Electricity Transmission Revenue Proposal

2008/09 – 2013/14

SP AusNet
A member of Singapore Power Group

About SP AusNet

SP AusNet is a major energy network business that owns and operates key regulated electricity transmission and electricity and gas distribution assets located in Victoria, Australia. These assets include:

- A 6,574 kilometre electricity transmission network indirectly servicing all electricity consumers across Victoria;
- An electricity distribution network delivering electricity to approximately 580,000 customer supply points in an area of more than 80,000 square kilometres of eastern Victoria; and
- A gas distribution network delivering gas to approximately 510,000 customer supply points in an area of more than 60,000 square kilometres in central and western Victoria.

SP AusNet's vision and mission are to be the best networks business delivering energy and associated services safely, reliably, responsibly and efficiently. The SP AusNet company values are:

- Commitment to the highest standards of service and performance when creating value for customers, the public, employees and shareholders
- Integrity to act with honesty and to practise the highest ethical standards
- Passion to take pride and ownership in all that we do
- Teamwork, to support, respect and trust each other, with continual learning through sharing of ideas and knowledge

The Victorian electricity transmission network is a key strategic asset servicing Australia's second largest economy and the National Electricity Market (NEM). The network serves in excess of 1.8 million households and 280,000 businesses transferring over 45 million megawatt hours of energy annually.

For more information visit: www.sp-ausnet.com.au

Contact

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1 Executive Summary

1.1 SP AusNet's Revenue Proposal

SP AusNet is pleased to provide the Australian Energy Regulator (AER) and its diverse stakeholders, with details of its plans and its Transmission Revenue Proposal for the six-year period 2008 / 09 – 2013 / 14. This executive summary provides a brief overview of SP AusNet's Transmission Revenue Proposal. The proposal reflects SP AusNet's long-term business plan.

This revenue proposal delivers

- **High network reliability meeting customers' expectations**
- **Sustainable network condition, and**
- **Substantial capital investment**
- **Competitive prices**

SP AusNet is committed to the sustainable and long-term delivery of the service and operational outcomes described in this proposal on the basis of the acceptance of the overall proposal by the AER.

It is SP AusNet's view that over the coming six years, high levels of service and relatively low pricing should continue; even in the face of significant network challenges that call for major increases in the level of capital expenditure.

The Victorian public and the wider national electricity market have been well served by SP AusNet's transmission infrastructure over the past five years. Backed by our asset management capabilities, high standards of service have been provided at relatively low prices by Australian and indeed international standards.

However, going forward it is the judgment of SP AusNet that the transmission system faces new ongoing challenges. Even with outstanding asset management practices, the fact remains many of our assets are old and due for replacement. Over the last decade, economic growth and changes in demand patterns have eliminated much of the spare capacity that had been created. And the public, as recent bushfire-related outages has reinforced, hold high expectations of continuous electricity supply.

In response to these challenges SP AusNet has a plan that includes a substantial increase in the level of capital expenditure; a program totaling more than $928 million ($836 million in 2007 / 08 dollars) over the six-year period. Despite the increase we have proposed only minor increases in pricing levels beyond inflation.

SP AusNet has confidence in the AER and the current regulatory regime, despite the risks inherent in the longer determination duration. The SP AusNet Board is supportive of the plans for reinvestment. They expect the integrity of the assets to be maintained, to ensure long-term sustainable performance.

We request that the AER, and other stakeholders, support our plans and our pricing proposals for the transmission network.

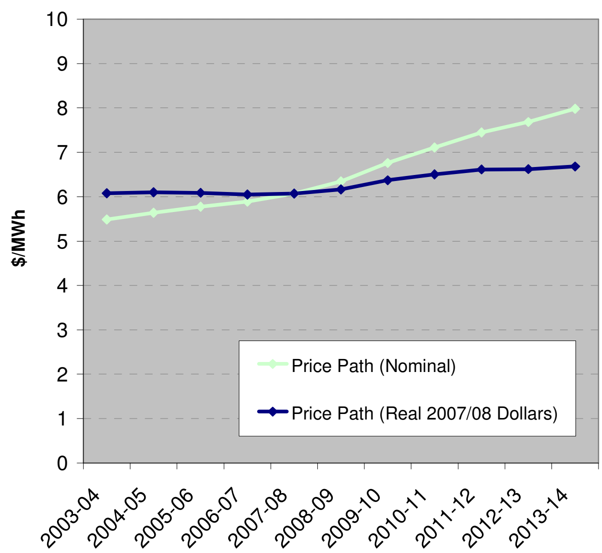
1.2 Future Price Trends

SP AusNet has the lowest charges for electricity transmission services in Australia.

