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Dear John

CONGESTION MANAGEMENT REVIEW

Macquarie Generation is concerned to ensure that any change to the policy framework governing transmission investment in the NEM takes into account information on the historical and present performance of the transmission system, the materiality of congestion in the NEM and proposed investment programs to relieve emerging points of transmission congestion.

In an effort to assist the AEMC with its review of congestion management in the NEM, Macquarie Generation commissioned McLennan Magasanik Associates to conduct an independent study of whether transmission network service providers are adequately managing intra-regional congestion in the NEM. A copy of the MMA report is attached for your information.

The MMA study reviews the annual planning reports of the TNSPs from 2001 to 2006 to examine how major intra-regional constraints were managed throughout this period. The study documents all anticipated and actual network constraints and the status, timing and cost of investment projects commissioned to relieve those constraints. MMA examined the following issues for each project and constraint:

- Was the constraint identified outside the lead time required for the most efficient option to be implemented?
- Did the determining factor of timing remain consistent over this period?
- Was the project committed in sufficient time to meet the service requirements?
- Did the estimated cost remain stable as the planning and design work was refined?
- Did the project pass the regulatory test on first application?

The MMA study found that TNSPs have performed more than satisfactorily in committing and constructing network solutions to address all significant intra-regional constraint problems within appropriate timeframes. MMA concluded that:

> *Transmission system reliability indicators indicate that system reliability has been improving and regional networks are performing well. These indicators as well as the development of network projects described in the APRs show that intra-regional constraints in each TNSP region have been managed appropriately. From the review of APRs over the years, is also clear that TNSPs are anticipating emerging constraints and responding appropriately such that no material congestion emerges. There are also no indications that TNSPs will not be able to continue their maintenance of networks in the future such that there is no material and persistent network congestion.*

The MMA study has analysed actual industry data to assess whether there is any evidence of a failure of TNSPs to manage the risks of transmission congestion. The MMA study indicates that there is no compelling reason for major changes to the current arrangements governing transmission network investment within NEM regions. TNSPs are committing resources to projects at the right time and in the right location to relieve significant points of intra-regional congestion. MMA expects that TNSPs will continue to make efficient investments in response to emerging constraints.

By providing a comprehensive review of TNSP practices and performance over recent years, Macquarie Generation hopes that the MMA study will provide a useful source of information for the AEMC when considering its transmission-related policy recommendations.

Please contact me (02 4968 7429) if you have any questions on the MMA study.

Yours sincerely

RUSSELL SKELTON
MANAGER MARKETING & TRADING

25 September 2006

Final Report to

Macquarie Generation

Management of Intra-Regional Constraints

25 September 2006

McLennan Magasanik Associates

Ref: J1390d1.0

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VERSION

Version	Date	Comment	Approved
Draft 0.1	6 September 2006	Issued to Macquarie Generation for review and comment	Ross Gawler
Draft 0.2	13 September 2006	Editorial enhancements plus section 2.1 added on methodology and 500kV development into Marulan	Ross Gawler
Final 1.0	25 September 2006	Previous draft issued as Final Report	Ross Gawler

EXECUTIVE SUMMARY

McLennan Magasanik Associates (MMA) has been engaged by Macquarie Generation to assist Macquarie Generation's understanding of whether the risks of intra-regional constraints are being adequately managed by transmission network service providers (TNSPs).

One of the roles of the TNSPs is to provide power system security services to NEMMCO. Part of a TNSP's responsibility to network planning and development is to analyse the future operation of its transmission networks and determine the extent of any future network constraints. Each TNSP is also obliged to publish an Annual Planning Report (APR) that identifies current and emerging network constraints. This study analyses the APRs for each region (as well as appropriate documents from NEMMCO) from 2001 to 2006 to assess how intra-regional constraints have been managed.

A review of major transfer flows or constraints discussed in each of the APRs indicates that for all network constraints, solutions have been identified and where necessary have been committed and constructed. The APRs are detailed documents that provide much information about the current and emerging constraints on the network. The APRs also describe the projects that have been completed, committed, proposed and identified to address these constraints. The APRs do not provide detailed information about the costs of every project nor the reasons why they may have been delayed and hence it was not possible to ascertain the efficiency of the network development as a whole. As each of the network projects that have been implemented have passed the Regulatory Test, it can be assumed that each project was identified as the lowest cost available option to relieve the particular constraints that were relieved by each project.

Most of the network augmentations undertaken by TNSPs are for reliability reasons as TNSPs have a legal obligation to meet network reliability standards. As TNSPs do not have a legal obligation to implement network augmentations to maximise market benefits, actions to relieve these constraints may be overlooked. It would be incumbent upon market participants who perceive that they are being disadvantaged by network conditions to seek the support of TNSPs to identify cost-effective options and to support the development process through to regulatory approval and financial commitment.

Transmission system reliability indicators as shown in Table 1, indicate that system reliability has been improving and the regional networks are performing well. Given the statistical nature of these indices and the impact of weather extremities and infrequent transmission plant failure, caution is required when interpreting trends from such necessarily limited data.

These indicators as well as the development of network projects described in the APRs show that intra-regional constraints in each region have been managed appropriately.

Table 1 TNSP system reliability performance[1]

	2001/02	2002/03	2003/04	2004/05
Powerlink –Loss of supply events, number greater than 0.2 system minutes	4	12	4	3
TransGrid – Network reliability, system minutes lost	0.44	4.4	2.2	0.15
VENCorp – Energy constraints, electricity not delivered due to constraints	Not available	Not available	0	0
ElectraNet – Number of events greater than 0.2 system minutes	3	4	2	7
Transend – Number of events greater than 0.1 system minutes	Not available	13	16	18

From the review of APRs over the years, it is also clear that TNSPs are anticipating emerging constraints and responding appropriately such that no material congestion emerges. There are also no indications that the TNSPs will not be able to continue their maintenance of networks in the future such that there are no material and persistent network congestions.

However, TNSPs do not always publish sufficient information on projected costs of new projects and value drivers that would enable market participants to identify and bring forward competing and lower cost opportunities for consideration. This lack of information limits the ability of regulators and market participants to monitor the investment process for efficiency and effectiveness and to co-ordinate generation and transmission investment to minimise costs.

[1] Data is sourced from each TNSP's Annual Reports

1 INTRODUCTION

Macquarie Generation has engaged McLennan Magasanik Associates (MMA) to assist its understanding of whether the risks of intra-regional constraints are being adequately managed by transmission network service providers (TNSPs).

Intra-regional constraints are used by NEMMCO to limit the loading on the transmission network within a local region to maintain:

- sufficiently reliable supply to regional customers
- power supply quality with respect to voltage variations and supply continuity
- the loading of transmission plant within its short-term rated capacity
- voltage control at transmission loads from which load is supplied or generation is connected
- stability of the power system against large and small disturbances
- the security of the power system so that credible contingencies will not lead to system collapse.

Intra-regional constraints directly relate to restrictions on generation or electricity supply due to limitations imposed by the network within the region. Inter-regional constraints, which are outside the scope of this proposal, relate to restrictions on power flows between regions and access to neighbouring spot prices by means of inter-regional settlement residues. Constraints are not always completely one or the other. For example, inter-regional power flows can have a secondary effect on some intra-regional constraints and it is arguable whether the constraint is intra or inter-regional. The key determinant factor is whether the most economic means to relieve the constraint involved transmission works across or within a major inter-regional link. If so, then it would be reasonable to describe this as an inter-regional constraint. Conversely, if the most economic investment to relieve a constraint is within a region, then we may consider it as an intra-regional constraint even if it is affected by inter-regional power flows to some extent. This is the basis for considerations in this report.

One of the roles of the TNSPs is to provide power system security services to NEMMCO. Part of a TNSP's responsibility to network planning and development is to analyse the future operation of its transmission network and determine the extent of any future network constraints. Each TNSP is also obliged to publish an Annual Planning Report (APR) that identifies current and emerging network constraints. The APR publishes a schedule of completed, committed and approved network augmentations that are required. The APR also discusses proposed network developments that can be used to address emerging and potential network constraints. The TNSPs' published APRs are also intended to encourage market participants and interested parties to formulate and propose options to relieve the network constraints such as by adding local generation capacity or establishing load control facilities to enable demand management.

This study analyses APRs for each region (as well as appropriate documents from NEMMCO) from 2001 to 2006 to assess how intra-regional constraints have been managed.

1.1 TNSP Network Planning Process

The network planning processes used by TNSPs are set out by the National Electricity Rules (NER). For each new regulated network augmentation proposal, the TNSP has to apply the Regulatory Test (RT) which is promulgated by the Australian Energy Regulator (AER).

The significant inputs into the network planning process are:

- The forecast of customer electricity demands and their locations. Peak demand and its seasonal variation is the key value driver for transmission capacity;
- Location, capacity and expected operation of generation. With respect to transmission capacity the availability of the generation plant at times of seasonal peak demand is a key factor;
- An assessment of future network capability as defined by maximum power flows on particular transmission links or groups of connections as appropriate, to develop a practical definition of the constraints that could arise for normal and credible adverse supply conditions;
- Planning criteria for the network which determine the level of redundancy or reliability standard required;
- Prediction of future loading on the transmission network, which is determined by the load flow across parallel transmission paths according to the physical characteristics of electrical circuits.

Ten-year load and generation pattern forecasts for each jurisdiction are used to model the potential flows on the transmission network elements. Where potential flows on transmission system elements could exceed network capability, the TNSP is required to notify market participants of these emerging network limitations. If augmentations are considered necessary, joint planning investigations are carried out with the distribution network service provider (DNSP) in accordance with the provisions of the NER and with the aim of identifying the most cost effective network solution.

In addition to the requirements of the NER, TNSPs may also face state government obligations that govern how they should address forecast network limitations. For example, Powerlink (TNSP in Queensland) is required by the Electricity Act 1994 (Qld) to 'ensure as far as technically and economically practicable, that the transmission grid is operated with enough capacity (and if necessary, augmented or extended to provide enough capacity) to provide network services to persons authorised to connect to the grid or take electricity from the grid'.

Hence it is a condition of the TNSP to plan and develop their transmission grid in accordance with good industry practice such that power quality and reliability standards in the NER are met for normal and outage conditions and that the power transfer available through the power system will be adequate to supply the forecast peak demand immediately following the most critical single network element or generation unit outage.

1.2 Regulatory Test

The Regulatory Test (RT) is a form of cost benefit analysis for assessing alternative investment options. The RT is structured to recognise the two main drivers of network augmentations and either one must be satisfied to justify the expenditure required. These two distinct limbs of test are:

- the 'reliability limb' is used for considering augmentations required to meet reliability or technical standards that Network Service Providers (NSP) must meet. The specified project must meet the applicable standards at the lowest cost.
- the 'market benefits limb' is used for assessing the present value of the market benefits of a project against the present value of its costs. The project adopted must provide the highest overall net benefit relative to adopting alternative available options, including taking no action to alleviate constraints.

Determining the 'reliability limb' of the RT is more straightforward than the 'market benefits limb'. For the 'reliability limb' of the RT if the technical standards under the NER or each jurisdiction's reliability standards are to be breached then the TNSP has a clear obligation to devise options to ensure that the standards continue to be met and to find the lowest cost available option to do so.

The 'market benefits limb' requires the analysis of whether a network corridor is able to transfer all generation following contingencies. If a network corridor is unable to do so, generators may have to be controlled to ensure network ratings are not breached and hence impose a cost to the market by not allowing the dispatch of the generation with the lowest bid price. An assessment would then be required as to whether augmentation is justified by the net market benefits it delivers in mitigating dispatch constraints that would otherwise apply. The TNSP has no legal obligation to pursue augmentations on the basis that they meet the market benefits test. It is expected that commercial interest would focus the attention of TNSPs on opportunities to enhance the network and earn a satisfactory return on capital invested.

