	1,500,000	1,500,000	**7,797,530**
Committed Projects	17,954,000	800,000	0	0	0	**18,754,000**
Minor Projects	35,694,134	37,028,205	29,383,402	24,167,950	28,590,615	**154,864,306**
Regional Depots	690,000	13,759,600	14,154,000	8,342,000	2,337,000	**39,282,600**
TOTALTRANSGRID PROPOSALS	**66,091,930**	**73,992,497**	**67,371,165**	**57,389,120**	**60,794,567**	**325,639,278**

Project	04/05	05/06	06/07	07/08	08/09	Total
Refurbishment of 875 - option 1	332,988	431,410	2,105,810	1,918,133	0	**4,788,341**
Refurbishment of 990 Line - Option 1	0	115,000	901,664	1,466,356	7,603,652	**10,086,672**
Condition Based Line Replacement	**332,988**	**546,410**	**3,007,474**	**3,384,489**	**7,603,652**	**14,875,013**
Armidale 132kV Tx Replace	191,364	1,600,710	0	0	0	**1,792,075**
Armidale 330kV Tx Replacement	0	351,000	4,734,000	0	0	**5,085,000**
Wellington 330kV Tx	605,170	6,954,728	24,410	0	0	**7,584,308**
Finley 132/66kV Tx Replacement	0	0	0	990,030	0	**990,030**
Glen Innes Tx Replacement - Option 2	0	0	1,980,060	0	0	**1,980,060**
Orange - Condition Based Tx Replacement	0	0	398,721	3,500,373	0	**3,899,094**
Pt Macquarie 132kV Tx replacement	402,297	3,553,685	0	0	0	**3,955,982**
Newcastle No 1 Tx replacement	7,437,576	62,362	0	0	0	**7,499,938**
41 Cable Shunt Reactor replacement	0	0	289,600	1,898,900	0	**2,188,500**
Sydney West No 1 Tx replacement	130,229	785,075	4,917,080	0	0	**5,832,384**
Sydney West No 2 Tx Replacement	0	0	130,229	785,075	4,917,080	**5,832,384**
Sydney West No 3 Tx Replacement	0	130,229	785,075	4,917,080	0	**5,832,384**
Sydney West No 4 Tx Replacement	915,305	4,917,080	0	0	0	**5,832,384**
Tamworth Reactors - Stage 1	138,555	518,607	1,979,698	0	0	**2,636,861**
Condition Based Tx Replacement	**9,820,497**	**18,873,476**	**15,238,874**	**12,091,458**	**4,917,080**	**60,941,385**
Rebuild Queanbeyan substation	0	0	0	0	280,485	**280,485**
Rebuild Queanbeyan substation	0	0	0	1,553,223	11,940,735	**13,493,958**
Strategy Based Substation Replacement	**0**	**0**	**0**	**1,553,223**	**12,221,220**	**13,774,443**
Canberra Secondary System Replacement	0	0	350,000	700,000	350,000	**1,400,000**
Tunnel Board Replacement	**0**	**0**	**350,000**	**700,000**	**350,000**	**1,400,000**
Taree secondary system replacement	0	0	2,025,000	4,050,000	2,025,000	**8,100,000**
Secondary Systems Replacement	**0**	**0**	**2,025,000**	**4,050,000**	**2,025,000**	**8,100,000**
Protection System Upgrades	640,000	870,000	1,490,000	1,600,000	1,250,000	**5,850,000**
Protection System Upgrades	**640,000**	**870,000**	**1,490,000**	**1,600,000**	**1,250,000**	**5,850,000**
Vales Point 330kV Tx	63,427	1,179,805	1,597,414	0	0	**2,840,646**
PCB	751,884	885,000	125,000	0	0	**1,761,884**
Mine subsidence	145,000	50,000	0	0	0	**195,000**
Future Regulatory Projects	0	0	0	1,500,000	1,500,000	**3,000,000**
Regulatory Projects	**960,311**	**2,114,805**	**1,722,414**	**1,500,000**	**1,500,000**	**7,797,530**
Sydney West SVC	3,383,000	0	0	0	0	**3,383,000**
QNI	1,000,000	0	0	0	0	**1,000,000**
Yass 330kV Substation	8,599,000	800,000	0	0	0	**9,399,000**
Yass 330kV T/L	4,972,000	0	0	0	0	**4,972,000**
Committed Projects	**17,954,000**	**800,000**	**0**	**0**	**0**	**18,754,000**

Substation Projects	18,637,478	14,549,243	11,792,239	9,848,531	13,734,787	**68,562,278**
Mains Projects	5,198,425	4,899,150	3,164,555	3,103,335	3,430,590	**19,796,055**
Protection and Metering	319,000	737,000	353,500	258,000	258,000	**1,925,500**
Communications Projects	1,873,941	1,906,532	2,730,728	2,127,854	1,348,290	**9,987,345**
Security Projects	9,665,290	14,936,280	11,342,380	8,830,230	9,818,948	**54,593,128**
Minor Projects	**35,694,134**	**37,028,205**	**29,383,402**	**24,167,950**	**28,590,615**	**154,864,306**
Metropolitan Regional Depot	325,000	10,629,600	11,981,000	2,785,000	0	**25,720,600**
Orange Regional Depot	25,000	2,500,000	988,000	0	0	**3,513,000**
Newcastle Regional Centre	0	0	500,000	3,235,000	2,337,000	**6,072,000**
Tamworth Regional Centre	0	0	0	2,322,000	0	**2,322,000**
Wagga Regional Centre	145,000	330,000	330,000	0	0	**805,000**
Yass Regional Centre	195,000	300,000	355,000	0	0	**850,000**
Regional Depots	**690,000**	**13,759,600**	**14,154,000**	**8,342,000**	**2,337,000**	**39,282,600**

Asset Replacement

PB Assoc. Recommend

	04/05	05/06	06/07	07/08	08/09	Total
Condition Based Line Replacement	0	107,180	840,351	1,366,644	7,086,604	**9,400,778**
Condition Based Transformer Replacement	7,924,697	10,070,267	16,591,964	11,269,239	4,582,718	**50,438,886**
Strategy Based Substation Replacement	0	0	0	1,447,604	11,390,177	**12,837,781**
Tunnel Board Replacement	0	0	326,200	652,400	326,200	**1,304,800**
Secondary Systems Replacement	0	0	1,509,840	3,019,680	1,509,840	**6,039,360**
Protection Systems Upgrade	534,208	726,189	1,243,703	1,335,520	1,043,375	**4,882,995**
Regulatory Projects	1,155,998	2,234,578	1,813,790	200,000	200,000	**5,604,367**
Committed Projects	17,954,000	800,000	0	0	0	**18,754,000**
Minor Projects	34,977,042	36,321,390	28,742,768	23,742,620	27,620,392	**151,404,213**
Regional Depots	452,500	3,243,630	3,188,343	7,076,980	1,635,000	**15,596,453**
TOTALTRANSGRID PROPOSALS	**62,998,445**	**53,503,235**	**54,256,960**	**50,110,686**	**55,394,307**	**276,263,632**

Project	**04/05**	**05/06**	**06/07**	**07/08**	**08/09**	**Total**
Refurbishment of 875 - option 1						**0**
Refurbishment of 990 Line - Option 1	$0	$107,180.00	$840,350.85	$1,366,643.79	$7,086,603.66	**9,400,778**
Condition Based Line Replacement	**$0**	**$107,180**	**$840,351**	**$1,366,644**	**$7,086,604**	**9,400,778**
Armidale 132kV Tx Replace	$178,351	$1,491,862	$0	$0	0	**1,670,213**
Armidale 330kV Tx Replacement		$327,132	$4,412,088	$0	0	**4,739,220**
Wellington 330kV Tx	$564,018	$6,481,807	$22,750	$0	0	**7,068,575**
Finley 132/66kV Tx Replacement	$0	$0	$0	$922,708	0	**922,708**
Glen Innes Tx Replacement - Option 2	$0	$0	$922,708	$0	0	**922,708**
Orange - Condition Based Tx Replacement	$0	$0	$371,608	$3,262,347	0	**3,633,955**
Pt Macquarie 132kV Tx replacement	0	$374,940	$3,312,034	$0	0	**3,686,974**
Newcastle No 1 Tx replacement	$6,931,821	$58,121	$0	$0	0	**6,989,942**
41 Cable Shunt Reactor replacement	$0	$0	$269,915	$1,769,775	0	**2,039,689**
Sydney West No 1 Tx replacement	$121,373	$731,690	$4,582,718	$0	0	**5,435,782**
Sydney West No 2 Tx Replacement		$0	$121,374	$731,690	$4,582,718	**5,435,782**
Sydney West No 3 Tx Replacement	$0	$121,374	$731,690	$4,582,718	0	**5,435,782**
Sydney West No 4 Tx Replacement			$0	$0	0	**0**
Tamworth Reactors - Stage 1	$129,133	$483,342	$1,845,079	$0	0	**2,457,554**
Condition Based Tx Replacement	**$7,924,697**	**$10,070,267**	**$16,591,964**	**$11,269,239**	**$4,582,718**	**50,438,886**
Rebuild Queanbeyan substation	$0	$0.00	$0.00	$0	$261,412	**261,412**
Rebuild Queanbeyan substation	$0	$0.00	$0.00	$1,447,604	$11,128,765	**12,576,369**
Strategy Based Substation Replacement	**$0**	**$0**	**$0**	**$1,447,604**	**$11,390,177**	**12,837,781**
Canberra Secondary System Replacement	$0	$0.00	$326,200	$652,400	$326,200	**1,304,800**
Tunnel Board Replacement	**$0**	**$0**	**$326,200**	**$652,400**	**$326,200**	**1,304,800**
Taree secondary system replacement	$0	$0.00	$1,509,840	$3,019,680	$1,509,840	**6,039,360**
Secondary Systems Replacement	**$0**	**$0**	**$1,509,840**	**$3,019,680**	**$1,509,840**	**6,039,360**
Protection System Upgrades	$534,208	$726,189	$1,243,703	$1,335,520	$1,043,375	**4,882,995**
Protection System Upgrades	**$534,208**	**$726,189**	**$1,243,703**	**$1,335,520**	**$1,043,375**	**4,882,995**
Vales Point 330kV Tx	59,114	$1,099,578.26	$1,488,790.29	$0.00	$0.00	**2,647,483**
PCB	751,884	$885,000.00	$125,000.00			**1,761,884**
Mine subsidence	145,000	$50,000.00				**195,000**
Future Regulatory Projects	200,000	$200,000.00	$200,000.00	$200,000.00	$200,000.00	**1,000,000**
Regulatory Projects	**$1,155,998**	**$2,234,578**	**$1,813,790**	**$200,000**	**$200,000**	**5,604,367**
Sydney West SVC	3,383,000	0	0	0	0	**3,383,000**
QNI	1,000,000					**1,000,000**
Yass 330kV Substation	8,599,000	800,000	0	0	0	**9,399,000**

Yass 330kV T/L	4,972,000	0	0	0	0	**4,972,000**
Committed Projects	**$17,954,000**	**$800,000**	**$0**	**$0**	**$0**	**18,754,000**
Substation Projects	$18,031,453	$13,965,419	$11,343,837	$9,505,539	$13,341,482	**66,187,730**
Mains Projects	$5,120,252	$4,815,813	$3,018,587	$3,056,785	$2,877,766	**18,889,202**
Protection and Metering	$314,215	$725,945	$348,198	$254,130	$254,130	**1,896,618**
Communications Projects	$1,845,832	$1,877,934	$2,689,767	$2,095,936	$1,328,066	**9,837,535**
Security Projects	$9,665,290	$14,936,280	$11,342,380	$8,830,230	$9,818,948	**54,593,128**
Minor Projects	**$34,977,042**	**$36,321,390**	**$28,742,768**	**$23,742,620**	**$27,620,392**	**151,404,213**
Metropolitan Regional Depot	$292,500	$566,640	$1,782,900	$2,506,500		**5,148,540**
Orange Regional Depot	$25,000	$2,346,990	$625,443			**2,997,433**
Newcastle Regional Centre			$425,000	$2,290,000	$1,635,000	**4,350,000**
Tamworth Regional Centre				$2,280,480		**2,280,480**
Wagga Regional Centre	$85,000	$330,000	$300,000			**715,000**
Yass Regional Centre	$50,000		$55,000			**105,000**
Regional Depots	**$452,500**	**$3,243,630**	**$3,188,343**	**$7,076,980**	**$1,635,000**	**15,596,453**

Asset Replacement

Variation between PB Associates Recommendation and TransGrid Proposal

	04/05	05/06	06/07	07/08	08/09	Total
Condition Based Line Replacement	-332,988	-439,230	-2,167,124	-2,017,845	-517,048	**-5,474,235**
Condition Based Transformer Replacement	-1,895,800	-8,803,209	1,353,090	-822,219	-334,361	**-10,502,499**
Strategy Based Substation Replacement	0	0	0	-105,619	-831,043	**-936,662**
Tunnel Board Replacement	0	0	-23,800	-47,600	-23,800	**-95,200**
Secondary Systems Replacement	0	0	-515,160	-1,030,320	-515,160	**-2,060,640**
Protection Systems Upgrade	-105,792	-143,811	-246,297	-264,480	-206,625	**-967,005**
Regulatory Projects	195,687	119,773	91,376	-1,300,000	-1,300,000	**-2,193,163**
Committed Projects	0	0	0	0	0	**0**
Minor Projects	-717,092	-706,815	-640,634	-425,330	-970,223	**-3,460,093**
Regional Depots	-237,500	-10,515,970	-10,965,657	-1,265,020	-702,000	**-23,686,147**
TOTALTRANSGRID PROPOSALS	**-3,093,485**	**-20,489,262**	**-13,114,205**	**-7,278,434**	**-5,400,260**	**-49,375,645**

Project	**04/05**	**05/06**	**06/07**	**07/08**	**08/09**	**Total**
Refurbishment of 875 - option 1	-332,988	-431,410	-2,105,810	-1,918,133	0	**-4,788,341**
Refurbishment of 990 Line - Option 1	0	-7,820	-61,313	-99,713	-517,048	**-685,894**
Condition Based Line Replacement	**-332,988**	**-439,230**	**-2,167,124**	**-2,017,845**	**-517,048**	**-5,474,235**
Armidale 132kV Tx Replace	-13,013	-108,848	0	0	0	**-121,862**
Armidale 330kV Tx Replacement	0	-23,868	-321,912	0	0	**-345,780**
Wellington 330kV Tx	-41,151	-472,922	-1,660	0	0	**-515,733**
Finley 132/66kV Tx Replacement	0	0	0	-67,322	0	**-67,322**
Glen Innes Tx Replacement - Option 2	0	0	-1,057,352	0	0	**-1,057,352**
Orange - Condition Based Tx Replacement	0	0	-27,113	-238,025	0	**-265,138**
Pt Macquarie 132kV Tx replacement	-402,297	-3,178,745	3,312,034	0	0	**-269,007**
Newcastle No 1 Tx replacement	-505,756	-4,240	0	0	0	**-509,996**
41 Cable Shunt Reactor replacement	0	0	-19,685	-129,125	0	**-148,811**
Sydney West No 1 Tx replacement	-8,856	-53,385	-334,361	0	0	**-396,603**
Sydney West No 2 Tx Replacement	0	0	-8,856	-53,385	-334,361	**-396,602**
Sydney West No 3 Tx Replacement	0	-8,856	-53,385	-334,361	0	**-396,602**
Sydney West No 4 Tx Replacement	-915,305	-4,917,080	0	0	0	**-5,832,384**
Tamworth Reactors - Stage 1	-9,422	-35,265	-134,620	0	0	**-179,307**
Condition Based Tx Replacement	**-1,895,800**	**-8,803,209**	**1,353,090**	**-822,219**	**-334,361**	**-10,502,499**
Rebuild Queanbeyan substation	0	0	0	0	-19,073	**-19,073**
Rebuild Queanbeyan substation	0	0	0	-105,619	-811,970	**-917,589**
Strategy Based Substation Replacement	**0**	**0**	**0**	**-105,619**	**-831,043**	**-936,662**
Canberra Secondary System Replacement	0	0	-23,800	-47,600	-23,800	**-95,200**
Tunnel Board Replacement	**0**	**0**	**-23,800**	**-47,600**	**-23,800**	**-95,200**
Taree secondary system replacement	0	0	-515,160	-1,030,320	-515,160	**-2,060,640**
Secondary Systems Replacement	**0**	**0**	**-515,160**	**-1,030,320**	**-515,160**	**-2,060,640**
Protection System Upgrades	-105,792	-143,811	-246,297	-264,480	-206,625	**-967,005**
Protection System Upgrades	**-4,313**	**-80,227**	**-108,624**	**0**	**0**	**-193,163**
Vales Point 330kV Tx	0	0	0	0	0	**0**
PCB	0	0	0	0	0	**0**
Mine subsidence	200,000	200,000	200,000	-1,300,000	-1,300,000	**-2,000,000**
Future Regulatory Projects	195,687	119,773	91,376	-1,300,000	-1,300,000	**-2,193,163**
Regulatory Projects	**0**	**0**	**0**	**0**	**0**	**0**
Sydney West SVC	0	0	0	0	0	**0**
QNI	0	0	0	0	0	**0**
Yass 330kV Substation	0	0	0	0	0	**0**
Yass 330kV T/L	0	0	0	0	0	**0**
Committed Projects	**-606,025**	**-583,824**	**-448,402**	**-342,992**	**-393,305**	**-2,374,548**

Substation Projects	-78,173	-83,337	-145,968	-46,550	-552,824	**-906,853**
Mains Projects	-4,785	-11,055	-5,303	-3,870	-3,870	**-28,883**
Protection and Metering	-28,109	-28,598	-40,961	-31,918	-20,224	**-149,810**
Communications Projects	0	0	0	0	0	**0**
Security Projects	-717,092	-706,815	-640,634	-425,330	-970,223	**-3,460,093**
Minor Projects	**-32,500**	**-10,062,960**	**-10,198,100**	**-278,500**	**0**	**-20,572,060**
Metropolitan Regional Depot	0	-153,010	270,443	0	0	**-515,567**
Orange Regional Depot	0	0	-13,729,000	-6,052,000	-702,000	**-34,932,600**
Newcastle Regional Centre	0	0	0	2,280,480	0	**2,280,480**
Tamworth Regional Centre	-60,000	0	300,000	0	0	**715,000**
Wagga Regional Centre	-145,000	-300,000	55,000	0	0	**105,000**
Yass Regional Centre	-237,500	-10,515,970	-10,965,657	-1,265,020	-702,000	**-23,686,147**
Regional Depots	**-237,500**	**-10,515,970**	**-10,965,657**	**-1,265,020**	**-702,000**	**-23,686,147**

APPENDIX C
Small Augmentation Projects – Comparison of Proposed and Recommended Expenditures ($2004)

Small Augmentations

TransGrid Proposal

	04/05	05/06	06/07	07/08	08/09	Total
NEW LINES	643,887	2,866,141	13,109,106	23,016,444	28,483,490	**68,119,067**
NEW SUBSTATIONS	57,500	242,231	3,096,295	21,333,818	2,926,929	**27,656,772**
REACTIVE PLANT	3,417,257	18,171,346	14,520,673	5,946,066	3,851,029	**45,906,370**
SUBSTATIONS	3,461,489	11,366,184	41,240,210	46,469,944	23,749,091	**126,286,918**
TRANSFORMERS	1,894,554	15,850,276	9,352,514	19,201,945	20,562,804	**66,862,093**
COMMITED PROJECTS	40,697,000	22,328,000	23,973,000	46,517,000	2,171,000	**135,686,000**
TECHNICAL SERVICES	0	277,200	7,649,400	8,291,800	7,013,600	**23,232,000**
TOTAL TRANSGRID PROPOSAL	**50,171,686**	**71,101,378**	**112,941,198**	**170,777,016**	**88,757,943**	**493,749,221**

Project	04/05	05/06	06/07	07/08	08/09	Total
Inverell 132kV Switchbay	0	0	0	0	93,495	**93,495**
Glen Innes 132kV Switchbay	0	0	25,868	300,701	1,175,602	**1,502,171**
Inverell 132kV Switchbay	0	0	25,438	283,767	1,067,456	**1,376,662**
Glen Innes to Inverell 132kV Line	73,333	559,479	1,311,540	3,785,291	8,739,773	**14,469,416**
Upgrade 966 Armidale - Koolkhan 132kV Line	225,553	759,320	6,707,587	3,219,240	0	**10,911,700**
Finley 132kV Substation Augmentation	0	0	0	0	0	**0**
Mulwala 132kV Substation Augmentation	0	0	0	0	0	**0**
Finley 132kV Substation Augmentation	0	0	0	0	0	**0**
Mulwala 132kV Substation Augmentation	0	0	0	0	0	**0**
Finley to Mulwala 132kV Line	0	0	0	293,333	1,082,618	**1,375,951**
TS - Mulwala to Finley 132kV line	0	0	0	0	0	**0**
TS - Mulwala to Finley 132kV line	0	0	0	0	0	**0**
Narrandera 132kV substation	0	0	0	0	0	**0**
Narrandera 132kV substation	0	0	0	0	0	**0**
Narrandera to Lockhart 132kV Line	0	0	0	0	0	**0**
TS - Narrandera 132kV substation	0	0	0	0	0	**0**
TS - Narrandera 132kV substation	0	0	0	0	0	**0**
Manildra 132kV switchbay	0	0	0	0	0	**0**
Parkes 132kV Switchbay	0	0	0	0	0	**0**
Manildra 132kV switchbay	0	0	0	50,856	303,561	**354,416**
Parkes 132kV Switchbay	0	0	0	50,856	303,561	**354,416**
Manildra to Parkes 132kV Line	0	220,000	971,528	1,678,256	12,260,677	**15,130,461**
Yass - Cowra Line Upgrade	0	0	0	0	0	**0**
Coleambally 132kV Line Switchbay	0	0	0	0	0	**0**
Darlington Pt 132kV line switchbay	0	0	0	0	0	**0**
Coleambally 132kV Line Switchbay	0	0	0	0	0	**0**
Darlington Pt 132kV line switchbay	0	0	0	0	0	**0**
Darlington Pt - Coleambally 132kV Line	0	0	0	0	55,000	**55,000**
Upgrade 64 line to 85C	115,000	402,225	1,058,734	2,544,626	998,574	**5,119,159**
Upgrade 65 line to 85C	115,000	402,225	1,058,734	2,544,626	998,574	**5,119,159**
Upgrade 66 line to 85 C	115,000	522,891	1,309,678	4,104,893	1,404,598	**7,457,060**
Rebuild 875 at 132kV						
41 cable series reactor replacement	0	0	640,000	4,160,000	0	**4,800,000**
NEW LINES	**643,887**	**2,866,141**	**13,109,106**	**23,016,444**	**28,483,490**	**68,119,067**
Boggabri 132kV Substation	0	0	0	0	0	**0**
Boggabri 132kV Substation	0	0	0	0	785,368	**785,368**
Boggabri Line Outlets	0	0	27,500	117,983	141,931	**287,413**
TS - Boggabri 132kV substation	0	0	0	0	0	**0**