2 REVIEW OF ANNUAL PLANNING REPORTS

The APR and other relevant documents for each of the NEM regions were reviewed by MMA to assess how TNSPs manage intra-regional constraints. Information about the identified projects in each APR from 2001 to 2006 which form the basis of the conclusions on this report is outlined in Appendix A . Each state region is discussed in the following sections.

2.1 Methodology

To assess how the TNSPs manage intra-regional constraints, the main intra-regional constraints for each NEM region where studied from 2001 to 2006. The issues that were used to analyse how these constraints were managed were based upon the following questions:

- Did the justification for the project based on reliability or wider market benefits remain consistent during the review period?
- Was the constraint identified outside the lead time required for the most efficient option to be implemented?
- Did the determining factor of timing remain consistent over the period?
- Was the project committed in sufficient time to meet the service requirements?
- Did the estimated cost remain stable as the planning and design work was refined?
- Did the project pass the regulatory test on first application?

The tables listed in Appendix A show the assessment of each identified project over the six years. From this analysis it can be determined which network augmentations options have been identified and how these options have changed with time. This analysis shows how each project's status, timing, cost and identified constraints have changed over time.

If the analysis shows that the answer to these questions are generally affirmative, then it can be ascertained that the intra-regional constraints are being managed in a timely and efficient manner such that TNSPs are anticipating emerging congestion and responding in such a way that no material congestion emerges.

2.2 Queensland

Queensland's transmission network is 1,700km long and comprises 275kV transmission lines from Cairns in the north to Mudgeeraba in the south. In addition, 110kV and 132kV transmission network systems provide backup to the 275kV grid as well as providing transmission in local zones. There are also 330kV lines that link Braemar, Middle Ridge, Millmerran and Bulli Creek to the NSW network. The majority of Queensland's generating capacity is located in Central and South West Queensland. The main power transfers are from Central Queensland to the north and south and from South West Queensland to the major load centres in South East Queensland.

Powerlink Queensland is the TNSP that owns, develops, operates and maintains Queensland's high voltage transmission network. It has also been appointed by the Queensland Governments as the Jurisdictional Planning Body (JPB) which is responsible for transmission network planning within the state.

Electricity usage in Queensland has grown strongly in the past 10 years and over the past 5 years, state-wide growth in summer maximum demand was 31%, including a record growth of 42% in South East Queensland. In response to the growth in electricity demand, Powerlink has implemented many projects and over the course of the last decade has built 25 new substations and more than 2,600km of new transmission lines.[1]

For this study, the main intra-regional power flows and their constraints identified are between North and Central Queensland (NQ-CQ), Central and South Queensland (CQ-SQ) and South West and South East Queensland (SWQ-SEQ). Table 2-1 shows the main identified transmission constraints and the projects identified to address them. Overall, Powerlink has identified the constraints outside the lead time required for the most efficient option to be implemented and that projects have been committed in sufficient time to meet the reserve requirements. The determining factor for timing did not change over the APR periods. From the APRs there was not enough information to ascertain whether these project costs have changed over time or whether the project passed the regulatory test on first application. The APRs do provide a clear description of current and emerging constraints and of the projects that have been committed, proposed or identified to address them.

[1] Powerlink Queensland Annual Report 04/05

Table 2-1 Identified Queensland transmission constraints

Qld Main Flow Paths	Projects to Address Constraint	Status as of APR 2006	Reliability or Market Benefits	Did the determining factor of timing change	Was the project committed in sufficient time to meet service requirements
CQ-NQ	New Stanwell to Broadsound 275kV line and Strathmore 275/132kV transformer	Commissioned in 2003	Market benefits	No	Yes
CQ-NQ	Staged construction of 275kV line between Broadsound and Ross and install static var compensators (SVC) at Strathmore, increase limit by 300MW	Committed	Reliability	No	Yes
CQ-NQ	Installation of 275kV and/or 132kV capacitor banks	Routine	Reliability	No	Yes
CQ-SQ	Option 1) Installation of an SVC on the coastal CQ-SQ circuit, limit increase by 100MW Option 2) Addition of switching station on the Tarong-Calvale lines at Auburn River, limit increased by 200MW Opt 3) build new double circuit 275kV line from Calvale to Tarong, limit increase by 800MW Opt4)build 500kV double circuit between CQ and SQ, limit increased by 1,500MW	Conceptual	Market benefits and potentially reliability	No	Not applicable
CQ-SQ	Installation of 275kV and/or 132kV capacitor banks	Routine	Reliability	No	Yes
SWQ-SEQ	Build new 275kV double circuit line from Middle Ridge to Greenbank and installation of 2nd Middle Ridge 330/275kV transformer, increase Tarong limit by 250MW and SWQ limit by 500-700MW	Committed	Reliability	No	Yes

Qld Main Flow Paths	Projects to Address Constraint	Status as of APR 2006	Reliability or Market Benefits	Did the determining factor of timing change	Was the project committed in sufficient time to meet service requirements
SWQ-SEQ	Upgrade existing Middle Ridge 330/275kV transformer to 1,500MVA, SWQ limit up by 250MW	Routine	Reliability	No	Yes
SWQ-SEQ	Install of series reactors on the Millmerran-Middle Ridge 330kV circuits, SWQ limit up by 150MW	Routine	Reliability	No	Yes
SWQ-SEQ	Build new double circuit line from Braemar to Tarong, increase limit by 500-1,000MW or build new Halys substation and construct new double circuit 500kV line from Halys to Blackwall substation, substantially increases Tarong Transfer	Conceptual	Reliability	No	Yes
SWQ-SEQ	Installation of 275kV and/or 132kV capacitor banks	Routine	Reliability	No	Yes

2.3 New South Wales

The NSW high voltage transmission network was designed to transfer power from the coal-fired power stations in the Hunter Valley, Central Coast and Lithgow areas to the major load centres. The network was also designed to transmit the NSW/ACT share of Snowy generation towards Canberra and Sydney. The development of the NEM and interconnection with Queensland has increasingly imposed a wider range of loading conditions on the network than was originally planned. It has been recognised that significant network augmentations will be required over the next decade to ensure that intra-regional constraints do not markedly limit the economic operation of the NEM or adversely affect the reliability of supply to load centres in NSW.

TransGrid is responsible for the planning and development of transmission networks in NSW and acts as both a TNSP and JPB. For this study, the main constraints identified are in Western NSW, Yass, Central Coast and North Coast as listed in Table 2-2. Table 2-2 shows that the main projects identified to address transmission constraints were mainly required for reliability. In general, TransGrid has identified the constraints outside the lead time required for the most efficient option to be implemented and that projects were committed in sufficient time to meet the reserve requirements. The determining factor for timing did change for almost half of the projects. The reasons for these were not always explicitly explained and may be due to revised forecasts or altered assessment of network constraints.

From the APRs there was not enough information to ascertain whether these project costs have changed over time or whether the project passed the regulatory test on first application. The APRs provide a clear description of current and emerging constraints and of the projects that have been committed, proposed or identified to address them.

Table 2-2: Identified NSW transmission constraints

NSW Region	Projects to Address Constraint	Status as of APR 2006	Reliability or Market Benefits	Did the determining factor of timing change	Was the project committed in sufficient time to meet service requirements
Limitations in the system supplying the Western area of NSW (Wellington, Forbes, Parkes areas)	Construction of a 330kV switching station on the Bayswater to Mt Piper line at Wollar and a 330kV transmission line from Wollar Switching Stations to 330kV Wellington substation	Approved – in 2005 a proposal for a 115MW gas fired power station at Cobar was announced proposed to be in service in mid 2008) TransGrid and Country Energy are currently reviewing the suitability of this or similar proposals to provide support in the Western area, such proposals may enable the Wollar-Wellington project to be deferred.)	Reliability	Yes	Not applicable
Limitations in the system supplying the Western area of NSW (Wellington, Forbes, Parkes areas)	Upgrade the Bayswater-Mt Piper-Marulan line to 500kV and uprate Marulan-Dapto and Marulan-Avon 330kV lines.	Proposed – regulatory consultation for this project has commenced	Reliability	No	Not applicable
Yass area	At this stage one indicative network option that will achieve a low level upgrade is the establishment of a new sub at Bannaby or the diversion of the Sydney West - Yass 330kV line into Marulan.	Identified as a constraint emerging requiring relief within 5 years	Reliability	Yes	Not applicable

NSW Region	Projects to Address Constraint	Status as of APR 2006	Reliability or Market Benefits	Did the determining factor of timing change	Was the project committed in sufficient time to meet service requirements
Central Coast	Minor 330kV line rearrangements near Eraring and Vales Point	Approved to be carried out in 2008	Market Benefits	Yes – works to be coordinated with power station outages	Yes
Central Coast	Reconstructed section of single circuit 330kV line between Tuggerah 330kV substation and Sterland substation to double circuit 330kV	Completed in spring 2003 and autumn 2004	Reliability	No	Yes
Central Coast	Rearrangement of 330kV lines (24, 25, 26) near Vales Pt and uprate line thermal equipment at Munmorah and Vales Pt.	Approved to be carried out in 2008	Reliability	Yes– works to be coordinated with power station outages	Yes
North Coast (Armidale, Coffs Harbour, Port Macquarie, Lismore areas)	Establish 330/132 kV substation adjacent to the Coffs Harbour area and connect to existing Armidale-Lismore 330kV line.	Completed by mid 2006	Reliability	No	Yes
North Coast (Armidale, Coffs Harbour, Port Macquarie, Lismore areas)	Construct an additional line between Port Macquarie and Kempsey.	Proposed - intended that a consultation and application of the Regulatory Test to this proposal and other options be commenced in late 2006/07	Reliability	No	Not applicable

NSW Region	Projects to Address Constraint	Status as of APR 2006	Reliability or Market Benefits	Did the determining factor of timing change	Was the project committed in sufficient time to meet service requirements
North Coast (Armidale, Coffs Harbour, Port Macquarie, Lismore areas)	Prefer to uprate the 966 Armidale -Koolkhan 132kV line	Committed to be completed by late 2006	Reliability	No	Yes

2.4 Victoria

The Victorian transmission system operates at voltages of 500kV, 330kV, 275kV and 220kV. The 500kV network primarily transports bulk electricity from generators in the Latrobe Valley to the major load centre of Melbourne, and then on to the major smelter load at Portland and the Heywood interconnection with South Australia. A strongly meshed 220kV transmission network supplies the metropolitan area and the major regional cities of Victoria. The 330kV network interconnects with the Snowy region and NSW. The 275kV transmission line from Heywood interconnects with South Australia.

VENCorp is the TNSP for Victoria and its objective is to ensure the long-term reliability of the transmission network that transports electricity between generators and load centres. Table 2-3 shows the projects to address constraints in the Latrobe Valley to Melbourne transmission corridor, supply to and from the Moorabool bus and supply to the Melbourne metropolitan area. Table 2-3 shows that the projects identified were mainly for reliability. In general, VENCorp has identified the constraints outside the lead time required for the most efficient option to be implemented and that projects were committed in sufficient time to meet the reserve requirements. The determining factor for timing did change for almost all projects. The reasons for these were not always explicitly explained and may be due to revised forecasts or altered assessment of network constraints.

From the APRs there was not enough information to ascertain whether these project costs have changed over time or whether the project passed the regulatory test on first application. The APRs provide a clear description of current and emerging constraints and of the projects that have been committed, proposed or identified to address them.