TS - Boggabri 132kV substation	0	0	0	0	13,200	**13,200**
Bulladelah 132kV Substation	0	0	0	178,860	0	**178,860**
Bulladelah 132kV Substation	0	0	160,092	3,738,260	603,219	**4,501,570**
Bulladelah Line Cut in	0	95,833	190,022	846,134	893,604	**2,025,593**
TS - Glen Innes	0	0	583,000	0	0	**583,000**
TS - Glen Innes	0	11,660	46,640	0	0	**58,300**
Wagga North 132kV Substation	0	0	0	373,980	0	**373,980**
Wagga North 132kV Substation	0	0	865,957	7,881,614	470,540	**9,218,111**
TS - Wagga North	0	0	0	1,430,000	0	**1,430,000**
TS - Wagga North	0	0	0	123,933	19,067	**143,000**
Cooma Switching Station Capacitors						
Cooma North 132 Switching Station	0	0	0	186,990	0	**186,990**
Cooma North 132 Switching Station	0	0	1,061,772	6,168,146	0	**7,229,918**
Cooma North 132kV Line Cut In	57,500	134,738	161,313	287,919	0	**641,469**
NEW SUBSTATIONS	**57,500**	**242,231**	**3,096,295**	**21,333,818**	**2,926,929**	**27,656,772**
Canberra - 132kV Capacitor Bank	282,372	1,872,425	0	0	0	**2,154,797**
Cowra - Capacitor bank	0	195,336	1,120,251	0	0	**1,315,588**
Forbes - Capacitor	0	142,778	798,480	0	0	**941,259**
Panorama 66kV Cap bank	0	0	88,889	1,099,399	0	**1,188,287**
Parkes - Capacitor	0	130,923	766,881	0	0	**897,804**
Dapto - 2x120MVAr Cap Banks	448,985	2,948,405	0	0	0	**3,397,390**
Darlington Point 132kV Cap Banks	597,483	3,987,115	0	0	0	**4,584,598**
Koolkhan 66kV Cap	0	226,080	976,486	0	0	**1,202,566**
Nambucca 66kV Cap	0	226,080	976,486	0	0	**1,202,566**
Regentville No.3 80MVAr Cap bank	0	0	0	1,418,921	0	**1,418,921**
Sydney West 330kV Cap Bank 200MVar	157,802	1,107,228	0	0	0	**1,265,031**
Vales Point 330kV Cap Bank (2*200MVar)	469,910	3,358,205	0	0	0	**3,828,115**
Narrabri - Capacitor Bank	0	95,912	549,152	0	0	**645,064**
Deniliquin - Capacitor Bank						
Cooma - Capacitor Bank						
Bayswater/Liddell 330kV Cap bank 150MVar	0	847,728	5,633,476	0	0	**6,481,204**
Eraring 330kV Cap bank 150MVar	0	472,751	3,177,907	0	0	**3,650,658**
Mt Piper 330kV Cap bank 150MVar	0	0	432,664	2,882,188	0	**3,314,852**
330kV Cap bank 200MVar - location 1	0	0	0	181,853	1,283,676	**1,465,529**
330kV Cap bank 200MVar - location 2	0	0	0	181,853	1,283,676	**1,465,529**
330kV Cap bank 200MVar - location 3	0	0	0	181,853	1,283,676	**1,465,529**
Tamworth Reactors - Stage2	1,460,704	2,560,378	0	0	0	**4,021,082**
REACTIVE PLANT	**3,417,257**	**18,171,346**	**14,520,673**	**5,946,066**	**3,851,029**	**45,906,370**
33kV supply for EA at Vales Point	0	423,494	4,157,974	26,893	0	**4,608,361**
TS - Bulladelah 132kV substation	0	0	0	528,000	0	**528,000**
TS - Bulladelah 132kV substation	0	0	0	45,760	7,040	**52,800**
Eraring Switchyard augmentation	0	0	312,685	0	0	**312,685**
Eraring Switchyard augmentation	226,714	1,127,020	2,762,073	0	0	**4,115,807**
Turn in 24 line at Eraring	191,946	176,245	415,337	0	0	**783,528**
TS - Rearrangement near Vales Pt&Munmorah	0	0	660,000	0	0	**660,000**
TS - Turn 24 line into Eraring	0	0	550,000	0	0	**550,000**
TS - Rearrangement near Vales Pt&Munmorah	0	26,400	39,600	0	0	**66,000**
TS - Turn 24 line into Eraring	0	22,000	33,000	0	0	**55,000**
Rearrangement near Vales Point	12,407	110,474	910,655	0	0	**1,033,536**
89 line connection at Armidale	0	0	0	0	0	**0**
89 line connection at Armidale	131,664	699,426	1,091,348	0	0	**1,922,439**
Reconnection of 89 line	174,814	192,260	246,156	0	0	**613,230**
Dapto - Fault Level	0	0	377,591	1,112,043	5,632,036	**7,121,670**
Dapto - 132kV Line Switchbay	0	0	186,990	0	0	**186,990**
Dapto - 132kV Line Switchbay	82,846	311,823	1,012,358	0	0	**1,407,028**

Finley 132 Tx Capacity Limits	0	0	0	268,290	0	**268,290**
Finley 132 Tx Capacity Limits	0	109,049	1,562,664	2,455,419	0	**4,127,132**
Frequency injection point - Kempsey	500,000	0	0	0	0	**500,000**
Frequency injection point - Port Macquarie	500,000	0	0	0	0	**500,000**
Frequency injection point - Taree	225,000	0	0	0	0	**225,000**
Glen Innes Substation Rebuild - Option2	0	0	178,860	0	0	**178,860**
Glen Innes Substation Rebuild - Option2	0	508,213	7,255,511	0	0	**7,763,724**
Line Terminal Ratings - Bayswater to Liddell 33&34	45,035	171,063	0	0	0	**216,098**
Line Terminal Ratings - Kemps Creek to Avon No 37	74,562	331,244	0	0	0	**405,805**
Line Terminal Ratings - Mummorah to Vales Pt No23	84,687	371,222	0	0	0	**455,908**
Line Terminal Ratings - UTSS to Canberra No 01	109,363	501,352	0	0	0	**610,715**
Line Terminal Ratings - UTSS to Yass No 02	109,363	501,352	0	0	0	**610,715**
Line Terminal Ratings - Vales Pt to Newcastle No24	45,035	171,063	0	0	0	**216,098**
Line Terminal Ratings - Yass to Canberra No 9	121,164	507,113	0	0	0	**628,276**
Line Terminal Ratings - Yass to Marulan No 4	64,273	222,434	0	0	0	**286,707**
Line Terminal Ratings - Yass to Marulan No 5	2,587	15,560	0	0	0	**18,147**
Orange 132kV Augmentation	0	0	0	536,580	0	**536,580**
Orange 132kV Augmentation	0	0	884,465	11,437,789	0	**12,322,254**
Orange 132kv substation- 66kV line reconnection	0	132,667	665,667	2,311,667	0	**3,110,000**
TS - Orange 132kV substation	0	0	0	880,000	0	**880,000**
TS - Orange 132kV substation	0	0	17,600	70,400	0	**88,000**
Murray Switching Station Refurbishment	0	332,439	1,225,852	4,767,726	0	**6,326,016**
Upper Tumut Refurbishment	0	454,345	2,406,791	5,911,899	0	**8,773,036**
Mount Annan 330kV Substation	0	0	0	0	388,520	**388,520**
Mount Annan 330kV Substation	0	0	1,544,551	5,380,675	14,712,995	**21,638,222**
TS - Mt Annan 330kV substation	0	0	0	0	1,870,000	**1,870,000**
TS - Mt Annan 330kV substation	0	0	0	74,800	112,200	**187,000**
Sydney North 132kV FL Upgrade	305,313	1,101,757	3,471,679	0	0	**4,878,749**
Sydney East - Duplicate breakers on No 2 Tx	0	55,358	384,368	647,341	0	**1,087,067**
Sydney North - Duplicate breakers on No 1 Tx	0	55,358	384,368	647,341	0	**1,087,067**
Sydney West - Duplicate breaker on No1 Tx	0	55,358	384,368	647,341	0	**1,087,067**
Sydney West - Duplicate breaker on 30 line	0	0	156,343	0	0	**156,343**
Sydney West - Duplicate breaker on 30 line	112,919	593,436	1,343,860	0	0	**2,050,215**
Sydney West 132kV Switchbays	0	0	186,990	0	0	**186,990**
Sydney West 132kV Switchbays	88,630	414,920	1,019,145	0	0	**1,522,695**
Sydney West FL Upgrade - 330kV switchyard	50,000	111,168	292,077	1,859,669	0	**2,312,914**
Tomago 330/132kV supply point	0	0	0	178,860	0	**178,860**
Tomago 330/132kV supply point	0	437,297	3,097,835	6,618,752	0	**10,153,885**
Tuggerah 132kV Augmentations	0	0	93,495	0	0	**93,495**
Tuggerah 132kV Augmentations	119,346	785,711	735,824	0	0	**1,640,881**
TS - Tuggerah Augmentation	0	0	0	0	990,000	**990,000**
TS - Tuggerah Augmentation	0	0	0	62,700	36,300	**99,000**
Vineyard 132kV line switchbays	0	0	186,990	0	0	**186,990**
Vineyard 132kV line switchbays	83,821	337,566	1,005,139	0	0	**1,426,527**
SUBSTATIONS	**3,461,489**	**11,366,184**	**41,240,210**	**46,469,944**	**23,749,091**	**126,286,918**
Armidale 132kV Tx Aug	253,043	1,773,513	0	0	0	**2,026,556**
Armidale 330kV Tx Aug	0	493,103	6,652,219	43,952	0	**7,189,274**
Marulan 330kV Tx	0	43,147	574,269	1,300,614	0	**1,918,031**
Vineyard 330kV Tx	842,749	5,230,411	0	0	0	**6,073,160**
Wellington 330 Tx augmentation	476,316	5,457,057	11,002	0	0	**5,944,374**
Cowra Transformer Replacement	0	0	0	106,692	975,936	**1,082,628**
Dapto - Additional 375MVA Tx	0	0	0	869,740	6,307,557	**7,177,297**
Deniliquin - Transformer Upgrade	0	0	0	0	0	**0**
Kempsey 132kV Tx Limitation	0	0	0	409,833	3,590,912	**4,000,745**
Koolkhan Tx Augmentation	0	0	0	0	325,156	**325,156**

Parkes Second Transformer	0	0	318,230	2,834,422	0	**3,152,652**
Pt Macquarie Augmentation (Tx)	322,447	2,853,043	0	0	0	**3,175,490**
Sydney South Tx No 3 & 4 replacement	0	2	1,510,583	10,635,736	0	**12,146,322**
Tuggerah 330kV switchyard and second Tx	0	0	0	0	224,318	**224,318**
Tuggerah 330kV switchyard and second Tx	0	0	286,210	3,000,955	9,138,926	**12,426,091**
Yanco 132kV Tx Limits	0	0	0	0	0	**0**
TRANSFORMERS	**1,894,554**	**15,850,276**	**9,352,514**	**19,201,945**	**20,562,804**	**66,862,093**
Coffs Harbour 330kV Substation	1,131,000	15,172,000	4,530,000	0	0	20,833,000
Coffs Harbour TL Rearrangement	284,000	3,139,000	0	0	0	3,423,000
Coleambally 132 kV Substation	40,000	0	0	0	0	40,000
Darlington Pt Communication	528,000	0	0	0	0	528,000
Inner City Substgation and Cable works	17,700,000	0	0	0	0	17,700,000
Koolkhan 132kV Substation	400,000	0	0	0	0	400,000
Liverpool Third Transformer	3,681,000	480,000	0	0	0	4,161,000
Newcastle 330kV Substation augmentation	901,000	0	0	0	0	901,000
Southern Communication Upgrade	1,793,000	0	0	0	0	1,793,000
Sydney West New 132 kV Switchbay	100,000	0	0	0	0	100,000
Tomago 330kV Switching Station	440,000	0	0	0	0	440,000
Tuggerah Sterland Upgrade	250,000	0	0	0	0	250,000
Vales Point and Munmorah Switchyard uprating	100,000	0	0	0	0	100,000
Vineyard No 1 Transformer replacement	4,000,000	385,000	0	0	0	4,385,000
Vineyard No 2 Tx Replacement	3,808,000	0	0	0	0	3,808,000
Waratah West 330kV Substation	3,773,000	0	0	0	0	3,773,000
Wellington 330kV Augmentation	48,000	140,000	841,000	1,438,000	0	2,467,000
Wollar 330kV Switching Station		940,000	2,584,000	10,676,000	0	14,200,000
Wollar Communications	250,000	600,000	600,000	0	0	1,450,000
Wollar to Wellington 330kV T/L	1,470,000	1,472,000	15,418,000	34,403,000	2,171,000	54,934,000
COMMITTED PROJECTS	**40,697,000**	**22,328,000**	**23,973,000**	**46,517,000**	**2,171,000**	**135,686,000**
TS - Darlington Pt Radio Development	0	0	2,750,000	0	0	**2,750,000**
TS - Darlington Pt Radio Development	0	110,000	165,000	0	0	**275,000**
TS - Hume SCADA	0	0	0	0	880,000	**880,000**
TS - Hume SCADA	0	0	0	35,200	52,800	**88,000**
TS - Lismore to Dumaresq	0	0	0	4,840,000	0	**4,840,000**
TS - Lismore to Dumaresq	0	0	193,600	290,400	0	**484,000**
TS - Minor Technical Services Projects	0	0	0	0	0	**0**
TS - Minor Technical Services Projects	0	0	0	0	220,000	**220,000**
TS - New England SCADA	0	0	0	0	0	**0**
TS - New England SCADA	0	0	0	0	39,600	**39,600**
TS - North Coast SCADA	0	0	4,180,000	0	0	**4,180,000**
TS - North Coast SCADA	0	167,200	250,800	0	0	**418,000**
TS - OPGW Backup:Southern	0	0	0	0	0	**0**
TS - OPGW Backup:Southern	0	0	0	0	127,600	**127,600**
TS - OPGW Backup:Western	0	0	0	0	2,310,000	**2,310,000**
TS - OPGW Backup:Western	0	0	0	92,400	138,600	**231,000**
TS - Radio Replacement	0	0	0	2,750,000	0	**2,750,000**
TS - Radio Replacement	0	0	110,000	165,000	0	**275,000**
TS - Snowy OPGW Augmentation	0	0	0	0	2,970,000	**2,970,000**
TS - Snowy OPGW Augmentation	0	0	0	118,800	178,200	**297,000**
TS - South Western NSW Development	0	0	0	0	0	**0**
TS - South Western NSW Development	0	0	0	0	96,800	**96,800**
TECHNICAL SERVICES	**0**	**277,200**	**7,649,400**	**8,291,800**	**7,013,600**	**23,232,000**

Small Augmentations

PB Associates Recommendation

	04/05	05/06	06/07	07/08	08/09	Total
NEW LINES	3,880,124	10,340,126	10,954,115	15,439,453	26,495,353	**67,109,171**
NEW SUBSTATIONS	53,590	214,892	2,842,278	21,650,252	2,697,825	**27,458,838**
REACTIVE PLANT	1,894,106	15,227,627	13,438,140	5,541,734	3,678,549	**39,780,156**
SUBSTATIONS	3,120,867	9,783,787	34,490,187	40,562,990	22,491,114	**110,448,946**
TRANSFORMERS	1,465,204	12,413,942	11,375,579	16,604,213	9,108,507	**50,967,446**
COMMITED PROJECTS	40,697,000	22,328,000	23,973,000	46,517,000	2,171,000	**135,686,000**
TECHNICAL SERVICES	500,000	749,480	7,210,220	3,335,756	6,356,642	**18,152,098**
TOTAL	**51,610,891**	**71,057,855**	**104,283,520**	**149,651,398**	**72,998,990**	**449,602,654**

Project	04/05	05/06	06/07	07/08	08/09	Total
Inverell 132kV Switchbay	$0	$0	$0	$0	$87,137	$87,137
Glen Innes 132kV Switchbay	$0	$0	$24,109	$280,253	$1,095,661	$1,400,024
Inverell 132kV Switchbay	$0	$0	$23,708	$264,471	$994,869	$1,283,049
Glen Innes to Inverell 132kV Line	$68,347	$521,434	$1,222,355	$3,527,891	$8,145,469	$13,485,496
Upgrade 966 Armidale - Koolkhan 132kV Line	$0	$0	$0	$0	$0	$0
Finley 132kV Substation Augmentation	$0	$0	$0	$0	$0	$0
Finley 132kV Substation Augmentation	$0	$0	$0	$0	$0	$0
Finley 132kV Substation Augmentation	$0	$0	$0	$0	$0	$0
Finley 132kV Substation Augmentation	$0	$0	$0	$0	$0	$0
Finley 132kV Substation Augmentation	$0	$0	$0	$273,387	$1,009,000	$1,282,387
Finley 132kV Substation Augmentation	$0	$0	$0	$0	$0	$0
Finley 132kV Substation Augmentation	$0	$0	$0	$0	$0	$0
Narrandera 132kV substation	$0	$0	$0	$0	$0	$0
Narrandera 132kV substation	$0	$0	$0	$0	$0	$0
Narrandera 132kV substation	$0	$0	$0	$0	$0	$0
Narrandera 132kV substation	$0	$0	$0	$0	$0	$0
Narrandera 132kV substation	$0	$0	$0	$0	$0	$0
Narrandera 132kV substation	$0	$0	$0	$0	$0	$0
Narrandera 132kV substation	$0	$0	$0	$0	$0	$0
Narrandera 132kV substation	$0	$0	$0	$47,398	$282,919	$330,316
Narrandera 132kV substation	$0	$0	$0	$47,398	$282,919	$330,316
Narrandera 132kV substation	$0	$205,040	$905,464	$1,564,134	$11,426,951	$14,101,590
Narrandera 132kV substation	$0	$0	$0	$0	$0	$0
Coleambally 132kV Line Switchbay	$0	$0	$0	$0	$0	$0
Coleambally 132kV Line Switchbay	$0	$0	$0	$0	$0	$0
Coleambally 132kV Line Switchbay	$0	$0	$0	$0	$0	$0
Coleambally 132kV Line Switchbay	$0	$0	$0	$0	$0	$0
Coleambally 132kV Line Switchbay	$0	$0	$0	$0	$0	$0
Upgrade 64 line to 85C	$107,180	$374,874	$986,740	$2,371,591	$930,671	$4,771,056
Upgrade 65 line to 85C	$107,180	$374,874	$986,740	$2,371,591	$930,671	$4,771,056
Upgrade 66 line to 85 C	$107,180	$487,335	$1,220,620	$3,825,760	$1,309,086	$6,949,980
Rebuild 875 at 132kV	$3,490,237	$8,376,569	$5,584,379	$865,579	$0	$18,316,765
41 cable series reactor replacement	$0	$0	$0	$0	$0	$0
NEW LINES	**$3,880,124**	**$10,340,126**	**$10,954,115**	**$15,439,453**	**$26,495,353**	**$67,109,171**
Boggabri 132kV Substation	$0	$0	$0	$0	$0	$0
Boggabri 132kV Substation	$0	$0	$0	$0	$731,963	$731,963
Boggabri 132kV Substation	$0	$0	$25,630	$109,960	$132,279	$267,869
Boggabri 132kV Substation	$0	$0	$0	$0	$0	$0

Boggabri 132kV Substation	$0	$0	$0	$0	$0	$0
Bulladelah 132kV Substation	$0	$0	$0	$166,698	$0	$166,698
Bulladelah 132kV Substation	$0	$0	$149,206	$3,484,058	$562,200	$4,195,464
Bulladelah Line Cut in	$0	$89,317	$177,100	$788,597	$832,839	$1,887,852
TS - Glen Innes	$0	$0	$543,356	$0	$0	$543,356
TS - Glen Innes	$0	$0	$0	$0	$0	$0
Wagga North 132kV Substation	$0	$0	$0	$348,549	$0	$348,549
Wagga North 132kV Substation	$0	$0	$807,072	$7,345,664	$438,543	$8,591,279
TS - Wagga North	$0	$0	$0	$1,332,760	$0	$1,332,760
TS - Wagga North	$0	$0	$0	$0	$0	$0
Cooma Switching Station Capacitors				$1,882,640	$0	$1,882,640
Cooma North 132 Switching Station	$0	$0	$0	$174,275	$0	$174,275
Cooma North 132 Switching Station	$0	$0	$989,571	$5,748,712	$0	$6,738,283
Cooma North 132kV Line Cut In	$53,590	$125,575	$150,344	$268,340	$0	$597,849
NEW SUBSTATIONS	**$53,590**	**$214,892**	**$2,842,278**	**$21,650,252**	**$2,697,825**	**$27,458,838**
Canberra - 132kV Capacitor Bank	$263,171	$1,745,100	$0	$0	$0	$2,008,271
Cowra - Capacitor bank	$0	$182,053	$1,044,074	$0	$0	$1,226,128
Forbes - Capacitor	$0	$133,069	$744,184	$0	$0	$877,253
Panorama 66kV Cap bank	$0	$0	$82,844	$1,024,640	$0	$1,107,484
Parkes - Capacitor	$0	$122,020	$714,733	$0	$0	$836,754
Dapto - 2x120MVAr Cap Banks	$418,454	$2,747,914	$0	$0	$0	$3,166,368
Darlington Point 132kV Cap Banks	$556,854	$3,715,991	$0	$0	$0	$4,272,846
Koolkhan 66kV Cap	$0	$210,706	$910,085	$0	$0	$1,120,791
Nambucca 66kV Cap	$0	$0	$0	$0	$0	$0
Regentville No.3 80MVAr Cap bank	$0	$0	$0	$1,322,434	$0	$1,322,434
Sydney West 330kV Cap Bank 200MVar	$147,072	$1,031,937	$0	$0	$0	$1,179,009
Vales Point 330kV Cap Bank (2*200MVar)	$437,956	$3,129,847	$0	$0	$0	$3,567,803
Narrabri - Capacitor Bank	$0	$0	$0	$0	$89,390	$89,390
Deniliquin - Capacitor Bank	$0	$107,576	$1,326,767	$0	$0	$1,434,343
Cooma - Capacitor Bank	$70,599	$870,726	$0	$0	$0	$941,325
Bayswater/Liddell 330kV Cap bank 150MVar	$0	$790,083	$5,250,400	$0	$0	$6,040,483
Eraring 330kV Cap bank 150MVar	$0	$440,604	$2,961,809	$0	$0	$3,402,413
Mt Piper 330kV Cap bank 150MVar	$0	$0	$403,243	$2,686,199	$0	$3,089,442
330kV Cap bank 200MVar - location 1	$0	$0	$0	$169,487	$1,196,386	$1,365,873
330kV Cap bank 200MVar - location 2	$0	$0	$0	$169,487	$1,196,386	$1,365,873
330kV Cap bank 200MVar - location 3	$0	$0	$0	$169,487	$1,196,386	$1,365,873
Tamworth Reactors - Stage2	$0	$0	$0	$0	$0	$0
REACTIVE PLANT	**$1,894,106**	**$15,227,627**	**$13,438,140**	**$5,541,734**	**$3,678,549**	**$39,780,156**
33kV supply for EA at Vales Point	$0	$394,696	$3,875,232	$25,065	$0	$4,294,993
TS - Bulladelah 132kV substation	$0	$0	$0	$492,096	$0	$492,096
TS - Bulladelah 132kV substation	$0	$0	$0	$0	$0	$0
Eraring Switchyard augmentation	$0	$0	$291,422	$0	$0	$291,422
Eraring Switchyard augmentation	$211,297	$1,050,383	$2,574,252	$0	$0	$3,835,932
Turn in 24 line at Eraring	$178,894	$164,260	$387,094	$0	$0	$730,248
TS - Rearrangement near Vales Pt&Munmorah	$0	$0	$615,120	$0	$0	$615,120
TS - Turn 24 line into Eraring	$0	$0	$512,600	$0	$0	$512,600
TS - Rearrangement near Vales Pt&Munmorah	$0	$24,605	$36,907	$0	$0	$61,512
TS - Turn 24 line into Eraring	$0	$20,504	$30,756	$0	$0	$51,260
Rearrangement near Vales Point	$11,563	$102,962	$848,730	$0	$0	$963,255
89 line connection at Armidale	$0	$0	$0	$0	$0	$0
89 line connection at Armidale	$122,711	$651,865	$1,017,137	$0	$0	$1,791,713
Reconnection of 89 line	$162,927	$179,186	$229,417	$0	$0	$571,530
Dapto - Fault Level	$0	$0	$351,915	$1,036,424	$5,249,058	$6,637,396
Dapto - 132kV Line Switchbay	$0	$0	$174,275	$0	$0	$174,275
Dapto - 132kV Line Switchbay	$77,213	$290,619	$943,518	$0	$0	$1,311,350