Table 2-3: Identified Victorian transmission constraints

Victorian Region	Projects to Address Constraint	Status as of APR 2006	Reliability or Market Benefits	Did the determining factor of timing change	Was the project committed in sufficient time to meet service requirements
Latrobe Valley to Melbourne 500kV network	Conversion of the 4th Hazelwood to Rowville 500kV line (at 220kV operation) for 500kV operation with installation of additional 500/220kV 1,000MVA transformation at Cranbourne, reconfiguration and circuit breaker replacement in the LV network and re-instatement of the Hazelwood-Jeeralang No 2 220kV line.	Completed	Reliability	Yes – project was delayed	Yes
Latrobe Valley to Melbourne 500kV network	Installation and switching of a 2nd 500/220kV, 1,000MVA transformer at Rowville and fault level mitigation works at Rowville and East Rowville 220kV switchyards.	Committed	Reliability	Yes	Yes
Latrobe Valley to Melbourne 500kV network	Opt1) install 5th 220/500kV transformer at Hazelwood, Opt2) install generation tripping scheme to control loading on Hazelwood transformer.	Following the development of a new Latrobe Valley 220kV configuration, VENCorp will undertake a detailed regulatory test assessment to determine if this constraint can be economically mitigated	Reliability	Yes	Not applicable
Latrobe Valley to Melbourne 500kV	Wind monitoring for the 6x220kV lines from Yallourn and Hazelwood to Rowville. This project will increase each	Committed	Reliability	No	Yes

Victorian Region	Projects to Address Constraint	Status as of APR 2006	Reliability or Market Benefits	Did the determining factor of timing change	Was the project committed in sufficient time to meet service requirements
network	line rating by 18%.				
Regional Victoria – supply to the Moorabool 220kV bus	Installation of 2nd 500/220kV, 1,000MVA transformer at Moorabool Terminal Station Keilor to Geelong wind monitoring scheme.	Committed	Reliability	Yes	Yes
Regional Victoria – supply from the Moorabool 220kV bus	Wind monitoring on No1 220kV between Moorabool and Ballarat which will enable the No.1 line to be dynamically rated based on measured wind speeds to minimise constraints during critical loading periods following loss of line No.2.	Committed	Reliability	Yes	Yes
Melbourne metropolitan area – supply to Ringwood terminal station	Preferred option is installation of a fast load shedding scheme at Ringwood terminal station.	Committed	Reliability	No	Yes

2.5 South Australia

South Australia's (SA) transmission network can be viewed as four main power transfer corridors, which are the north distributor, the port distributor, the central distributor and the south distributor. The north distributor provides power transfers between Adelaide metropolitan area and the northern parts of the State, in particular the power stations at Port Augusta. The port distributor provides power transfers between the power stations located in the Port Adelaide area and Adelaide's northern metropolitan area. The central distributor provides power transfers between the northern and southern regions of metropolitan Adelaide. The south distributor provides power transfers between the Adelaide metropolitan area and the lower south eastern areas of the State.

The Electricity Supply Industry Planning Council (ESIPC) is responsible for producing the APRs that examine the future development of the South Australian electricity supply industry. ESIPC is registered as a network service provider in order to undertake power system planning matters on behalf of the jurisdiction and does not own, contract or operate any of South Australia's electrical infrastructure. Network planning in South Australia is the responsibility of the individual network owners, ElectraNet and ETSA Utilities. ElectraNet is the TNSP and ETSA Utilities responsibilities are in the sub-transmission and distribution networks. ElectraNet and ETSA Utilities have both provided their network plans to ESIPC.

The APRs that were reviewed for South Australia included documents published by ESIPC and ElectraNet. Table 2-4 shows the projects that were identified to address constraints in the Adelaide metropolitan area and in the South East areas. These two areas were identified as the areas which are the most network constrained. In general, ESIPC and ElectraNet have identified the constraints outside the lead time required for the most efficient option to be implemented and that projects were committed in sufficient time to meet the reserve requirements. The determining factor for timing did not change for most of the projects.

From the APRs there was not enough information to ascertain whether these project costs have changed over time or whether the project passed the regulatory test on first application. The APRs provide information of current and emerging constraints. The APRs also describe projects that have been identified and are in progress.

Table 2-4: Identified South Australian transmission constraints

South Australian Region	Projects to Address Constraint	Status as of APR 2006	Reliability or Market Benefits	Did the determining factor of timing change	Was the project committed in sufficient time to meet service requirements
Adelaide Metropolitan area	Install 3rd 225MVA 275/66kV transformer at Northfield substation	Completed in 2005	Reliability	No	Yes
Adelaide Metropolitan area	Establish switching station at Tungkillo	In progress	Reliability	No	Yes
Adelaide Metropolitan area	Establish 275/66kV Panorama substation. Installation of 275kV cable from Happy Valley substation to Panorama substation.	Identified	Reliability	Yes	Not applicable
Adelaide Metropolitan area	Install 3rd 225MVA 275/66kV transformer at Morphett Vale East substation	Identified	Reliability	Yes	Not applicable
South East	Build new 132kV line from South East to Snuggery substations	Proposed – delayed due to seeking development approval	Reliability	Yes	Not applicable

2.6 Tasmania

The Tasmanian transmission system consists of 220kV bulk transmission network which, with some parallel 110kV transmission circuits, provides power transfer corridors for several major generation centres to load centres and power transfers between major load centres. A peripheral transmission network which is largely radial connects load centres or generators to the bulk transmission network. The future adequacy of the bulk transmission network depends mainly on the order of dispatch of generation and the adequacy of the peripheral transmission network is determined by the impacts of the forecast loads. The commissioning of Basslink has also introduced significant changes to the transmission system loading patterns.

Transend is the TNSP of Tasmania. Table 2-5 lists the projects that were implemented to ease constraints in the south transmission network and Launceston and Hobart areas. In general, Transend has identified the constraints outside the lead time required for the most efficient option to be implemented and that projects were committed in sufficient time to meet the reserve requirements. The determining factor for timing did not change for most of the projects.

From the APRs there was not enough information to ascertain whether these project costs have changed over time or whether the project passed the regulatory test on first application. The APRs provide a clear description of current and emerging constraints. The APRs also describe projects that have been identified and are in progress.

Table 2-5: Identified Tasmanian transmission constraints

Tasmanian Region	Projects to Address Constraint	Status as of APR 2006	Reliability or Market Benefits	Did the determining factor of timing change	Was the project committed in sufficient time to meet service requirements
Hobart area	Replace 110kV and 11kV assets in Risdon substation	Completed in 2002	Reliability	No	Yes
Hobart area	Redevelopment of Risdon Substation from 22kV to 33kV.	Committed	Reliability	No	Yes
Launceston area	Build new 110/22kV Mowbray station and transmission line from Trevallyn to Mowbray.	Complete	Reliability	Yes	Yes
Southern transmission	Construction of 220kV transmission line from Waddamana to Lindisfarne	Advanced	Reliability	No	Not applicable

3 TRANSMISSION SYSTEM PERFORMANCE

Table 3-1 shows the system reliability performance for each TNSP's network. The indicators indicate that system reliability has been improving and is mostly performing well. It must be recognised that such measures are statistical in nature and may vary from year to year based upon weather extremities and the uncertain nature of infrequent transmission equipment failure. It is therefore necessary to be cautious about inferring trends from such limited data.

These indicators as well as the development of network projects described in the APRs indicate that intra-regional constraints in each TNSP region have been managed appropriately. From the review of APRs over the years, it is also clear that TNSPs are anticipating emerging constraints and responding appropriately such that no material congestion emerges. There are also no indications that the TNSPs will not be able to continue their maintenance of networks in the future such that there are no material and persistent network congestions.

Table 3-1 TNSP system reliability performance[1]

	2001/02	2002/03	2003/04	2004/05
Powerlink –Loss of supply events, number greater than 0.2 system minutes	4	12	4	3
TransGrid – Network reliability, system minutes lost	0.44	4.4	2.2	0.15
VENCorp – Energy constraints, electricity not delivered due to constraints	Not available	Not available	0	0
ElectraNet – Number of events greater than 0.2 system minutes	3	4	2	7
Transend – Number of events greater than 0.1 system minutes	Not available	13	16	18

To some extent, this performance could have been a matter of good fortune. There is little published information about the risks being accepted prior to new developments. In VENCorp reports, some risks are quantified because a probabilistic approach is adopted. Hence, in most cases it was not possible from examining the published information to assess whether the risks of unreliable supply have been effectively evaluated and to what extent the transmission service levels were critical prior to the new works being commissioned. The absence of news about major intra-regional transmission disturbances in the media supports the view that the process of transmission system development has

[1] Data is sourced from each TNSP's Annual Reports

been effective in the recent period. However it may be that critical outages have not occurred at times of peak demand and revealed that capacity was inadequate. Therefore, we cannot be certain from this information alone that investment performance has been fully adequate.

However, TNSPs do not always publish sufficient information on projected costs of new projects and value drivers that would enable market participants to identify and bring forward competing and lower costs opportunities for consideration. This lack of information also limits the ability of regulators and market participants to monitor the investment process for efficiency and effectiveness and to co-ordinate generation and transmission investment to minimise costs.

4 CONCLUSIONS

The primary objective for TNSPs is to ensure the long-term reliability of the transmission network that transports electricity between generators and load centres. The APRs are detailed documents that provide much information about the current and emerging constraints on the network. The APRs also describe the projects that have been completed, committed, proposed and identified to address these constraints.

A review of major transfer flows or constraints discussed in each of the APRs indicate that for all network constraints, solutions have been identified and where necessary have been committed and constructed. The APRs do not provide detailed information about the costs of every project nor the reasons why they may have been delayed and hence it was not possible to ascertain the efficiency of the network development as a whole. As each of the network projects that have been implemented have passed the Regulatory Test, it can be assumed that each project was identified as the lowest cost available option to relieve the particular constraints that were relieved by each project.

Most of the network augmentations undertaken by TNSPs are for reliability reasons as TNSPs have a legal obligation to meet network reliability standards. As TNSPs do not have a legal obligation to implement network augmentations to meet market benefits, actions to relieve these constraints may be overlooked. It would be incumbent upon market participants who perceive that they are being disadvantaged by network conditions to seek the support of TNSPs to identify cost-effective options and to support the development process through to regulatory approval and financial commitment.

Transmission system reliability indicators indicate that system reliability has been improving and the regional networks are performing well. These indicators as well as the development of network projects described in the APR show that intra-regional constraints in each TNSP region have been managed appropriately. From the review of APRs over the years, it is also clear that TNSPs are anticipating emerging constraints and responding appropriately such that no material congestion emerges. There are also no indications that the TNSPs will not be able to continue their maintenance of networks in the future such that there are no material and persistent network congestions.

However, TNSPs do not always publish sufficient information on projected costs of new projects and value drivers that would enable market participants to identify and bring forward competing and lower costs opportunities for consideration. This lack of information limits the ability of regulators and market participants to monitor the investment process for efficiency and effectiveness and to co-ordinate generation and transmission investment to minimise costs.