Finley 132 Tx Capacity Limits	$0	$0	$0	$0	$0	$0
Finley 132 Tx Capacity Limits	$0	$0	$0	$1,837,875	$501,924	$2,339,799
Frequency injection point - Kempsey	$466,000	$0	$0	$0	$0	$466,000
Frequency injection point - Port Macquarie	$466,000	$0	$0	$0	$0	$466,000
Frequency injection point - Taree	$209,700	$0	$0	$0	$0	$209,700
Glen Innes Substation Rebuild - Option2	$0	$0	$166,698	$0	$0	$166,698
Glen Innes Substation Rebuild - Option2	$0	$473,654	$6,762,136	$0	$0	$7,235,791
Line Terminal Ratings - Bayswater to Liddell 33&34	$41,973	$159,430	$0	$0	$0	$201,403
Line Terminal Ratings - Kemps Creek to Avon No 37	$69,491	$308,719	$0	$0	$0	$378,211
Line Terminal Ratings - Mummorah to Vales Pt No23	$78,928	$345,978	$0	$0	$0	$424,906
Line Terminal Ratings - UTSS to Canberra No 01	$101,926	$467,260	$0	$0	$0	$569,186
Line Terminal Ratings - UTSS to Yass No 02	$101,926	$467,260	$0	$0	$0	$569,186
Line Terminal Ratings - Vales Pt to Newcastle No24	$41,973	$159,430	$0	$0	$0	$201,403
Line Terminal Ratings - Yass to Canberra No 9	$112,925	$472,629	$0	$0	$0	$585,553
Line Terminal Ratings - Yass to Marulan No 4	$59,903	$207,309	$0	$0	$0	$267,211
Line Terminal Ratings - Yass to Marulan No 5	$2,411	$14,502	$0	$0	$0	$16,913
Orange 132kV Augmentation	$0	$0	$0	$500,093	$0	$500,093
Orange 132kV Augmentation	$0	$0	$824,321	$10,660,020	$0	$11,484,341
Orange 132kv substation- 66kV line reconnection	$0	$123,645	$620,401	$2,154,473	$0	$2,898,520
TS - Orange 132kV substation	$0	$0	$0	$820,160	$0	$820,160
TS - Orange 132kV substation	$0	$0	$0	$0	$0	$0
Murray Switching Station Refurbishment	$0	$309,833	$1,142,494	$4,443,520	$0	$5,895,847
Upper Tumut Refurbishment	$0	$423,450	$2,243,129	$5,509,890	$0	$8,176,469
Mount Annan 330kV Substation	$0	$0	$0	$0	$362,101	$362,101
Mount Annan 330kV Substation	$0	$0	$1,439,522	$5,014,789	$13,712,512	$20,166,822
TS - Mt Annan 330kV substation	$0	$0	$0	$0	$1,742,840	$1,742,840
TS - Mt Annan 330kV substation	$0	$0	$0	$0	$0	$0
Sydney North 132kV FL Upgrade	$284,552	$1,026,837	$3,235,605	$0	$0	$4,546,994
Sydney East - Duplicate breakers on No 2 Tx	$0	$0	$0	$0	$0	$0
Sydney North - Duplicate breakers on No 1 Tx	$0	$0	$0	$0	$0	$0
Sydney West - Duplicate breaker on No1 Tx	$0	$0	$0	$0	$0	$0
Sydney West - Duplicate breaker on 30 line	$0	$0	$0	$0	$0	$0
Sydney West - Duplicate breaker on 30 line	$0	$0	$0	$0	$0	$0
Sydney West 132kV Switchbays	$0	$0	$174,275	$0	$0	$174,275
Sydney West 132kV Switchbays	$82,603	$386,706	$949,843	$0	$0	$1,419,152
Sydney West FL Upgrade - 330kV switchyard	$46,600	$103,608	$272,216	$1,733,211	$0	$2,155,636
Tomago 330/132kV supply point	$0	$0	$0	$166,698	$0	$166,698
Tomago 330/132kV supply point	$0	$407,561	$2,887,183	$6,168,677	$0	$9,463,420
Tuggerah 132kV Augmentations	$0	$0	$87,137	$0	$0	$87,137
Tuggerah 132kV Augmentations	$111,230	$732,283	$685,788	$0	$0	$1,529,301
TS - Tuggerah Augmentation	$0	$0	$0	$0	$922,680	$922,680
TS - Tuggerah Augmentation	$0	$0	$0	$0	$0	$0
Vineyard 132kV line switchbays	$0	$0	$174,275	$0	$0	$174,275
Vineyard 132kV line switchbays	$78,122	$314,612	$936,790	$0	$0	$1,329,523
SUBSTATIONS	**$3,120,867**	**$9,783,787**	**$34,490,187**	**$40,562,990**	**$22,491,114**	**$110,448,946**
Armidale 132kV Tx Aug	$235,836	$1,652,914	$0	$0	$0	$1,888,750
Armidale 330kV Tx Aug	$0	$459,572	$6,199,868	$40,963	$0	$6,700,403
Marulan 330kV Tx	$0	$40,213	$535,219	$1,212,172	$0	$1,787,605
Vineyard 330kV Tx	$785,442	$4,874,743	$0	$0	$0	$5,660,185
Wellington 330 Tx augmentation	$443,926	$5,085,977	$10,254	$0	$0	$5,540,157
Cowra Transformer Replacement	$0	$0	$0	$0	$0	$0
Dapto - Additional 375MVA Tx	$0	$0	$0	$0	$0	$0
Deniliquin - Transformer Upgrade	$0	$0	$0	$0	$0	$0
Kempsey 132kV Tx Limitation	$0	$0	$0	$0	$381,965	$381,965
Koolkhan Tx Augmentation	$0	$0	$0	$0	$0	$0

Parkes Second Transformer	$0	$0	$296,590	$2,641,681	$0	$2,938,272
Pt Macquarie Augmentation (Tx)	$0	$300,521	$2,659,036	$0	$0	$2,959,557
Sydney South Tx No 3 & 4 replacement	$0	$2	$1,407,864	$9,912,506	$0	$11,320,372
Tuggerah 330kV switchyard and second Tx	$0	$0	$0	$0	$209,064	$209,064
Tuggerah 330kV switchyard and second Tx	$0	$0	$266,748	$2,796,890	$8,517,479	$11,581,117
Yanco 132kV Tx Limits	$0	$0	$0	$0	$0	$0
TRANSFORMERS	**$1,465,204**	**$12,413,942**	**$11,375,579**	**$16,604,213**	**$9,108,507**	**$50,967,446**
Coffs Harbour 330kV Substation	$1,131,000	$15,172,000.00	$4,530,000.00			$20,833,000
Coffs Harbour TL Rearrangement	$284,000	$3,139,000.00				$3,423,000
Coleambally 132 kV Substation	$40,000					$40,000
Darlington Pt Communication	$528,000					$528,000
Inner City Substgation and Cable works	$17,700,000					$17,700,000
Koolkhan 132kV Substation	$400,000					$400,000
Liverpool Third Transformer	$3,681,000	$480,000.00				$4,161,000
Newcastle 330kV Substation augmentation	$901,000					$901,000
Southern Communication Upgrade	$1,793,000					$1,793,000
Sydney West New 132 kV Switchbay	$100,000					$100,000
Tomago 330kV Switching Station	$440,000					$440,000
Tuggerah Sterland Upgrade	$250,000					$250,000
Vales Point and Munmorah Switchyard uprating	$100,000					$100,000
Vineyard No 1 Transformer replacement	$4,000,000	$385,000.00				$4,385,000
Vineyard No 2 Tx Replacement	$3,808,000					$3,808,000
Waratah West 330kV Substation	$3,773,000					$3,773,000
Wellington 330kV Augmentation	$48,000	$140,000.00	$841,000.00	$1,438,000.00		$2,467,000
Wollar 330kV Switching Station		$940,000.00	$2,584,000.00	$10,676,000.00		$14,200,000
Wollar Communications	$250,000	$600,000.00	$600,000.00			$1,450,000
Wollar to Wellington 330kV T/L	$1,470,000	$1,472,000.00	$15,418,000.00	$34,403,000.00	$2,171,000.00	$54,934,000
COMMITTED PROJECTS	**$40,697,000**	**$22,328,000**	**$23,973,000**	**$46,517,000**	**$2,171,000**	**$135,686,000**
TS - Darlington Pt Radio Development	0	0	2,475,000	0	0	$2,475,000
TS - Darlington Pt Radio Development	0	99,000	148,500	0	0	$247,500
TS - Hume SCADA	0	0	0	0	792,000	$792,000
TS - Hume SCADA	0	0	0	31,680	47,520	$79,200
TS - Lismore to Dumaresq	0	0	0	0	0	$0
TS - Lismore to Dumaresq	0	0	0	0	0	$0
TS - Minor Technical Services Projects	500,000	500,000	500,000	500,000	500,000	$2,500,000
TS - Minor Technical Services Projects						
TS - New England SCADA						
TS - New England SCADA	0	0	0	0	35,640	$35,640
TS - North Coast SCADA	0	0	3,762,000	0	0	$3,762,000
TS - North Coast SCADA	0	150,480	225,720	0	0	$376,200
TS - OPGW Backup:Southern						
TS - OPGW Backup:Southern	0	0	0	0	109,098	$109,098
TS - OPGW Backup:Western	0	0	0	0	1,975,050	$1,975,050
TS - OPGW Backup:Western	0	0	0	79,002	118,503	$197,505
TS - Radio Replacement	0	0	0	2,475,000	0	$2,475,000
TS - Radio Replacement	0	0	99,000	148,500	0	$247,500
TS - Snowy OPGW Augmentation	0	0	0	0	2,539,350	$2,539,350
TS - Snowy OPGW Augmentation	0	0	0	101,574	152,361	$253,935
TS - South Western NSW Development						
TS - South Western NSW Development	0	0	0	0	87,120	$87,120
TECHNICAL SERVICES	500,000	749,480	7,210,220	3,335,756	6,356,642	**$18,152,098**

Small Augmentations

Variation between PB Associates Recommendation and TransGrid Proposal

	04/05	05/06	06/07	07/08	08/09	Total
NEW LINES	3,236,237	7,473,985	-2,154,991	-7,576,991	-1,988,137	**-1,009,896**
NEW SUBSTATIONS	-3,910	-27,339	-254,017	316,435	-229,104	**-197,935**
REACTIVE PLANT	-1,523,151	-2,943,718	-1,082,533	-404,333	-172,480	**-6,126,215**
SUBSTATIONS	-340,622	-1,582,397	-6,750,022	-5,906,954	-1,257,977	**-15,837,972**
TRANSFORMERS	-429,350	-3,436,334	2,023,065	-2,597,731	-11,454,297	**-15,894,647**
COMMITED PROJECTS	0	0	0	0	0	**0**
TECHNICAL SERVICES	500,000	472,280	-439,180	-4,956,044	-656,958	**-5,079,902**
TOTAL	**1,439,204**	**-43,523**	**-8,657,678**	**-21,125,618**	**-15,758,953**	**-44,146,567**

Project	04/05	05/06	06/07	07/08	08/09	Total
Inverell 132kV Switchbay	0	0	0	0	-6,358	**-6,358**
Glen Innes 132kV Switchbay	0	0	-1,759	-20,448	-79,941	**-102,148**
Inverell 132kV Switchbay	0	0	-1,730	-19,296	-72,587	**-93,613**
Glen Innes to Inverell 132kV Line	-4,987	-38,045	-89,185	-257,400	-594,305	**-983,920**
Upgrade 966 Armidale - Koolkhan 132kV Line	-225,553	-759,320	-6,707,587	-3,219,240	0	**-10,911,700**
Finley 132kV Substation Augmentation	0	0	0	0	0	**0**
Finley 132kV Substation Augmentation	0	0	0	0	0	**0**
Finley 132kV Substation Augmentation	0	0	0	0	0	**0**
Finley 132kV Substation Augmentation	0	0	0	0	0	**0**
Finley 132kV Substation Augmentation	0	0	0	-19,947	-73,618	**-93,565**
Finley 132kV Substation Augmentation	0	0	0	0	0	**0**
Finley 132kV Substation Augmentation	0	0	0	0	0	**0**
Narrandera 132kV substation	0	0	0	0	0	**0**
Narrandera 132kV substation	0	0	0	0	0	**0**
Narrandera 132kV substation	0	0	0	0	0	**0**
Narrandera 132kV substation	0	0	0	0	0	**0**
Narrandera 132kV substation	0	0	0	0	0	**0**
Narrandera 132kV substation	0	0	0	0	0	**0**
Narrandera 132kV substation	0	0	0	0	0	**0**
Narrandera 132kV substation	0	0	0	-3,458	-20,642	**-24,100**
Narrandera 132kV substation	0	0	0	-3,458	-20,642	**-24,100**
Narrandera 132kV substation	0	-14,960	-66,064	-114,121	-833,726	**-1,028,871**
Narrandera 132kV substation	0	0	0	0	0	**0**
Coleambally 132kV Line Switchbay	0	0	0	0	0	**0**
Coleambally 132kV Line Switchbay	0	0	0	0	0	**0**
Coleambally 132kV Line Switchbay	0	0	0	0	0	**0**
Coleambally 132kV Line Switchbay	0	0	0	0	0	**0**
Coleambally 132kV Line Switchbay	0	0	0	0	-55,000	**-55,000**
Upgrade 64 line to 85C	-7,820	-27,351	-71,994	-173,035	-67,903	**-348,103**
Upgrade 65 line to 85C	-7,820	-27,351	-71,994	-173,035	-67,903	**-348,103**
Upgrade 66 line to 85 C	-7,820	-35,557	-89,058	-279,133	-95,513	**-507,080**
Rebuild 875 at 132kV	3,490,237	8,376,569	5,584,379	865,579	0	**18,316,765**
41 cable series reactor replacement	0	0	-640,000	-4,160,000	0	**-4,800,000**
NEW LINES	**3,236,237**	**7,473,985**	**-2,154,991**	**-7,576,991**	**-1,988,137**	**-1,009,896**
Boggabri 132kV Substation	0	0	0	0	0	**0**
Boggabri 132kV Substation	0	0	0	0	-53,405	**-53,405**
Boggabri 132kV Substation	0	0	-1,870	-8,023	-9,651	**-19,544**
Boggabri 132kV Substation	0	0	0	0	0	**0**
Boggabri 132kV Substation	0	0	0	0	-13,200	**-13,200**
Bulladelah 132kV Substation	0	0	0	-12,162	0	**-12,162**

Bulladelah 132kV Substation	0	0	-10,886	-254,202	-41,019	**-306,107**
Bulladelah Line Cut in	0	-6,517	-12,921	-57,537	-60,765	**-137,740**
TS - Glen Innes	0	0	-39,644	0	0	**-39,644**
TS - Glen Innes	0	-11,660	-46,640	0	0	**-58,300**
Wagga North 132kV Substation	0	0	0	-25,431	0	**-25,431**
Wagga North 132kV Substation	0	0	-58,885	-535,950	-31,997	**-626,832**
TS - Wagga North	0	0	0	-97,240	0	**-97,240**
TS - Wagga North	0	0	0	-123,933	-19,067	**-143,000**
Cooma Switching Station Capacitors	0	0	0	1,882,640	0	**1,882,640**
Cooma North 132 Switching Station	0	0	0	-12,715	0	**-12,715**
Cooma North 132 Switching Station	0	0	-72,200	-419,434	0	**-491,634**
Cooma North 132kV Line Cut In	-3,910	-9,162	-10,969	-19,578	0	**-43,620**
NEW SUBSTATIONS	**-3,910**	**-27,339**	**-254,017**	**316,435**	**-229,104**	**-197,935**
Canberra - 132kV Capacitor Bank	-19,201	-127,325	0	0	0	**-146,526**
Cowra - Capacitor bank	0	-13,283	-76,177	0	0	**-89,460**
Forbes - Capacitor	0	-9,709	-54,297	0	0	**-64,006**
Panorama 66kV Cap bank	0	0	-6,044	-74,759	0	**-80,804**
Parkes - Capacitor	0	-8,903	-52,148	0	0	**-61,051**
Dapto - 2x120MVAr Cap Banks	-30,531	-200,492	0	0	0	**-231,023**
Darlington Point 132kV Cap Banks	-40,629	-271,124	0	0	0	**-311,753**
Koolkhan 66kV Cap	0	-15,373	-66,401	0	0	**-81,774**
Nambucca 66kV Cap	0	-226,080	-976,486	0	0	**-1,202,566**
Regentville No.3 80MVAr Cap bank	0	0	0	-96,487	0	**-96,487**
Sydney West 330kV Cap Bank 200MVar	-10,731	-75,292	0	0	0	**-86,022**
Vales Point 330kV Cap Bank (2*200MVar)	-31,954	-228,358	0	0	0	**-260,312**
Narrabri - Capacitor Bank	0	-95,912	-549,152	0	89,390	**-555,674**
Deniliquin - Capacitor Bank	0	107,576	1,326,767	0	0	**1,434,343**
Cooma - Capacitor Bank	70,599	870,726	0	0	0	**941,325**
Bayswater/Liddell 330kV Cap bank 150MVar	0	-57,646	-383,076	0	0	**-440,722**
Eraring 330kV Cap bank 150MVar	0	-32,147	-216,098	0	0	**-248,245**
Mt Piper 330kV Cap bank 150MVar	0	0	-29,421	-195,989	0	**-225,410**
330kV Cap bank 200MVar - location 1	0	0	0	-12,366	-87,290	**-99,656**
330kV Cap bank 200MVar - location 2	0	0	0	-12,366	-87,290	**-99,656**
330kV Cap bank 200MVar - location 3	0	0	0	-12,366	-87,290	**-99,656**
Tamworth Reactors - Stage2	-1,460,704	-2,560,378	0	0	0	**-4,021,082**
REACTIVE PLANT	**-1,523,151**	**-2,943,718**	**-1,082,533**	**-404,333**	**-172,480**	**-6,126,215**
33kV supply for EA at Vales Point	0	-28,798	-282,742	-1,829	0	**-313,369**
TS - Bulladelah 132kV substation	0	0	0	-35,904	0	**-35,904**
TS - Bulladelah 132kV substation	0	0	0	-45,760	-7,040	**-52,800**
Eraring Switchyard augmentation	0	0	-21,263	0	0	**-21,263**
Eraring Switchyard augmentation	-15,417	-76,637	-187,821	0	0	**-279,875**
Turn in 24 line at Eraring	-13,052	-11,985	-28,243	0	0	**-53,280**
TS - Rearrangement near Vales Pt&Munmorah	0	0	-44,880	0	0	**-44,880**
TS - Turn 24 line into Eraring	0	0	-37,400	0	0	**-37,400**
TS - Rearrangement near Vales Pt&Munmorah	0	-1,795	-2,693	0	0	**-4,488**
TS - Turn 24 line into Eraring	0	-1,496	-2,244	0	0	**-3,740**
Rearrangement near Vales Point	-844	-7,512	-61,925	0	0	**-70,280**
89 line connection at Armidale	0	0	0	0	0	**0**
89 line connection at Armidale	-8,953	-47,561	-74,212	0	0	**-130,726**
Reconnection of 89 line	-11,887	-13,074	-16,739	0	0	**-41,700**
Dapto - Fault Level	0	0	-25,676	-75,619	-382,978	**-484,274**
Dapto - 132kV Line Switchbay	0	0	-12,715	0	0	**-12,715**
Dapto - 132kV Line Switchbay	-5,634	-21,204	-68,840	0	0	**-95,678**
Finley 132 Tx Capacity Limits	0	0	0	-268,290	0	**-268,290**
Finley 132 Tx Capacity Limits	0	-109,049	-1,562,664	-617,544	501,924	**-1,787,333**
Frequency injection point - Kempsey	-34,000	0	0	0	0	**-34,000**
Frequency injection point - Port Macquarie	-34,000	0	0	0	0	**-34,000**

Frequency injection point - Taree	-15,300	0	0	0	0	**-15,300**
Glen Innes Substation Rebuild - Option2	0	0	-12,162	0	0	**-12,162**
Glen Innes Substation Rebuild - Option2	0	-34,558	-493,375	0	0	**-527,933**
Line Terminal Ratings - Bayswater to Liddell 33&34	-3,062	-11,632	0	0	0	**-14,695**
Line Terminal Ratings - Kemps Creek to Avon No 37	-5,070	-22,525	0	0	0	**-27,595**
Line Terminal Ratings - Mummorah to Vales Pt No23	-5,759	-25,243	0	0	0	**-31,002**
Line Terminal Ratings - UTSS to Canberra No 01	-7,437	-34,092	0	0	0	**-41,529**
Line Terminal Ratings - UTSS to Yass No 02	-7,437	-34,092	0	0	0	**-41,529**
Line Terminal Ratings - Vales Pt to Newcastle No24	-3,062	-11,632	0	0	0	**-14,695**
Line Terminal Ratings - Yass to Canberra No 9	-8,239	-34,484	0	0	0	**-42,723**
Line Terminal Ratings - Yass to Marulan No 4	-4,371	-15,126	0	0	0	**-19,496**
Line Terminal Ratings - Yass to Marulan No 5	-176	-1,058	0	0	0	**-1,234**
Orange 132kV Augmentation	0	0	0	-36,487	0	**-36,487**
Orange 132kV Augmentation	0	0	-60,144	-777,770	0	**-837,913**
Orange 132kv substation- 66kV line reconnection	0	-9,021	-45,265	-157,193	0	**-211,480**
TS - Orange 132kV substation	0	0	0	-59,840	0	**-59,840**
TS - Orange 132kV substation	0	0	-17,600	-70,400	0	**-88,000**
Murray Switching Station Refurbishment	0	-22,606	-83,358	-324,205	0	**-430,169**
Upper Tumut Refurbishment	0	-30,895	-163,662	-402,009	0	**-596,566**
Mount Annan 330kV Substation	0	0	0	0	-26,419	**-26,419**
Mount Annan 330kV Substation	0	0	-105,029	-365,886	-1,000,484	**-1,471,399**
TS - Mt Annan 330kV substation	0	0	0	0	-127,160	**-127,160**
TS - Mt Annan 330kV substation	0	0	0	-74,800	-112,200	**-187,000**
Sydney North 132kV FL Upgrade	-20,761	-74,919	-236,074	0	0	**-331,755**
Sydney East - Duplicate breakers on No 2 Tx	0	-55,358	-384,368	-647,341	0	**-1,087,067**
Sydney North - Duplicate breakers on No 1 Tx	0	-55,358	-384,368	-647,341	0	**-1,087,067**
Sydney West - Duplicate breaker on No1 Tx	0	-55,358	-384,368	-647,341	0	**-1,087,067**
Sydney West - Duplicate breaker on 30 line	0	0	-156,343	0	0	**-156,343**
Sydney West - Duplicate breaker on 30 line	-112,919	-593,436	-1,343,860	0	0	**-2,050,215**
Sydney West 132kV Switchbays	0	0	-12,715	0	0	**-12,715**
Sydney West 132kV Switchbays	-6,027	-28,215	-69,302	0	0	**-103,543**
Sydney West FL Upgrade - 330kV switchyard	-3,400	-7,559	-19,861	-126,457	0	**-157,278**
Tomago 330/132kV supply point	0	0	0	-12,162	0	**-12,162**
Tomago 330/132kV supply point	0	-29,736	-210,653	-450,075	0	**-690,464**
Tuggerah 132kV Augmentations	0	0	-6,358	0	0	**-6,358**
Tuggerah 132kV Augmentations	-8,115	-53,428	-50,036	0	0	**-111,580**
TS - Tuggerah Augmentation	0	0	0	0	-67,320	**-67,320**
TS - Tuggerah Augmentation	0	0	0	-62,700	-36,300	**-99,000**
Vineyard 132kV line switchbays	0	0	-12,715	0	0	**-12,715**
Vineyard 132kV line switchbays	-5,700	-22,954	-68,349	0	0	**-97,004**
SUBSTATIONS	**-340,622**	**-1,582,397**	**-6,750,022**	**-5,906,954**	**-1,257,977**	**-15,837,972**
Armidale 132kV Tx Aug	-17,207	-120,599	0	0	0	**-137,806**
Armidale 330kV Tx Aug	0	-33,531	-452,351	-2,989	0	**-488,871**
Marulan 330kV Tx	0	-2,934	-39,050	-88,442	0	**-130,426**
Vineyard 330kV Tx	-57,307	-355,668	0	0	0	**-412,975**
Wellington 330 Tx augmentation	-32,389	-371,080	-748	0	0	**-404,217**
Cowra Transformer Replacement	0	0	0	-106,692	-975,936	**-1,082,628**
Dapto - Additional 375MVA Tx	0	0	0	-869,740	-6,307,557	**-7,177,297**
Deniliquin - Transformer Upgrade	0	0	0	0	0	**0**
Kempsey 132kV Tx Limitation	0	0	0	-409,833	-3,208,947	**-3,618,780**
Koolkhan Tx Augmentation	0	0	0	0	-325,156	**-325,156**
Parkes Second Transformer	0	0	-21,640	-192,741	0	**-214,380**
Pt Macquarie Augmentation (Tx)	-322,447	-2,552,522	2,659,036	0	0	**-215,933**
Sydney South Tx No 3 & 4 replacement	0	-0	-102,720	-723,230	0	**-825,950**
Tuggerah 330kV switchyard and second Tx	0	0	0	0	-15,254	**-15,254**
Tuggerah 330kV switchyard and second Tx	0	0	-19,462	-204,065	-621,447	**-844,974**
Yanco 132kV Tx Limits	0	0	0	0	0	**0**