APPENDIX A IDENTIFIED PROJECTS TO ADDRESS CONSTRAINTS

A.1 Abbreviations

The following abbreviations are used in the following tables:

tx	transmission
gen	generation
tfr	transformer

A.2 Queensland

A.2.1 Central to North Queensland

Table A-1 Large network options to address constraints in Central to North Queensland transfers

Annual Report	2001	2002	2003	2004	2005	2006
Network Augmentation s	Consultation also underway to address CQ-NQ limit, net benefits expected if implemented prior to 2002/03 summer. (pg49)	New Stanwell to Broadsound 275kV line (pg48) Strathmore 275/132kV tfr	New Stanwell to Broadsound 275kV line and 275/132kV Strathmore tfr (pg48)	Opt1) Build 275kV tx line between Broadsound and Ross with associated capacitive compensation (increase limit by +300MW) (pg18)	Opt1) Build 275kV tx line between Broadsound and Ross with associated capacitive compensation (increase limit by +300MW), Opt2) build 275kV tx line between Broadsound and Ross, stringing of 3rd circuit between Stanwell and Broadsound and installation of capacitive compensation (pg 16)	Opt1) Staged construction of 275kV tx line between Broadsound and Ross and install SVC at Strathmore (increase limit by +300MW), Opt2) Opt1 plus stringing the 2nd side of the existing Stanwell to Broadsound 275kV circuit and sub works at NQ subs, increase limit by 350MW (pg 14)
Time		late 2002	Nov-02	Possible 2008		Opt1, stage 1 by late 2007, stage 2 by late 2008 and stage 3 by late 2010
Costs						Opt1 $200-$300m
Status		Under construction	Commissioned	Identified	Cap banks - routine, Opt1 and Opt2 conceptual	Opt1 - committed, Op2 conceptual

Annual Report	2001	2002	2003	2004	2005	2006
Constraint	The max transfer between Central and North Queensland is currently limited by transient instability with the critical contingency as a fault at Stanwell on the Stanwell to Broadsound 275kV tx line	The max transfer between Central and North Queensland is currently limited by transient instability with the critical contingency as a fault at Stanwell on the Stanwell to Broadsound 275kV tx line	These augmentations increased the max secure transfer across CQ-NQ from 800MW to 925-985MW. These significantly higher flows are limited by dynamic stability following an outage of a 275kV tx circuit between Nebo and Strathmore or between Strathmore and Ross sub.	Central to North Queensland transfer capacity plus local generation may be insufficient to meet future load - reliability requirement	Central to North Queensland transfer capacity plus local generation may be insufficient to meet future load - reliability requirement	Central to North Queensland transfer capacity plus local generation may be insufficient to meet future load - reliability requirement

Table A-2 Small network options to address constraints in Central to North Queensland transfers

Annual Planning Report	2001	2002	2003	2004	2005	2006
Network Augmentations					Installation of 275kV and/or 132kV capacitor banks (pg16)	Installation of 275kV and/or 132kV capacitor banks (pg14)
Time						
Costs						
Status					Routine	Routine
Constraint					Small network projects to ensure transfer capability is maintained - reliability requirement	Small network projects to ensure transfer capability is maintained - reliability requirement

A.2.2 *Central to South Queensland*

Table A-3 Large network options to address Central to South Queensland transfers

Annual Planning Report	2001	2002	2003	2004	2005	2006
Network Augmentations	Planning with Ergon to address the overloading of the parallel 132kV Ergon Energy network between Gin Gin and Woolooga.			Op1) Addition of switching station on the Tarong-Calvale lines at Auburn River, and addition of series capacitors at Auburn River,(limit increased by +300MW Opt 2) build 275kV tx line CQ-SQ (limit increased by +600MW), Opt3) build 500kV double circuit between CQ and SQ (limit increased by 700MW) (pg18)	Op1) Addition of switching station on the Tarong-Calvale lines at Auburn River, and addition of series capacitors at Auburn River,(limit increased by 150MW Opt 2) establish Auburn River sub and installation of series capacitors, increase limit by 250MW Opt3) build 275kV tx line CQ-SQ (limit increased by +900MW), Opt4) build 500kV double circuit between CQ and SQ (limit increased by 1500MW) (pg16)	Op1) Installation of an SVC on the coastal CQ-SQ circuit, limit increase by 100MW Opt2) Addition of switching station on the Tarong-Calvale lines at Auburn River, limit increased by 200MW Opt 3) build new double circuit 275kV tx line from Calvale to Tarong, limit increase by 800MW Opt4)build 500kV double circuit between CQ and SQ (limit increased by 1500MW) (pg15)
Time				Possible 2008 or later		
Costs						
Status				Identified	Conceptual	Conceptual

Annual Planning Report	2001	2002	2003	2004	2005	2006
Constraint	CQ-SQ is limited to 1800MW due to potential overloading of parallel 132kV Ergon Energy network.	The max power transfer is limited by the occurrence of unstable voltage levels during contingencies. The critical contingency is an outage of a Calvale to Tarong 275kV tx circuit. The limit results from an exhaustion of reactive power reserves in the Central West and Gladstone zones. As a result the no. of generating units on-line in these zones impacts the limit. More gen units on line increases the reactive power support and therefore increases the limit	The max power transfer is limited by the occurrence of unstable voltage levels during contingencies. The critical contingency is an outage of a Calvale to Tarong 275kV tx circuit. The limit results from an exhaustion of reactive power reserves in the Central West and Gladstone zones. As a result the no. of generating units on-line in these zones impacts the limit. More gen units on line increases the reactive power support and therefore increases the limit	Constraints on between central and southern Queensland are expected to occur under scenarios in which significant new base load generation is built in central or north Qld - market requirement	Constraints on between central and southern Queensland are expected to occur under scenarios in which significant new base load generation is built in central or north Qld - market requirement	Constraints on between central and southern Queensland are expected to occur under scenarios in which significant new base load generation is built in central or north Qld - market benefit and potentially reliability requirement

Table A-4 Small network options to address constraints in Central to South Queensland transfers

Annual Planning Report	2001	2002	2003	2004	2005	2006
Network Augmentations					Installation of 275kV and/or 132kV capacitor banks (pg16)	Installation of 275kV and/or 132kV capacitor banks (pg15)
Time						
Costs						
Status					Routine	Routine
Constraint					Small network projects to ensure transfer capability is maintained - reliability requirement	Small network projects to ensure transfer capability is maintained - reliability requirement

A.2.3 South West to South East Queensland

Table A-5 Large network options to address constraints in South West to South East Queensland transfers

Annual Report	2001	2002	2003	2004	2005	2006
Network Augmentations	Installation of shunt capacitors in SQ, various 110kV network augmentations in the Brisbane area, additional switching at Mt England and the advent of Swanbank E and Tarong North will increase this limit (pg40)	The advent of Swanbank E and Tarong North, 275/110kV tx augmentations at Swanbank and Rocklea, establishment of Upper Kedron 110kV and Loganlea 275kV subs and rearrangement of the 110kV network at West Darra and capacitor bank additions at Blackwall and in the Energex distribution network will increase this limit. Construction of an additional 275kV tx line from Blackwell and Belmont will increase the Blackwell voltage stability limit (pg50)	The advent of Swanbank E, Millmerran and Tarong North has increased the amount of secure supportable load in southern Qld for these critical contingencies. In addition several completed, committed and proposed projects aimed at addressing reliability limitations within the greater Brisbane area contribute to increasing the limit. (pg 52)	Opt1) Build new 275kV double circuit tx line from Middle Ridge to Greenbank and associated capacitive compensation Opt2) build new 500kV double circuit tx line from SWQ to SEQ and associated capacitive compensation (pg18)	Opt1) Build new 275kV double circuit tx line from Middle Ridge to Greenbank and installation of 2nd Middle Ridge 330/275kV tfr, increase limit by 450MW Opt2) build new 500kV double circuit tx line from SWQ to SEQ and associated capacitive compensation, increase limit by 1000MW (pg17)	Opt1) Build new 275kV double circuit tx line from Middle Ridge to Greenbank and installation of 2nd Middle Ridge 330/275kV tfr, increase Tarong limit by 250MW and SWQ limit by 500-700MW Opt2) Upgrade existing Middle Ridge 330/275kV tfr to 1500MVA, SWQ limit up by 250MW, Opt3) install of series reactors on the Millmerran-Middle Ridge 330kV circuits, SWQ limit up by 150MW Opt4)build new double circuit tx line from Braemar to Tarong, increase limit by 500-1000MW, Opt5) build new Halys sub and construct new double circuit 500kV tx line from Halys to Blackwall sub, substantially increases Tarong Transfer (pg16)

Annual Report	2001	2002	2003	2004	2005	2006
Time	Next three years	2003		Possible 2007 or later - scenario dependant		Opt1) Late 2007
Costs						
Status	Committed	Committed	Committed	Identified	Conceptual	Opt1)committed, Opt2) routine, Opt3)routine Opt4)routine, Opt5) conceptual
Constraint	The max power transfer is limited by the occurrence of unstable voltage levels. The outlook is that it is unlikely that power flows across this grid section will encroach on the limits over the period of the committed projects.	The max power transfer is limited by the occurrence of unstable voltage levels. The outlook is that it is unlikely that power flows across this grid section will encroach on the limits over the period of the committed projects.	The max power transfer is limited by the occurrence of unstable voltage levels. The outlook to 2006 is that it is unlikely that power flows across this grid section will encroach on the limits over the period of the committed projects.	SWQ to SEQ transfer capacity plus local generation may be insufficient to meet future load - reliability requirement	SWQ to SEQ transfer capacity plus local generation may be insufficient to meet future load - reliability requirement	SWQ to SEQ transfer capacity plus local generation may be insufficient to meet future load - reliability requirement

Table A-6 Small network options to address constraints in Central to South Queensland transfers

Annual Planning Report	2001	2002	2003	2004	2005	2006
Network Augmentations					Installation of 275kV and/or 132kV capacitor banks (pg16)	Installation of 275kV and/or 132kV capacitor banks (pg16)
Time						
Costs						
Status					Routine	Routine
Constraint					Small network projects to ensure transfer capability is maintained - reliability requirement	Small network projects to ensure transfer capability is maintained - reliability requirement

A.3 New South Wales

A.3.1 System Supplying the Western Area of Sydney

Table A-7 Large network options to address constraints in Western Sydney

Annual Report	2001	2002	2003	2004	2005	2006
Network Augmentations	Opt1)Stage 1:construction of 330kV switching station on the Bayswater to Mt Piper line at Wollar Stage2: construction of 330/132kV sub near Icely, Opt2) Stage1: Construction of 330/132kV sub near Icely Stage2: construction of 330kV tx line from Mt Piper to Icely Stage3: construction of 330kV line from Icely to Wellington (pg44)	Opt1)Stage 1:construction of 330kV switching station on the Bayswater to Mt Piper line at Wollar (500/330kV sub would need to be installed at Wollar if/when Bayswater-Mt Piper line operates at 500kV) Stage2: construction of 330/132kV sub near Icely, Opt2) construction of a 330/132kV sub in the Kerr's Creek area and a 330kV tx line from Yetholme to Kerr's Creek by 2006 Opt3) construction of 330kV tx from Yetholme to Wellington via Kerr's Creek and a section of 132kV line from Wallerawang or Mt Piper to Yetholme(pg41)	Option 1 is proposed solution: Construction of 330kV switching station on the Bayswater to Mt Piper line at Wollar and construction of a 330kV tx line from Wollar Switching Station to Wellington 330kV Sub. A 500/330kV sub would need to be installed at Wollar if/when Bayswater to Mt Piper line is operated at 500kV. In the longer term a 330/132kV sub in the Icely or Kerr's Creek areas could be built (pg48)	Construction of a 330kV switching station on the Bayswater to Mt Piper line at Wollar and a 330kV tx line from Wollar Switching Station to 330kV Wellington sub (pg29)	Construction of a 330kV switching station on the Bayswater to Mt Piper line at Wollar and a 330kV tx line from Wollar Switching Station to 330kV Wellington sub (pg28)	Construction of a 330kV switching station on the Bayswater to Mt Piper line at Wollar and a 330kV tx line from Wollar Switching Station to 330kV Wellington sub (pg34)

Annual Report	2001	2002	2003	2004	2005	2006
Time	Opt1) Stage 1 2004/05, Stage 2 2006 Opt2) Stage 1 2003, Stage 2 2004, Stage 3 2005	Opt1) by 2006 Opt2) by 2006 Opt3) 2006	by 2007	by mid 2007	by late 2007	N/A
Costs	Opt1) Stage 1 $45 million Stage 2 $20 million Opt2) Stage 1 $20million, Stage 2 $18 million, Stage 3 $35 million	Opt1) $54 million Opt2) $58 million, Opt3) $58 million	$61 million	N/A	N/A	N/A
Status	Identified and determine preferred option during latter half of 2001 (other constraints relieved in 5 years)	Identified, TransGrid and Country Energy have commenced consultation with interested parties. Intended to apply for regulatory test to these proposals and get recommended option by mid to late 2002 (constraints requiring removal)	Proposals for new network assets - Consultations commenced prior to 8th Mar 2002	Approved	Approved (extensive community consultation has taken place since late 2003 to select the most appropriate location for the new switching station and route for the tx line	Approved (in 2005 a proposal for a 115MW gas fired power station at Cobar was announced proposed to be in service in mid 2008) TransGrid and Country Energy are currently reviewing the suitability of this or similar proposals to provide support in the Western area, such proposals may enable the Wollar-Wellington project to be deferred.)

Annual Report	2001	2002	2003	2004	2005	2006
Constraint	Due to load growth, adequate voltage levels may not be maintained at Wellington, Forbes, Parkes, thermal line ratings of some 132kV feeders will be exceeded and loading limit on 330/132kV tfr at Wallerawang will be exceeded	Due to load growth, adequate voltage levels may not be maintained at Wellington, Forbes, Parkes, thermal line ratings of some 132kV feeders will be exceeded and loading limit on 330/132kV tfr at Wallerawang will be exceeded	Due to load growth, adequate voltage levels may not be maintained at Wellington, Forbes, Parkes, thermal line ratings of some 132kV feeders will be exceeded and loading limit on 330/132kV tfr at Wallerawang will be exceeded	If the 330kV line between Mt Piper and Wellington 330kV sub were to be out of service, voltages in the sub-transmission and distribution networks particularly in the areas west of Wellington may not be about to be controlled	If the 330kV line between Mt Piper and Wellington 330kV sub were to be out of service, voltages in the sub-transmission and distribution networks particularly in the areas west of Wellington may not be about to be controlled	If the 330kV line between Mt Piper and Wellington 330kV sub were to be out of service, voltages in the sub-transmission and distribution networks particularly in the areas west of Wellington may not be about to be controlled

Table A-8 Large network options to address constraints Hunter Valley to NSW Load Centre Constraints

Annual Report	2001	2002	2003	2004	2005	2006
Network Augmentations		Upgrade the Bayswater-Mt Piper-Marulan line to 500kV (pg67)	Upgrade the Bayswater-Mt Piper-Marulan line to 500kV (pg62)	Upgrade the Bayswater-Mt Piper-Marulan line to 500kV (pg54)	Upgrade the Bayswater-Mt Piper-Marulan line to 500kV which involves: establish 500kV switchyards at Bayswater, Mt Piper and Wollar and installation of 500/330kV tfrs at each site, development of 500kV switchyard and 500/330kV tfrs at Marulan or Bannaby, connection of 2 generating Bayswater units to the 500kV switchyard, uprating switchgear in the Wallerawang 330kV switchyard, uprating lines and thermal equipment for the Marulan - Dapto 330kV tx and Marulan to Avon 330kV tx. (pg48)	Upgrade the Bayswater-Mt Piper-Marulan line to 500kV and uprate Marulan-Dapto and Marulan-Avon 330kV lines (pg46)
Time		Bayswater - Mt Piper section be upgraded by about 2007 with the Mt Piper - Marulan segment soon after				
Costs						

Annual Report	2001	2002	2003	2004	2005	2006
Status		Identified - Network constraints emerging in 5 years	Identified - Network constraints emerging in 5 years	Proposed - expected to complete planning analysis and commence Regulatory Test from late 2004	Proposed - expects to complete planning analysis and commence Regulatory Test in the near future	Proposed - regulatory consultation for this project has commenced. It is expected that a final report will be published in late 2006.
Constraint		There is a growing trend for power flows from the north of the state, including import over QNI, to the south of the state to supply growing NSW loads and the supply needs of Vic and SA.	There is an increasing need for power transfer from the north to the south of the state and alternatively from the south of the state towards Sydney to supply NSW loads at times of peak load. Issues that require reinforcement include line thermal limitations particularly between the Hunter Valley and Central Coast, transient stability performance and reactive power support requirements of the core system.	There is an increasing need for power transfer from the north to the south of the state and alternatively from the south of the state towards Sydney to supply NSW loads at times of peak load. Issues that require reinforcement include line thermal limitations particularly between the Hunter Valley and Central Coast, transient stability performance and reactive power support requirements of the core system.	There is an increasing need for power transfer from the north to the south of the state and alternatively from the south of the state towards Sydney to supply NSW loads at times of peak load. Issues that require reinforcement include line thermal limitations particularly between the Hunter Valley and Central Coast, transient stability performance and reactive power support requirements of the core system	The majority of load within NSW is located in the Newcastle/Sydney/Wollongong area. The main transmission system supplying this area is facing two major constraints: line thermal limitations, particularly between Hunter Valley and the Newcastle area and voltage control and reactive power support limitations.

A.3.2 Yass Region

Table A- 9 Options to address Yass/Canberra and Southwest NSW

Annual Report	2001	2002	2003	2004	2005	2006
Network Augmentations	Diversion of the Sydney-West -Yass 330kV line into Marulan (pg 43)	Diversion of the Sydney-West -Yass 330kV line into Marulan (pg 61)	Diversion of the Sydney-West -Yass 330kV line into Marulan (pg 68)	At this stage one indicative network option that will achieve a low level upgrade is the establishment of a new sub at Bannaby or the diversion of the Sydney West - Yass 330kV line into Marulan. This may be achievable later in this decade (pg67)	At this stage one indicative network option that will achieve a low level upgrade is the establishment of a new sub at Bannaby or the diversion of the Sydney West - Yass 330kV line into Marulan. This may be achievable later in this decade (pg67)	At this stage one indicative network option that will achieve a low level upgrade is the establishment of a new sub at Bannaby or the diversion of the Sydney West - Yass 330kV line into Marulan. (pg60)
Time	2004	2006	2006/07			
Costs	$20 million	$22 million				
Status	Identified (constraints requiring relief within 5 years)	Identified (constraints requiring relief within 5 years)	Identified (constraints requiring relief within 5 years)	Identified (constraints emerging to 5 years)	Identified (constraints emerging to 5 years)	Identified (constraints emerging to 5 years)
Constraint			Transmission system will need to be supported to supply the growing SW area load. Reinforcement by transmission development would also increase the capability for the export power from NSW to Vic and possible from Vic to NSW			Transmission system will need to be supported to supply the growing SW area load. Reinforcement by transmission development would also increase the capability for the export power from NSW to Vic and possible from Vic to NSW

A.3.3 *Central Coast*

Table A- 10 Minor 330kV rearrangements near Eraring and Vales Point

Annual Report	2001	2002	2003	2004	2005	2006
Network Augmentations	Minor 330kV line rearrangements near Eraring and Vales Pt. Installation of two 330/132kV Tfrs and associated switchgear at Waratah West (pg 49)	Turn in of Newcastle - Vales Point 24 Line in to Eraring (pg49)	Turn in of Newcastle - Vales Point 24 Line in to Eraring (pg34)	Turn in of Newcastle - Vales Point 24 Line in to Eraring (pg30)	Turn in of Newcastle - Vales Point 24 Line in to Eraring (pg26)	Turn in of Newcastle - Vales Point 24 Line in to Eraring (pg33)
Time	line rearrangements by 2002/03 Switchgear by summer 2004/05	during 2003		2005/06 (due to need for system outages to be programmed in a coordinated manner)	2006/07 (due to need for system outages to be programmed in a coordinated manner)	carried out in 2008
Costs	Switchgear costs$12 million	$4 million				
Status	Proposed	Proposed	Committed	Approved	Approved	Approved
Constraint		The present circuit arrangements has the potential to cause constraints on generation dispatch	Emerging need to gain greater support of the Newcastle area voltage using reactive power generation from Eraring, potential to reduce system losses	Emerging need to gain greater support of the Newcastle area voltage using reactive power generation from Eraring, potential to reduce system losses	Emerging need to gain greater support of the Newcastle area voltage using reactive power generation from Eraring, potential to reduce system losses	

Table A- 11 Options to develop supply in the Central Coast

Annual Report	2001	2002	2003	2004
Network Augmentations	N/A	Opt 1) reconstruct existing 330kV line between Tuggerah and the tee at Sterling as a double circuit 330kV line, a 2nd Tfr at Tuggerah and reinforcing EA's 132kV network south of Tuggerah. Opt2) build new 330/132kV sub in Somersby area, a section of double circuit 330kV line to connect to existing Munmorah-Sydney North 330kV line and two 132kV double circuit lines to connect to EA's 132kV system (pg36)	After regulatory test, the recommended action is the reconstruction of the existing 330kV line between Tuggerah and the tee at Sterland as a double circuit 330kV line (pg 35)	Reconstructed section of single circuit 330kV line between Tuggerah 330kV sub and Sterland to double circuit 330kV. Full use of circuit line is not expected to be required until 2008/09 but reconstruction was carried out in spring 2003 and autumn 2004 (pg25).
Time	N/A	Both options over the next ten years	occur during Spring 2003 or if necessary Autumn 2004.	Spring 2003 and Autumn 2004
Costs	N/A	$25 to $30 million	N/A	N/A
Status	N/A	Identified - consultations commenced prior to 8th Mar 02	Committed	Completed
Constraint		Limited by thermal rating of EA's 957 Vales Pt - Ourimbah and 97E Munmorah - Charmhaven 132kV lines, on outage of the 330kV line to Tuggerah or the Tuggerah transformer This limit will be exceeded either when new mining load is connecter of by summer 2008/09 (based on 2002 forecasts) if the mine is delayed		

Table A- 12 330kV line rearrangements at Vales Point

Annual Report	2001	2002	2003	2004	2005	2006
Network Augmentations			Op1) rearrangement of 330kV lines on CC near Vales Pt to remove line crossing, Opt2)further uprating of line thermal equip together with major switchgear replacement program to increase fault level capability at Munmorah and Vales Pt (pg 39)	Rearrangement of 330kV lines (24,25,26) near Vales Pt and uprate line thermal equipment at Munmorah and Vales Pt.	Rearrangement of 330kV lines (24,25,26) near Vales Pt and uprate line thermal equipment at Munmorah and Vales Pt. (pg26)	Rearrangement of 330kV lines (24,25,26) near Vales Pt and uprate line thermal equipment at Munmorah and Vales Pt.(pg33)
Time			2004/05	2005/06	2006/07 due to need for system outages to be programmed in a coordinated manner	carried out in 2008
Costs			Op1 costs $2.5 million, Opt 2 costs significantly more than $2million			
Status			Proposed (reliability augmentation with no material inter-network impact)	Approved	Approved	Approved
Constraint			Vales Pt-Munmorah lines will exceed ratings with the next 2-3 years. Fault levels at Vales Pt and Munmorah are approaching the ratings of the switchyard equip.	Vales Pt-Munmorah lines will exceed ratings with the next 2-3 years. Fault levels at Vales Pt and Munmorah are approaching the ratings of the switchyard equip.		