TRANSFORMERS	**-429,350**	**-3,436,334**	**2,023,065**	**-2,597,731**	**-11,454,297**	**-15,894,647**
Coffs Harbour 330kV Substation	0	0	0	0	0	**0**
Coffs Harbour TL Rearrangement	0	0	0	0	0	**0**
Coleambally 132 kV Substation	0	0	0	0	0	**0**
Darlington Pt Communication	0	0	0	0	0	**0**
Inner City Substgation and Cable works	0	0	0	0	0	**0**
Koolkhan 132kV Substation	0	0	0	0	0	**0**
Liverpool Third Transformer	0	0	0	0	0	**0**
Newcastle 330kV Substation augmentation	0	0	0	0	0	**0**
Southern Communication Upgrade	0	0	0	0	0	**0**
Sydney West New 132 kV Switchbay	0	0	0	0	0	**0**
Tomago 330kV Switching Station	0	0	0	0	0	**0**
Tuggerah Sterland Upgrade	0	0	0	0	0	**0**
Vales Point and Munmorah Switchyard uprating	0	0	0	0	0	**0**
Vineyard No 1 Transformer replacement	0	0	0	0	0	**0**
Vineyard No 2 Tx Replacement	0	0	0	0	0	**0**
Waratah West 330kV Substation	0	0	0	0	0	**0**
Wellington 330kV Augmentation	0	0	0	0	0	**0**
Wollar 330kV Switching Station	0	0	0	0	0	**0**
Wollar Communications	0	0	0	0	0	**0**
Wollar to Wellington 330kV T/L	0	0	0	0	0	**0**
COMMITTED PROJECTS	**0**	**0**	**0**	**0**	**0**	**0**
TS - Darlington Pt Radio Development	0	0	-275,000	0	0	**-275,000**
TS - Darlington Pt Radio Development	0	-11,000	-16,500	0	0	**-27,500**
TS - Hume SCADA	0	0	0	0	-88,000	**-88,000**
TS - Hume SCADA	0	0	0	-3,520	-5,280	**-8,800**
TS - Lismore to Dumaresq	0	0	0	-4,840,000	0	**-4,840,000**
TS - Lismore to Dumaresq	0	0	-193,600	-290,400	0	**-484,000**
TS - Minor Technical Services Projects	500,000	500,000	500,000	500,000	500,000	**2,500,000**
TS - Minor Technical Services Projects	0	0	0	0	-220,000	**-220,000**
TS - New England SCADA	0	0	0	0	0	**0**
TS - New England SCADA	0	0	0	0	-3,960	**-3,960**
TS - North Coast SCADA	0	0	-418,000	0	0	**-418,000**
TS - North Coast SCADA	0	-16,720	-25,080	0	0	**-41,800**
TS - OPGW Backup:Southern	0	0	0	0	0	**0**
TS - OPGW Backup:Southern	0	0	0	0	-18,502	**-18,502**
TS - OPGW Backup:Western	0	0	0	0	-334,950	**-334,950**
TS - OPGW Backup:Western	0	0	0	-13,398	-20,097	**-33,495**
TS - Radio Replacement	0	0	0	-275,000	0	**-275,000**
TS - Radio Replacement	0	0	-11,000	-16,500	0	**-27,500**
TS - Snowy OPGW Augmentation	0	0	0	0	-430,650	**-430,650**
TS - Snowy OPGW Augmentation	0	0	0	-17,226	-25,839	**-43,065**
TS - South Western NSW Development	0	0	0	0	0	**0**
TS - South Western NSW Development	0	0	0	0	-9,680	**-9,680**
TECHNICAL SERVICES	**500,000**	**472,280**	**-439,180**	**-4,956,044**	**-656,958**	**-5,079,902**

APPENDIX D
IT Capital Expenditure Reconciliation

Classification	System	System components	Cost	Code	Asset Life Yrs	TransGrid Number of replacements	PB Number of Rplcmts	TG system replcmt cost	Specific review allocations	PB Associates Revised Cost	Variation
Total Capex											
Systems			**$10,335,000**								
	ERP		**$7,645,000**								
		MIMS	$3,700,000	Comitted	5	1	1	$3,700,000		$3,700,000	$0
		Tamis	$150,000	Planned	3	2	1.67	$300,000		$250,000	-$50,000
		Oracle Financials	$3,100,000	Planned	5	1	1.00	$3,100,000		$3,100,000	$0
		EDMS	$350,000	Planned	3	2	1.67	$700,000		$583,333	-$116,667
		TUOS	$145,000	Planned	3	2	1.67	$290,000		$241,667	-$48,333
		Fleet	$50,000	Planned	3	2	1.67	$100,000		$83,333	-$16,667
		Artemis	$150,000	Planned	3	2	1.67	$300,000		$250,000	-$50,000
	Intranet		**$1,200,000**								
		TransNet	$370,000	Planned	3	2	1.67	$740,000		$616,667	-$123,333
		SOL	$50,000	Planned	3	2	1.67	$100,000		$83,333	-$16,667
		IMS	$20,000	Planned	3	2	1.67	$40,000		$33,333	-$6,667
		Complaints handling	$10,000	Planned	3	2	1.67	$20,000		$16,667	-$3,333
		TRIM	$750,000	In Progress	3	2	1.67	$1,500,000		$1,250,000	-$250,000
	Other applications		**$1,490,000**								
		Perception	$30,000	Planned	3	2	1.67	$60,000		$50,000	-$10,000
		HVSI	$10,000	Planned	3	2	1.67	$20,000		$16,667	-$3,333
		Standards Plus	$50,000	Planned	3	2	1.67	$100,000		$83,333	-$16,667
		Chemalert	$50,000	Planned	3	2	1.67	$100,000		$83,333	-$16,667
		Contracts Admin data base	$76,000	Planned	3	2	1.67	$152,000		$126,667	-$25,333
		Executrack	$25,000	Planned	3	2	1.67	$50,000		$41,667	-$8,333
		EWR	$140,000	Planned	3	2	1.67	$280,000		$233,333	-$46,667
		TOD	$150,000	In Progress	3	2	1.67	$300,000		$250,000	-$50,000
		TOS	$144,000	In Progress	3	2	1.67	$288,000		$240,000	-$48,000
		Training Database	$40,000	In Progress	3	2	1.67	$80,000		$66,667	-$13,333
		RTI	$600,000	In Progress	3	2	1.67	$1,200,000		$1,000,000	-$200,000
		Online induction	$90,000	Planned	3	2	1.67	$180,000		$150,000	-$30,000
		Accstat	$30,000	Planned	3	2	1.67	$60,000		$50,000	-$10,000
		Metrack	$35,000	Planned	3	2	1.67	$70,000		$58,333	-$11,667

		Nemwatch	$10,000	Planned	3	2	1.67	$20,000		$16,667	-$3,333
		NEM complience	$10,000	In Progress	3	2	1.67	$20,000		$16,667	-$3,333
		Cheque printing system	$10,000	Planned	3	2	1.67	$20,000		$16,667	-$3,333
		HRIS	$250,000	Planned	3	1	1.67	$250,000		$416,667	$166,667
		Enterprise reporting	$300,000	Planned	3	1	1.67	$300,000		$500,000	$200,000
		Procure to Pay	$300,000	Planned	3	1	1.67	$300,000		$500,000	$200,000
		Market power analsys	$1,000,000	Planned	5	1	1.00	$1,000,000		$1,000,000	$0
Infrastructure			$14,028,100								$0
	File Print		**$1,640,000**								
		IDC DR	$310,000	Planned	3	2	1.67	$620,000		$516,667	-$103,333
		Sydney	$210,000	Planned	3	2	1.67	$420,000		$350,000	-$70,000
		Wallgrove	$190,000	Planned	3	2	1.67	$380,000		$316,667	-$63,333
		Yass	$190,000	Planned	3	2	1.67	$380,000		$316,667	-$63,333
		Newcastle	$190,000	Planned	3	2	1.67	$380,000		$316,667	-$63,333
		Orange	$100,000	Planned	3	2	1.67	$200,000		$166,667	-$33,333
		Software	$50,000	Planned	3	2	1.67	$100,000		$83,333	-$16,667
		External Services	$300,000	Planned	3	2	1.67	$600,000		$500,000	-$100,000
		Internal Labor costing	$100,000	Planned	3	2	1.67	$200,000		$166,667	-$33,333
		CAD Server	$200,000	Planned	3	2	1.67	$400,000		$333,333	-$66,667
	Tamis / EDMS		**$610,000**								$0
		Yass	$30,000	Planned	3	2	1.67	$60,000		$50,000	-$10,000
		Newcastle	$30,000	Planned	3	2	1.67	$60,000		$50,000	-$10,000
		Wallgrove	$190,000	Planned	3	2	1.67	$380,000		$316,667	-$63,333
		Sydney	$30,000	Planned	3	2	1.67	$60,000		$50,000	-$10,000
		IDC	$160,000	Planned	3	2	1.67	$320,000		$266,667	-$53,333
		Internal Labor costing	$70,000	Planned	3	2	1.67	$140,000		$116,667	-$23,333
		External Services	$100,000	Planned	3	2	1.67	$200,000		$166,667	-$33,333
	Exchange		**$700,000**								$0
		Wallgrove	$100,000	In Progress	3.5	2	1.43	$200,000	$200,000	$200,000	$0
		IDC	$150,000	In Progress	3.5	2	1.43	$300,000	$300,000	$300,000	$0
		External Services	$250,000	In Progress	3.5	2	1.43	$500,000	$500,000	$500,000	$0
		Internal Labor costing	$80,000	In Progress	3.5	2	1.43	$160,000	$160,000	$160,000	$0
		software	$120,000	In Progress	3.5	2	1.43	$240,000	$240,000	$240,000	$0
	Unix		**$2,740,000**								$0

		Production	$130,000	In Progress	4	1.3	1	$169,000	$169,000	$169,000	$0
		DR	$130,000	In Progress	4	1.3	1	$169,000	$169,000	$169,000	$0
		SAN	$1,500,000	In Progress	5	1.3	1.00	$1,950,000	$1,950,000	$1,950,000	$0
		Software	$250,000	In Progress		1.3	1	$325,000	$325,000	$325,000	$0
		FTP	$20,000	In Progress	4	1.3	1	$26,000	$26,000	$26,000	$0
		Reverse Proxy	$20,000	In Progress	4	1.3	1	$26,000	$26,000	$26,000	$0
		DNS PR	$20,000	In Progress	4	1.3	1	$26,000	$26,000	$26,000	$0
		DNS DR	$20,000	In Progress	4	1.3	1	$26,000	$26,000	$26,000	$0
		External Services	$550,000	In Progress		1.3	1	$715,000	$715,000	$715,000	$0
		Internal Labor costing	$100,000	In Progress		1.3	1	$130,000	$130,000	$130,000	$0
	VMS										$0
		Production				0	0	$0		$0	$0
		DR				0	0	$0		$0	$0
		Software				0	0	$0		$0	$0
		External Services				0	0	$0		$0	$0
		Internal Labor costing				0	0	$0		$0	$0
	Firewall		**$724,000**								$0
		firewall 1	$20,000	Planned	5	1	1.00	$20,000		$20,000	$0
		firewall 2	$20,000	Planned	5	1	1.00	$20,000		$20,000	$0
		firewall 3	$7,000	In Progress	3	2	1.67	$14,000		$11,667	-$2,333
		firewall 4	$7,000	In Progress	3	2	1.67	$14,000		$11,667	-$2,333
		Internet Router1	$60,000	Planned	5	1	1.00	$60,000		$60,000	$0
		Internet Router2	$60,000	Planned	5	1	1.00	$60,000		$60,000	$0
		DMZ switch1	$20,000	Planned	5	1	1.00	$20,000		$20,000	$0
		DMZ switch2	$20,000	Planned	5	1	1.00	$20,000		$20,000	$0
		DMZ Router1	$30,000	Planned	5	1	1.00	$30,000		$30,000	$0
		DMZ Router2	$30,000	Planned	5	1	1.00	$30,000		$30,000	$0
		software	$100,000	Planned	5	1	1.00	$100,000		$100,000	$0
		External Services	$250,000	Planned	5	1	1.00	$250,000		$250,000	$0
		Internal Labor costing	$100,000	Planned	5	1	1.00	$100,000		$100,000	$0
	Gateway		**$850,000**								$0
		Proxy1	$100,000	Planned	3 to 4	1	1	$100,000		$100,000	$0
		Proxy2	$70,000	Planned	3 to 4	1	1	$70,000		$70,000	$0
		Web scanner1	$100,000	Planned	3 to 4	1	1	$100,000		$100,000	$0

		Web scanner2	$70,000	Planned	3 to 4	1	1	$70,000		$70,000	$0
		Mail Scanner1	$100,000	Planned	3 to 4	1	1	$100,000		$100,000	$0
		Mail Scanner2	$70,000	Planned	3 to 4	1	1	$70,000		$70,000	$0
		Software	$100,000	Planned		1	1	$100,000		$100,000	$0
		External Services	$200,000	Planned		1	1	$200,000		$200,000	$0
		Internal Labor costing	$40,000	Planned		1	1	$40,000		$40,000	$0
	Remote Access		**$670,000**								$0
		MF-HO1-PR	$20,000	Planned	3	2	1.67	$40,000		$33,333	-$6,667
		MF-HO2-PR	$20,000	Planned	3	2	1.67	$40,000		$33,333	-$6,667
		MF-HO3-PR	$20,000	Planned	3	2	1.67	$40,000		$33,333	-$6,667
		MF-HO1-DEV	$20,000	Planned	3	2	1.67	$40,000		$33,333	-$6,667
		NFUSE1	$20,000	Planned	3	2	1.67	$40,000		$33,333	-$6,667
		NFUSE2	$20,000	Planned	3	2	1.67	$40,000		$33,333	-$6,667
		SG1	$20,000	Planned	3	2	1.67	$40,000		$33,333	-$6,667
		SG2	$20,000	Planned	3	2	1.67	$40,000		$33,333	-$6,667
		STA1	$20,000	Planned	3	2	1.67	$40,000		$33,333	-$6,667
		STA2	$20,000	Planned	3	2	1.67	$40,000		$33,333	-$6,667
		RSA1	$20,000	Planned	3	2	1.67	$40,000		$33,333	-$6,667
		RSA2	$20,000	Planned	3	2	1.67	$40,000		$33,333	-$6,667
		Software	$210,000	Planned	3	2	1.67	$420,000		$350,000	-$70,000
		External Services	$150,000	Planned	3	2	1.67	$300,000		$250,000	-$50,000
		Internal Labor costing	$70,000	Planned	3	2	1.67	$140,000		$116,667	-$23,333
	Portable T Room		**$60,000**								$0
		Portable training room	$60,000	Planned	3	2	1.67	$120,000		$100,000	-$20,000
	OWA		**$175,000**								$0
		OWA-HO1-PR	$65,000	Planned	3	2	1.67	$130,000		$108,333	-$21,667
		Software	$20,000	Planned	3	2	1.67	$40,000		$33,333	-$6,667
		External Services	$50,000	Planned	3	2	1.67	$100,000		$83,333	-$16,667
		Internal Labor costing	$40,000	Planned	3	2	1.67	$80,000		$66,667	-$13,333
	Management		**$1,200,000**								$0
		DTMS	$100,000	Planned	3	2	1.67	$200,000		$166,667	-$33,333
		External Services	$300,000	Planned	3	2	1.67	$600,000		$500,000	-$100,000
		Internal Labor costing	$100,000	Planned	3	2	1.67	$200,000		$166,667	-$33,333
		Software	$700,000	Planned	3	2	1.67	$1,400,000		$1,166,667	-$233,333

	Application and infrastructure servers		**$720,000**								$0
		Servers x 25	$320,000	Planned	3	2	1.67	$640,000		$533,333	-$106,667
		External Services	$310,000	Planned	3	2	1.67	$620,000		$516,667	-$103,333
		Internal Labor costing	$90,000	Planned	3	2	1.67	$180,000		$150,000	-$30,000
	Power system Analysis										$0
		TSAT Powertech (PSA)	$39,000	Comitted	5	1	1	$39,000		$39,000	$0
		VMS Hardware & Software (PSA)	$152,500	Comitted	5	1	1	$152,500		$152,500	$0
		Market System	$300,000	Comitted	5	1	1	$300,000		$300,000	$0
		Hardware for PSA Software	$21,000	Comitted	5	1	1	$21,000		$21,000	$0
		Data conversion for PSA Software	$50,000	Comitted	5	1	1	$50,000		$50,000	$0
	Market modelling for new Network Investment										$0
		Modelling software	$110,000	Comitted	5	1	1	$110,000		$110,000	$0
	Emergency Corporate Communications										$0
		Satellite phones	$4,000	Planned	4	1	1	$4,000		$4,000	$0
	Transmission Pricing										$0
		Connection to Government Radio Network	$24,000	Planned	5	1	1	$24,000		$24,000	$0
		TPRICE	$20,000	Planned	5	1	1	$20,000		$20,000	$0
		Asset value databases	$130,000	Planned	4	1	1	$130,000		$130,000	$0
CDN	**Network**		**$6,029,100**								$0
		SW LAN / WAN H/W	$1,045,900	Planned	5	1	1	$1,045,900		$1,045,900	$0
		YS LAN / WAN H/W	$188,300	Planned	5	1	1	$188,300		$188,300	$0
		NC LAN /WAN H/W	$384,700	Planned	5	1	1	$384,700		$384,700	$0
		OR LAN / WAN H/W	$87,800	Planned	5	1	1	$87,800		$87,800	$0
		WG LAN /WAN H/W	$104,200	Planned	5	1	1	$104,200		$104,200	$0
		TM LAN / WAN H/W	$144,100	Planned	5	1	1	$144,100		$144,100	$0
		IDC DR H/W	$65,600	Planned	5	1	1	$65,600		$65,600	$0
		Sydney LAN / WAN H/W	$1,567,500	Planned	5	1	1	$1,567,500		$1,567,500	$0
		Upgrade LAN connection to desktop TM	$16,000	Planned	5	1	1	$16,000		$16,000	$0
		Upgrade LAN connection to desktop NC	$96,000	Planned	5	1	1	$96,000		$96,000	$0
		Upgrade LAN connection to desktop SW	$144,000	Planned	5	1	1	$144,000		$144,000	$0
		Upgrade LAN connection to desktop OR	$16,000	Planned	5	1	1	$16,000		$16,000	$0
		Upgrade LAN connection to desktop HO	$264,000	Planned	5	1	1	$264,000		$264,000	$0
		Upgrade LAN connection to desktop	$42,000	Planned	5	1	1	$42,000		$42,000	$0

		YS									
		Upgrade LAN connection to desktop WG	$33,000	Planned	5	1	1	$33,000		$33,000	$0
		Upgrade LAN connection to desktop Remote sites	$330,000	Planned	5	1	1	$330,000		$330,000	$0
								$0		$0	$0
		Mincom	$70,000	Planned	5	1	1	$70,000		$70,000	$0
		ACER	$50,000	Planned	5	1	1	$50,000		$50,000	$0
		NEMMCO	$40,000	Planned	5	1	1	$40,000		$40,000	$0
		SSZ	$290,000	Planned	5	1	1	$290,000		$290,000	$0
		External Services	$900,000	Planned		1	1	$900,000		$900,000	$0
		Internal Labor costing	$150,000	Planned		1	1	$150,000		$150,000	$0
Desktop			**$7,671,043**								$0
	Applications T1 & T2										$0
		Windows OS	$550,000	Planned	3	2	1.67	$1,100,000	1	$1	-$1,099,999
		Office Pro	$804,000	Planned	3	2	1.67	$1,608,000	1512930	$1,512,930	-$95,070
		Visio (STD & Pro)	$268,989	Planned	3	2	1.67	$537,978	581000	$581,000	$43,022
		Project (369)	$471,582	Planned	3	2	1.67	$943,164	378225	$378,225	-$564,939
		Adobe acrobat (340)	$228,000	Planned	3	2	1.67	$456,000	238567	$238,567	-$217,433
		Internal Labor costing	$310,000	Planned	3	2	1.67	$620,000		$516,667	-$103,333
		CA Antivirus	$40,000	Planned	3	2	1.67	$80,000		$66,667	-$13,333
		WinZip (1000)	$9,000		3	2	1.67	$18,000		$15,000	-$3,000
	Note + to 128 management	External Services	$1,100,000	Planned	3	2	1.67	$2,200,000		$1,833,333	-$366,667
	Hardware										$0
		Desktops 664 /1353	$898,392	Comitted	4	1.25	1.25	$1,122,990	1312500	$1,312,500	$189,510
		Laptops 699 /2920	$2,041,080	Comitted	3	1.6	1.67	$3,265,728	2666667	$2,666,667	-$599,061
		Printers 130	$950,000	Comitted	5	1	1.00	$950,000		$950,000	$0
SCADA											$0
		Data Concentrator disaster recovery	$110,000	Commited	5	2	1.00	$220,000		$110,000	-$110,000
		Secure Historical Data connection to CDN	$180,000	Proposed	5	1	1.00	$180,000		$180,000	$0
		Newcastle wallboard	$250,000	In Progress	5	1	1.00	$250,000		$250,000	$0
		SCADA hardware and software upgrade	$4,550,000	Proposed	5	1	1.00	4550000		$4,550,000	$0
								$57,821,460		**$52,503,156**	**-$5,318,304**