A.3.4 North Coast

Table A- 13 Project to address limitations in the Coffs Harbour and Nambucca coastal areas

Annual Planning Report	2001	2002	2003	2004	2005	2006
Network Augmentation s	establish 330/132 kV substation near to the Coffs Harbour area and connect to existing Armidale-Lismore 330kV line (pg 50)	establish 330/132 kV substation near to the Coffs Harbour area and connect to existing Armidale-Lismore 330kV line (pg 36)	establish 330/132 kV substation adjacent to the Coffs Harbour area and connect to existing Armidale-Lismore 330kV line. Following commissioning of Coffs Harbour 330/132kV sub, it is proposed to build a second 330kV switchbay for the Armidale-Lismore line (pg 46)	establish 330/132 kV substation adjacent to the Coffs Harbour area and connect to existing Armidale-Lismore 330kV line. Following commissioning of Coffs Harbour 330/132kV sub, it is proposed to build a second 330kV switchbay for the Armidale-Lismore line (pg 29)	establish 330/132 kV substation adjacent to the Coffs Harbour area and connect to existing Armidale-Lismore 330kV line. Following commissioning of Coffs Harbour 330/132kV sub, it is proposed to build a second 330kV switchbay for the Armidale-Lismore line (pg 25)	establish 330/132 kV substation adjacent to the Coffs Harbour area and connect to existing Armidale-Lismore 330kV line. Following commissioning of Coffs Harbour 330/132kV sub, it is proposed to build a second 330kV switchbay for the Armidale-Lismore line (pg 30)
Time	by 2004	by winter 2005	Sub by winter 2006, Switchyard by 2005		By winter 2006	completed by mid 2006
Costs	$10 million	$15 million	$17 million (sub) $1-2 million (switchyard)			
Status	identified (constraints relief within 5 years)	Identified - consultations commenced prior to 8th Mar 02 (constraints requiring removal)	Identified - consultations commenced prior to 8th Mar 02	Approved augmentations	Committed	committed

Annual Planning Report	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Constraint	This will result in the capability of the 132 kV transmission system and the rating of the Armidale 330/132 kV transformers being exceeded by winter 2003.	The capacity of the 132kV system supplying the area is limited by unacceptably low voltages at Port Mac and Kempsey on outage of the 965 and at Coffs on outage of the 96C 132kV lines	The capacity of the 132kV system supplying the area is limited by unacceptably low voltages at Port Mac and Kempsey on outage of the 965 and at Coffs on outage of the 96C 132kV lines	The capacity of the 132kV system supplying the area is limited by unacceptably low voltages at Port Mac and Kempsey on outage of the 965 and at Coffs on outage of the 96C 132kV lines	The capacity of the 132kV system supplying the area is limited by unacceptably low voltages at Port Mac and Kempsey on outage of the 965 and at Coffs on outage of the 96C 132kV lines	The capacity of the 132kV system supplying the area is limited by unacceptably low voltages at Port Mac and Kempsey on outage of the 965 and at Coffs on outage of the 96C 132kV lines

Table A- 14 Project to address limitations in system supplying Taree, Port Macquarie and Kempsey areas

Annual Planning Report	2001	2002	2003	2004	2005	2006
Network Augmentations	uprating a 66kV circuit from Coffs Harbour to Kempsey to 132kV and forming a new 132kV circuit from Kempsey to Pt Macquarie (pg51)	Construct an additional 330kV tx line between Port Mac and Kempsey would operate at 132kV initially and in the medium term it would form part of a 330kV supply (pg42)	Construct an additional 330kV tx line between Port Mac and Kempsey would operate at 132kV initially and in the medium term it would form part of a 330kV supply (pg55)	Construct an additional 330kV tx line between Port Mac and Kempsey would operate at 132kV initially and in the medium term it would form part of a 330kV supply (pg49)	Construct an additional 330kV tx line between Port Mac and Kempsey would operate at 132kV initially and in the medium term it would form part of a 330kV supply (pg51)	Construct an additional tx line between Port Mac and Kempsey. To date this contingency has been managed by the installation of capacitors 39MVAr has been installed at Port Macquarie and 52MVAr at Taree. Installation of additional caps is of marginal benefit as the reactive loads at each location are already more than fully compensated (pg48)
Time						
Costs	$30 million	$20 million	$20 million			
Status	Identified (constraints requiring relief within 5 years)	Proposed	Proposed - intended that a consultation process and application of the regulatory test to this proposal be commenced in mid to late 2003	Proposed - intended that a consultation and application of the Regulatory Test to this proposal and other options be commenced in late 2004	Proposed - intended that a consultation and application of the Regulatory Test to this proposal and other options be commenced in late 2005	Proposed - intended that a consultation and application of the Regulatory Test to this proposal and other options be commenced in late 2006/07

Annual Planning Report	2001	2002	2003	2004	2005	2006
Constraint	By the winter of 2003, for an outage of any one of the 132 kV lines from Armidale - Kempsey, Kempsey - Port Macquarie, or either line to Taree from the South, voltage levels at Port Macquarie and Taree connection points would fall below acceptable levels.	The capacity of the 132kV system supplying Port Mac is limited by unacceptably low voltages at Port Macquarie on outage of the 96G Kempsey-Port Mac 132kV line. Capacity of this system based on 2002 forecasts will be exceeded by around winter 2004	Capacity of this system based on 2003 forecasts will be exceeded by around winter 2004	Capacity of this system based on most recent forecasts will be exceeded by around winter 2005		

Table A- 15 Options to address limitations in the system supplying the Lismore area

Annual Planning Report	2001	2002	2003	2004	2005	2006
Network Augmentations	Development of an additional 330kV line either from Dumaresq to Lismore or Armidale to Lismore (pg 49)	Option 1) Construction of additional 330kV line most probably Dumaresq to Lismore, Op2) build additional 132kV lines, Opt 3) local gen, Opt4) DSM Opt5) Directlink for network support (pg 69)	Option 1) Construction of additional 330kV line most probably Dumaresq to Lismore, Op2) build additional 132kV lines, Opt 3) local gen, Opt4) DSM Opt5) Directlink for network support (pg 69)	Option 1) Construction of additional 330kV line most probably Dumaresq to Lismore, Op2) build additional 132kV lines, Opt 3) local gen, Opt4) DSM Opt5) Directlink for network support (pg 51)	Prefer to uprate the 966 Armidale - Koolkhan 132kV line pg as cheapest and quickest option(50)	Prefer to uprate the 966 Armidale - Koolkhan 132kV line pg as cheapest and quickest option(31)
Time	by 2004					completed by late 2006
Costs	$100 million					
Status	identified (network development within 5 years)	identified (network development within 5 years)	identified (network development within 5 years)	identified (network development within 5 years)	identified (network development within 5 years) Intended that a consultation process and application of Regulatory Test to this proposal and other options commenced in mid to late 2005	committed

Annual Planning Report	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Constraints		Thermal limits of 966 123kV line on outage of 98 330kV line expected to be reached by summer 05/06. Low voltage limits off at Lismore expected to emerge by winter 06	Thermal limits of 966 123kV line on outage of 98 330kV line expected to be reached by summer 05/06. Low voltage limits off at Lismore expected to emerge by winter 06	Thermal limits of 966 123kV line on outage of 98 330kV line expected to be reached by summer 05/06. Low voltage limits off at Lismore expected to emerge by winter 06 and in winter 07 when the Koolkhan capacitors are installed		

A.4

A.5 Victoria

A.5.1 Latrobe Valley to Melbourne

Table A- 16 Project for 4th Latrobe Valley to Melbourne 500kV transmission line

Annual Planning Report	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Network Augmentations	Conversion of the 4th Hazelwood to Rowville 500kV line (at 220kV operation) for 500kV operation with installation of additional 500/220kV transformation in the Melbourne metropolitan area and rearrangement of the Hazelwood power station switchyard (pg61)	Conversion of the 4th Hazelwood to Rowville 500kV line (at 220kV operation) for 500kV operation with installation of additional 500/220kV transformation at Rowville or Cranbourne and rearrangement of the Hazelwood power station switchyard (pg65)	Conversion of the 4th Hazelwood to Rowville 500kV line (at 220kV operation) for 500kV operation with installation of additional 500/220kV transformation at Cranbourne, reconfiguration and circuit breaker replacement in the LV network and re-instatement of the Hazelwood-Jeeralang No 2 220kV line (pg39)	Conversion of the 4th Hazelwood to Rowville 500kV line (at 220kV operation) for 500kV operation with installation of additional 500/220kV 1000MVA transformation at Cranbourne, reconfiguration and circuit breaker replacement in the LV network and re-instatement of the Hazelwood-Jeeralang No 2 220kV line (pg174)	Conversion of the 4th Hazelwood to Rowville 500kV line (at 220kV operation) for 500kV operation with installation of additional 500/220kV 1000MVA transformation at Cranbourne, reconfiguration and circuit breaker replacement in the LV network and re-instatement of the Hazelwood-Jeeralang No 2 220kV line (pg6)	
Time	under review	2003	Dec 04 (optimum timing)	Dec-04	project has been delayed to summer 05/06	
Costs	$25 to $35 million	$23.8 million (Tfr at Rowville) $35.9 million (Tfr at Cranbourne)		$42million		
Status	Identified (review underway to determine optimal timing)	Proposed (VENCorp has published the Consultation Paper and public consultation closed on 28th Mar 2002, optimum location for the 500/220kV tfr will be	Proposed (VENCorp proceeding to tender process)	Project in progress	Project in progress	

Annual Planning Report	2001	2002	2003	2004	2005	2006
		determined after a tendering process.)				
Constraint	The 500kV tx network from LV to Melbourne could impose constraints on the existing LV generators under some conditions. With prior outage of one of the LV to Mel 500kV lines, LV gen may need to be reduced by up to 1000MW to secure the network from voltage collapse and thermal overloading which could otherwise occur with the next contingency.	The 500kV tx network from LV to Melbourne could impose constraints on the existing LV generators under some conditions. With prior outage of one of the LV to Mel 500kV lines, LV gen may need to be reduced by up to 1000MW to secure the network from voltage collapse and thermal overloading which could otherwise occur with the next contingency.	This project minimises the risk of load shedding as a result of a 500kV line outages, minimises transmission losses and will further improve the reliability and security of supply to the eastern metropolitan area and compliment the distribution businesses' development of 220/66kV transformation at Cranbourne			

Table A- 17 Eastern metropolitan Melbourne 500/220kV transformers

Annual Planning Report	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Network Augmentations	Installation of additional 500/220kV transformers in the Eastern Metropolitan region (pg63)	Installation of additional 500/220kV transformers in the Eastern Metropolitan region. The preferred location yet to be determined (pg68)	Installation of additional 500/220kV transformers in the Eastern Metropolitan region. The preferred location yet to be determined, preliminary studies indicate that Rowville is the most promising site (pg82)	First (opt1) minor upgrades on the Thomastown to Ringwood and Thomastown to Templestowe lines combined with fault level mitigation works to allow the Rowville 220kV buses to be closed after an outage of either the Rowville or Cranbourne Tx, Secondly (Opt2)Install new 500/220kV tfr in the eastern metropolitan region (pg85)	The Application Notice concludes a new 500/220kV 1000MVA tfr at Rowville Terminal station passes the Regulatory Test. (pg68)	Installation and switching of a 2nd 500/220kV, 1000MVA tfr at Rowville and fault level mitigation works at Rowville and East Rowville 220kV switchyards. (pg48)
Time	Dependant on metropolitan load growth and service of the 4th 500kV circuit between LV and Mel and timing of Basslink.	Dependant on metropolitan load growth and service of the 4th 500kV circuit between LV and Mel and timing of Basslink.	Tentative timing for summer 2008	Opt1) justified by Dec 05, Opt2) in Dec 06	recommended completion date by Sep 07	By Sep 07
Costs	N/A	$20 to $33 million per transformer development	$40 million	Opt1)$6m, Opt2)$45m	$37.1 +/- 25%	
Status	Identified	Identified	identified	identified	proposed	committed

Annual Planning Report	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Constraint	The Rowville 500/220kV transformer exceeds the continuous rating during peak demands periods following outage of the Rowville to Sth Morang 500kV line by summer 2001/02. Until an additional tfr could be justified tfr overloading will be managed by operating arrangements.	The Rowville 500/220kV transformer exceeds the continuous rating during peak demands periods following outage of the Rowville to Sth Morang 500kV, loss of the Rowville 500/220kV tfr. Power flow on the 2 Sth Morang 330/220kV tfr may exceed their ratings following outage of either Rowville 500/220kV tfr, Keilor 500/220kV A3 tfr or the Eildon-Thomastown 220kV line. Power flow on the Keilor tfr may exceed ratings following outage of either of Moorabool 500/220kV tfr. Until an additional tfr could be justified transformer overloading will be managed by operating arrangements.	The Rowville 500/220kV transformer exceeds the continuous rating during peak demands periods following outage of the Rowville to Sth Morang 500kV, loss of the Rowville 500/220kV tfr. Power flow on the 2 Sth Morang 330/220kV tfr may exceed their ratings following outage of either Rowville 500/220kV tfr, Keilor 500/220kV A3 tfr or the Eildon-Thomastown 220kV line. Power flow on the Keilor tfr may exceed ratings following outage of either of Moorabool 500/220kV tfr. Until an additional tfr could be justified transformer overloading will be managed by operating arrangements.			Project primarily improves the reliability of supply to customers in the east and south east metropolitan area of Mel by alleviating constraints on the existing 500/220kV tfr at Rowville and Cranbourne and the constraints associated with the outage of these critical tfrs. There will be no material in-ter regional impact.

Table A- 18 Project for Hazelwood tie transformer

Annual Planning Report	2001	2002	2003	2004	2005	2006
Network Augmentations			There is no economic network solution at this stage. It may be possible to justify an automatic control scheme around 2005/06. The alternative of additional 500/220kV tfr depends on generation development	Recommendation to continue to monitor this constraint. Should conditions effecting this emerging constraint remain as they are and Yallourn's Unit 1 remain unconditionally connected to the 500kV network, VENCorp could justify a Large Network Augmentation involving a new 500/220kV tfr at Hazelwood Terminal Station (pg121)	VENCorp's interim arrangement is a protection control scheme that trips specific generation following a forced tx outage passes the Regulatory test requirements. VENCorp will undertake an assessment for a permanent solution involving additional tfr at Hazelwood (pg91)	Opt1) install 5th 220/500kV Tx at Hazelwood, Opt2) install generation tripping scheme to control loading on Hazelwood tfrs. (pg59)
Time				Prior to Dec 2008	Control scheme Dec 05, Additional tfr between 2008 to 2010	
Costs			Automatic control scheme $500k, Tx $25m	$30million	Control scheme $620k,	
Status			Identified	Identified	Identified	Following the development of a new LV 220kV configuration, VENCorp will undertake a detailed regulatory test assessment to determine if this constraint can be economically mitigated

Annual Planning Report	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Constraint			The transformation capacity at Hazelwood Terminal Station can present a system normal thermal limitation on generation connected at the 220kV level in the LV. The Yallourn W1 generator has a flexible connection arrangement to the shared network. Under system normal conditions, it will be connected to the HWPS buses and contribute to loading on the critical transformers. However, if the constraint is forecast or actually binds, the output of Yallourn W1 will be transferred to the 220kV network via its alternative connection if system conditions are acceptable	The transformation capacity at Hazelwood Terminal Station can present a system normal thermal limitation on generation connected at the 220kV level in the LV. The Yallourn W1 generator has a flexible connection arrangement to the shared network. Under system normal conditions, it will be connected to the HWPS buses and contribute to loading on the critical transformers. However, if the constraint is forecast or actually binds, the output of Yallourn W1 will be transferred to the 220kV network via its alternative connection if system conditions are acceptable	The transformation capacity at Hazelwood Terminal Station can present a system normal thermal limitation on generation connected at the 220kV level in the LV. The Yallourn W1 generator has a flexible connection arrangement to the shared network. Under system normal conditions, it will be connected to the HWPS buses and contribute to loading on the critical transformers. However, if the constraint is forecast or actually binds, the output of Yallourn W1 will be transferred to the 220kV network via its alternative connection if system conditions are acceptable	Loading of the Hazelwood transformers presents a thermal constraint that can limit the output of all LV generation connecting into the 220kV buses at Hazelwood Power Station. The constraint typically occurs at times of high demand when all of this generation is likely to be dispatched.

A.5.2 Regional Victoria

Table A- 19 Options to address limitations for supply to Moorabool

Annual Planning Report	2001	2002	2003	2004	2005	2006
Network Augmentations	Opt1) procurement of spare phase for the 500/220kV tfr at Moorabool, opt2) install 2nd Moorabool 500/220kV 1000MVA tfr, Opt3) increase the thermal rating of the Keilor to Geelong 220kV line through wind monitoring Opt 4) build 4th 220kV tx line from Keilor to Geelong (pg60)	Preferred option is to purchase spare single phase tfr for the 500/200kV tfr at Moorabool (pg76)	Preferred solution is Opt1) fast load shedding (if feasible) by Dec 03 and a spare single phase tfr by Dec 04. If fast load shedding is not available then Opt2) is the 2nd 500/220kV 1000MVA tfr at Moorabool. (pg57)	Spare Moorabool 500/220kV single phase tfr and identified 2nd 500/220kV tfr at Moorabool (pg174) A wind monitoring scheme should be implemented for the Keilor to Geelong lines (pg96)	Spare Moorabool 500/220kV single phase tfr (pg43) A wind monitoring scheme has been installed for the Keilor to Geelong lines (pg41) VENCorp considers the installation of a 2nd 500/220kV Moorabool tfr is likely to pass the Regulatory Test (pg69)	Installation of 2nd 500/220kV, 1000MVA tfr at Moorabool Terminal Station (pg48) Keilor to Geelong wind monitoring scheme (pg49).
Time	To be determined	Tentative Dec 2004 (further augmentation i.e. installation of the full transformer may be required by 2008)		Single phase tfr at May 2005, 2nd tfr around 2006 (economic timing subjected to generation development in Keilor/Moorabool areas. Wind monitoring summer 04/05	Spare phase tfr in progress, wind monitoring completed, 2nd Moorabool Tx at Sep 2008	2nd tfr sep 2008, wind monitoring scheme by summer 06/07
Costs	Opt1) $4mill, Opt2) $24mill, Opt3) $1.5 mill	N/A	Opt 1)$4.5 million Opt2)$26 million	Single phase tfr $4m, 2nd tfr $26m, wind monitoring $400k	2nd Moorabool tfr cost $17m +/- 25%	

Annual Planning Report	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Status	Identified (VENCorp will undertake studies to determine augmentation in the next few months	Identified (VENCorp will initiate detailed studies to form the basis of a consultation process aimed at securing supply into the Moorabool 220kV bus)	Identified (net market benefit analysis has been carried out for each of the options)	Single phase tfr project in progress, proposed, wind monitoring proposed	Committed, proposed for 2nd Moorabool tfr	Committed
Constraint	An outage of the Moorabool 500/220kV transformer has significant impacts on power flows and voltages in the region.	An outage of the Moorabool 500/220kV transformer has significant impacts on power flows and voltages in the region.			An outage of the Moorabool 500/220kV transformer has significant impacts on power flows and voltages in the region.	Improves the reliability of supply to customers in the western metropolitan Melbourne, Geelong and regional western Vic. Project will not have a material inter-regional impact

Table A- 20 Options to address limitations for supply from Moorabool

Annual Planning Report	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Network Augmentations	Construction of a 3rd 220kV line from Moorabool to Ballarat (pg70)	Construction of a 3rd 220kV line from Moorabool to Ballarat (pg77)	Studies indicate that there is insufficient energy to justify a network solution to this constraint within the 5 year period. It is proposed to rely on the use of existing contingency analysis and other online monitoring facilities to alert system operators of the potential for this overload. If the contingency were to occur during a critical period, manual action after the event such as load shedding in the state grid area, or increasing NSW to Vic flow would be sufficient to relieve the overload (pg74)	Ballarat to Moorabool wind monitoring scheme (pg180)	Wind monitoring on No1 220kV between Moorabool and Ballarat which will enable the No.1 line to be dynamically rated based on measured wind speeds to minimise constraints during critical loading periods following loss of line No.2 (pg41)	Wind monitoring on No1 220kV between Moorabool and Ballarat which will enable the No.1 line to be dynamically rated based on measured wind speeds to minimise constraints during critical loading periods following loss of line No.2 (pg49)
Time	End of 10 year period	Based on planning criteria end of 2009-2012		Dec-05	Wind monitoring in progress	Completed for summer 06/07
Costs	$6 million	$8 million		$0.4m		
Status	Identified	Identified	Identified - assessment of energy at risk conducted	Identified	Committed	Committed

Annual Planning Report	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Constraint	Outage of the Moorabool to Ballarat No.2 line is the critical contingency as loading levels on the remaining No.1 line may increase unacceptable levels.	Outage of the Moorabool to Ballarat No.2 line is the critical contingency as loading levels on the remaining No.1 line may increase unacceptable levels.	Outage of the Moorabool to Ballarat No.2 line is the critical contingency as loading levels on the remaining No.1 line may increase unacceptable levels.		Outage of the Moorabool to Ballarat No.2 line is the critical contingency as loading levels on the remaining No.1 line may increase unacceptable levels.	

A.5.3 Melbourne Metropolitan Area

Table A- 21 Project for supply to Ringwood Terminal Station

Annual Planning Report	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Network Augmentations			Preferred option is installation of a fast load shedding scheme at Ringwood terminal station	Preferred option is installation of a fast load shedding scheme at Ringwood terminal station (pg48)		
Time			Dec-04	Dec-04		
Costs			$150 000			
Status			Identified (not reliability augmentation and has no material inter-network impact, (net market benefit analysis has been carried out for each of the options)	Committed		
Constraint			Ringwood terminal station is supplied via 2x220kV tx lines, one from Thomastown terminal station and the other from Rowville terminal station. Thomastown to Ringwood line would not be able to support full load if there is an outage of the Rowville to Ringwood lines. Constraints have arisen due to load growth at Ringwood terminal station	Ringwood terminal station is supplied via 2x220kV tx lines, one from Thomastown terminal station and the other from Rowville terminal station. Thomastown to Ringwood line would not be able to support full load if there is an outage of the Rowville to Ringwood lines. Constraints have arisen due to load growth at Ringwood terminal station		

A.6 South Australia

A.6.1 Adelaide Metropolitan Area

Table A- 22 Northfield 275/66kV transformer upgrade

Annual Report	2001	2002	2003	2004	2005	2006
Network Augmentations	Install 3rd 225MVA 275/66kV transformer at Northfield substation (ESIPC pg107)	Install 3rd 225MVA 275/66kV transformer at Northfield substation (ESIPC pg115)	Install 3rd 225MVA 275/66kV transformer at Northfield substation (ESIPC pg130)	Install 3rd 225MVA 275/66kV transformer at Northfield substation (ESIPC pg134)	Install 3rd 225MVA 275/66kV transformer at Northfield substation (ESIPC pg165)	
Time	By summer 2004/05		Nov-04	Dec-04		
Costs	$3m					
Status	Identified	Identified	Planned	Committed	Completed	
Constraint	This option is required as a result of the proposed Para-Paracombe development and to support load growth in the Northfield area. Studies indicated that by 2004/05 an unscheduled outage of an existing 275/66kV transformer at Northfield substation will cause the remaining unit to overload.	The 66kV electricity supply for the Eastern Suburbs of metropolitan Adelaide is provided by the interconnected 275/66kV ElectraNet SA network. From summer 2004/05 an outage of a Northfield 275/66kV transformer will overload the remaining Northfield unit	The 66kV electricity supply for the Eastern Suburbs of metropolitan Adelaide is provided by the interconnected 275/66kV ElectraNet SA network. From summer 2004/05 an outage of a Northfield 275/66kV transformer will overload the remaining Northfield unit		The 66kV electricity supply for the Eastern Suburbs of metropolitan Adelaide is provided by the interconnected 275/66kV ElectraNet SA network. From summer 2004/05 an outage of a Northfield 275/66kV transformer will overload the remaining Northfield unit	

Table A- 23 Tungkillo switching station

Annual Report	2001	2002	2003	2004	2005	2006
Network Augmentations		Establishing Tungkillo 275kV sub at the intersection of the Tailem Bend-Para 275kV tx lines and the Robertstown-Cherry Gardens 275kV tx lines. The 1st stage of Tungkillo sub involves connecting a single Tailem Bend-Para 275kV tx line to a single Robertstown-Cherry Gardens 175kV tx line (pg64)	Establish Tungkillo 275kV switchyard (ESIPC pg94)		Establish Tungkillo switching station (ESIPC pg x)	Establish Tungkillo switching station (ElectraNet pg 47)
Time		Dec-06				2007
Costs		$11m				
Status		Identified			Planned	In progress
Constraint		This development is needed to provide additional 275kV tx support to the Southern Suburbs and to help distribute system flows under a range of contingencies and system operating conditions	This switchyard would create two additional high capacity circuits between the north and southern suburbs around the periphery of the metropolitan area making more efficient use of existing in-service 275kV line segments		High level analysis indicates that the bulk transfer capability across the greater Adelaide area is approaching full capability but the Tungkillo switching station removes this limitation and supports future network development	

Table A- 24 Southern suburbs reinforcement – Happy Valley to Panorama 275kV line

Annual Report	2001	2002	2003	2004	2005	2006
Network Augmentations	Installation of a 275kV cable from Happy Valley sub to Panorama, the establishment of Panorama 275/66kV sub and installation of a single 225MVA 275/66kV tfr and switchgear. Options for construction of 275kV single circuit from Cherry Gardens and Wilunga together with establishment of Wilunga is also considered (pg90)	Installation of a 275kV cable from Happy Valley sub to Panorama, the establishment of Panorama 275/66kV sub and installation of a single 225MVA 275/66kV tfr and switchgear (pg57)	Installation of a 275kV cable from Happy Valley sub to Panorama, the establishment of Panorama 275/66kV sub and installation of a single 225MVA 275/66kV tfr and switchgear. Other options are also considered to provide support for Southern Suburbs (pg132)	Installation of a 275kV cable from Happy Valley sub to Panorama, the establishment of Panorama 275/66kV sub and installation of a single 225MVA 275/66kV tfr and switchgear. Other options are also considered to provide support for Southern Suburbs (pg134)	Installation of a 275kV cable from Happy Valley sub to Panorama, the establishment of Panorama 275/66kV sub and installation of a single 225MVA 275/66kV tfr and switchgear. Other options are also considered to provide support for Southern Suburbs (pg170)	Installation of a 275kV cable from Happy Valley sub to Panorama, the establishment of Panorama 275/66kV sub and installation of a single 225MVA 275/66kV tfr and switchgear. Other options are also considered to provide support for Southern Suburbs (pg77)
Time	Summer 2005/06	Dec-04	Nov-04		Summer 2007/08	
Costs	$25m	$35.6m				$72 to $100million
Status	Identified	Identified	Identified	Identified	Identified	Identified

Annual Report	2001	2002	2003	2004	2005	2006
Constraint	Studies indicated that by 2005/06 load growth throughout the southern suburbs and Fleurieu Peninsula may result in ETSA Utilities network compliance issues under system normal and contingency operating conditions.	By summer 2004/05 load growth in the Southern Suburbs may result in ETSA utilities 66kV network overloading under contingency operating conditions.	By summer 2004/05 load growth in the Southern Suburbs may result in ETSA utilities 66kV network overloading under contingency operating conditions.	By summer 2004/05 load growth in the Southern Suburbs may result in ETSA utilities 66kV network overloading under contingency operating conditions.	Until the summer of 2006/07 the existing ElectraNet 275/66kV delivery infrastructure will remain compliant with the Category 4 service standards outlined in the Electricity Transmission Code. After this time the forecast ETSA Utilities load will exceed this aggregate capacity in a contingency scenario.	This augmentation option will provide an additional 360MVA of transformer capacity to the Southern Suburbs grouped connection point. ETSA Utilities may need to augment their 66kV system as part of the augmentation proposal

Table A- 25 Southern suburbs reinforcement – Morphett Vale East transformer

Annual Report	2001	2002	2003	2004	2005	2006
Network Augmentations	Replacing Morphett Vale East No. 3 transformer 275/66kV rated 180MVA with one rated 225MVA (ESIPC pg108)	Installing a third 225MVA 275/66kV transformer at Morphett Vale East Substation (ESIPC pg111)	Installing a third 225MVA 275/66kV transformer at Morphett Vale East Substation (ESIPC pg131)	Installing a third 225MVA 275/66kV transformer at Morphett Vale East Substation (ESIPC pg134)	Installing a third 225MVA 275/66kV transformer at Morphett Vale East Substation (ESIPC pg177)	Installing a third 225MVA 275/66kV transformer at Morphett Vale East Substation (ElectraNet pg74)
Time	By summer 2001/02	Earliest date Dec 04	Nov-04		Summer 2011/12	2010
Costs	$0.15m					
Status	To be advised	Identified	Identified	Identified	Identified	Identified
Constraint	The existing 180MVA 275/66kV transformer located at Morphett Vale East will overload in summer 2001/02 with the loss of the other 275/66kV transformer at Morphett Vale East	To maintain 'N-1' capacity in the Southern Suburbs network for future load growth	To maintain 'N-1' capacity in the Southern Suburbs network for future load growth	To maintain 'N-1' capacity in the Southern Suburbs network for future load growth	To maintain 'N-1' capacity in the Southern Suburbs network for future load growth	To maintain 'N-1' capacity in the Southern Suburbs network for future load growth

A.6.2 South East

Table A- 26 South East – Snuggery 132kV transmission line

Annual Report	2001	2002	2003	2004	2005	2006
Network Augmentations		Build new single circuit 132kV line from South East substation to Snuggery substation (ESIPC pg 71)	In Dec 02 an information paper was released by ElectraNet SA that addressed network limitations in the South East region. No responses were received and an application notice is currently being prepared for public consultation (ElectraNet pg 74)	Build new 132kV line from South East to Snuggery substations (ESIPC pg 164)	Build new 132kV line from South East to Snuggery substations (ESIPC pg 121)	Build new 132kV line from South East to Snuggery substations (ElectraNet pg 146)
Time		Earliest operational date is Dec 2003		As soon as possible - currently seeking development approvals for this project	Delayed by local community opposition	As soon as possible - currently seeking development approvals for this project
Costs		$10.4m				
Status		Identified		Proposed	Proposed	Proposed
Constraint		Lower South East region has insufficient capability to support growth in demand for the combined demand of Mount Gambier, Blanche and Snuggery	Lower South East region has insufficient capability to support growth in demand for the combined demand of Mount Gambier, Blanche and Snuggery	South east 132kV network is unable to maintain supply to customers following a single contingency outage under some system conditions	South east 132kV network is unable to maintain supply to customers following a single contingency outage under some system conditions	South east 132kV network is unable to maintain supply to customers following a single contingency outage under some system conditions

A.7 Tasmania

A.7.1 Hobart Area

Table A- 27 Risdon substation

Annual Planning Report	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Network Augmentations	Replace aged 110kV and 11kV assets (pg66)	Replacement of five old transformers, 110kV switchgear and establishment of new 33kV connection point. (pg109)	Risdon 33kV development (pg54)	Redevelopment of Risdon Substation 33kV (pg85)	Redevelopment of Risdon Substation to 33kV	Redevelopment of Risdon Substation to 33kV (pg47)
Time	expected to be completed in Mar02	Almost complete		Delayed to be completed in June 06	Jun-06	Expected to be completed by end of 2006
Costs						
Status	In progress	In progress	In progress	Committed	Committed	Committed
Constraint	Improve reliability, security and quality of supply to the Hobart area and Pasminco Hobart Smelter. Allow for the future upgrading of the retail supply from 22kV and 33kV as part of Hobart Area Supply Upgrade project	Improve reliability, security and quality of supply to the Hobart area and Pasminco Hobart Smelter. Allow for the future upgrading of the retail supply from 22kV and 33kV as part of Hobart Area Supply Upgrade project	Provision of 33kV supply from Risdon substation is part of the Hobart Area Supply Upgrade (HASU) strategy.		Provision of 33kV supply from Risdon substation is part of the Hobart Area Supply Upgrade (HASU) strategy.	Hobart's sub-transmission network supplied capacity is being increased by upgrading the 22kV infrastructure to 33kV

Note: Pasminco is now trading as Zinifex.

A.7.2 Southern Transmission

Table A- 28 Options to address limitations in the Southern transmission system

Annual Planning Report	2001	2002	2003	2004	2005	2006
Network Augmentations	Opt1)connecting generation within the local distribution system, Opt2) DM or DSM, Opt3) extension of the 220kV system and new 220kV lines from Liapootah to Lindisfarne	Opt1)connecting generation within the local distribution system, Opt2) DM or DSM, Opt3) extension of the 220kV system and new 220kV lines from Liapootah to Lindisfarne (pg113)	New 220kV sub at Lindisfarne, Waddamana-Bridgewater upgrade, Tungatinah-L Echo-Waddamana upgrade, New Norfolk-Chapel St and Chapel St-Kingston reconnection (pg53)	A 220kV transmission line from Waddamana to Lindisfarne (pg86)	A 220kV transmission line from Waddamana to Lindisfarne (pg 71)	A 220kV transmission line from Waddamana to Lindisfarne (pg 50)
Time					winter 2008	
Costs						
Status	Identified - will conduct regulatory tests soon.	Regulatory test conducted will submit to RNPP	Proposed	Proposed - Planning for this project is proceeding	Planning approval process has commenced	Advanced

Annual Planning Report	2001	2002	2003	2004	2005	2006
Constraint	Strengthening southern transmission system to address concerns regarding the performance and serviceability of existing 110kV tx from Tungatinah, Tarraleah and Waddamana to the Hobart area. Provide additional tx capacity to supply the Hobart area and improved the supply reliability and avoid constraints on generation connect to the 110kV system.	Strengthening southern transmission system to address concerns regarding the performance and serviceability of existing 110kV tx from Tungatinah, Tarraleah and Waddamana to the Hobart area. Provide additional tx capacity to supply the Hobart area and improved the supply reliability and avoid constraints on generation connect to the 110kV system.	Provides second injection point into the Hobart area and the southern part of the Transend. The project will provide more secure supply to Hobart & southern network, reduce load & reliance on Chapel St, reinforce the existing weak eastern shore supply, reduce load on Creek Rd & Chapel St circuits to Risdon,	Provides second injection point into the Hobart area and the southern part of the Transend. The project will provide more secure supply to Hobart & southern network, reduce load & reliance on Chapel St, reinforce the existing weak eastern shore supply, reduce load on Creek Rd & Chapel St circuits to Risdon,	Provides second injection point into the Hobart area and the southern part of the Transend. The project will provide more secure supply to Hobart & southern network, reduce load & reliance on Chapel St, reinforce the existing weak eastern shore supply, reduce load on Creek Rd & Chapel St circuits to Risdon,	Provides second injection point into the Hobart area and the southern part of the Transend. The project will provide more secure supply to Hobart & southern network, reduce load & reliance on Chapel St, reinforce the existing weak eastern shore supply, reduce load on Creek Rd & Chapel St circuits to Risdon,

A.7.3 Launceston Area

Table A- 29 Mowbray substation and line development

Annual Planning Report	2001	2002	2003	2004	2005	2006
Network Augmentations	Build new 110/22kV substation at Mowbray (pg68)	Build new 110/22kV substation at Mowbray (pg112)	New 110kV line from Trevallyn to a new substation site in Mowbray, a new single transformer substation with 2x20MW 22kV backup feeder connections to Trevallyn (pg54)	Mowbray 110/22kV substation and transmission line development (pg84)	Mowbray 110/22kV substation and transmission line development (pg84)	Mowbray 110/22kV substation and transmission line development (pg45)
Time	May-03	Jun-04	Jun-04	Jun-05	Dec-05	
Costs						
Status	Advanced	Advanced	In progress	In progress	In progress	Complete
Constraint	Proposed as part of the overall Launceston upgrade and also reduce loading on Trevallyn and Norwood stations	Proposed as part of the overall Launceston upgrade and also reduce loading on Trevallyn and Norwood stations	Proposed as part of the overall Launceston upgrade providing additional feeder connections to Aurora to improve distribution feeder performance and also reduce loading on Trevallyn and Norwood stations	The development of Mowbray Substation is part of the overall upgrade to electricity supply in the Launceston area	Improve reliability, security and quality of supply to Launceston, reduce loading on the Trevallyn substation and provide for load growth in the area	This has enabled the transfer of load mainly from Trevallyn Substation and also the partial transfer of load from Norwood Substation