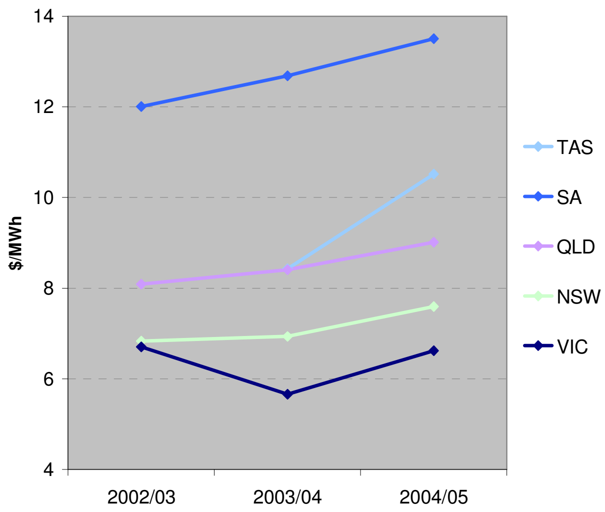
The revenue path outlined in this proposal will continue to deliver low charges to Victorian customers and ensure that the reliability and performance of the network is continually improved. Figure 1.2 illustrates the price proposal.

Figure 1.2: Future Price Path and Existing Transmission Charges

Forecast Transmission Price Path*



Transmission Charge 2002 / 03 to 2004 / 05



* Effects of the Victorian easement land tax and the roll-in of previously unregulated assets are excluded to allow a like-for-like comparison over time.

Source: SP AusNet, AER TNSP Comparison Reports.

1.3 Network Reliability

SP AusNet provides its customers with the most reliable and cost effective transmission service in the National Electricity Market (measured in system minutes off supply). The proposal outlined in this submission ensures that this level of performance is maintained, and that where possible, further enhancement is provided. SP AusNet remains committed to ensuring that high levels of reliability are maintained.

The Victorian transmission network is a mature network with a significant number of assets approaching their maximum expected life. SP AusNet monitors the condition of these ageing assets and models their replacement requirements in order to limit asset failure risk to within an acceptable band. This modelling demonstrates the requirement for an increased level of investment for the replacement of assets in the forthcoming regulatory period. The proposed investment builds on the already substantial increase in investment achieved during the current regulatory period.

Since the start of 2003, SP AusNet has invested $481 million ($506 million in 2007 / 08 dollars) to maintain the network's performance at the high levels required. This was an increase of over 180 percent on the average level of expenditure on the transmission network during the previous decade as excess capacity, built when under government ownership, became fully utilised.

1.4 Service Standards Proposals

SP AusNet has delivered large benefits to customers by increasing availability of plant during peak summer periods when market constraints and increased costs to consumers are most likely to occur. This performance has been driven by the existing service standard scheme, combined with the availability incentive scheme agreed with SP AusNet's largest customer, VENCorp.

As requested by the AER, SP AusNet is proposing new service standards to make them consistent with the rest of the National Electricity Market (NEM). The new proposal will entrench the benefits that customers already enjoy, achieved through ensuring a high level of transmission equipment availability in peak periods, while providing sufficient levels of access to the network in off-peak and intermediate periods, to allow the necessary construction and maintenance activities to be carried out. The benchmarks have been revised to reflect actual results and the planned works program.

The proposed service standards will provide the necessary linkage between performance measures and responsibilities, with incentives that will produce the desirable outcomes that the AER is seeking. These include:

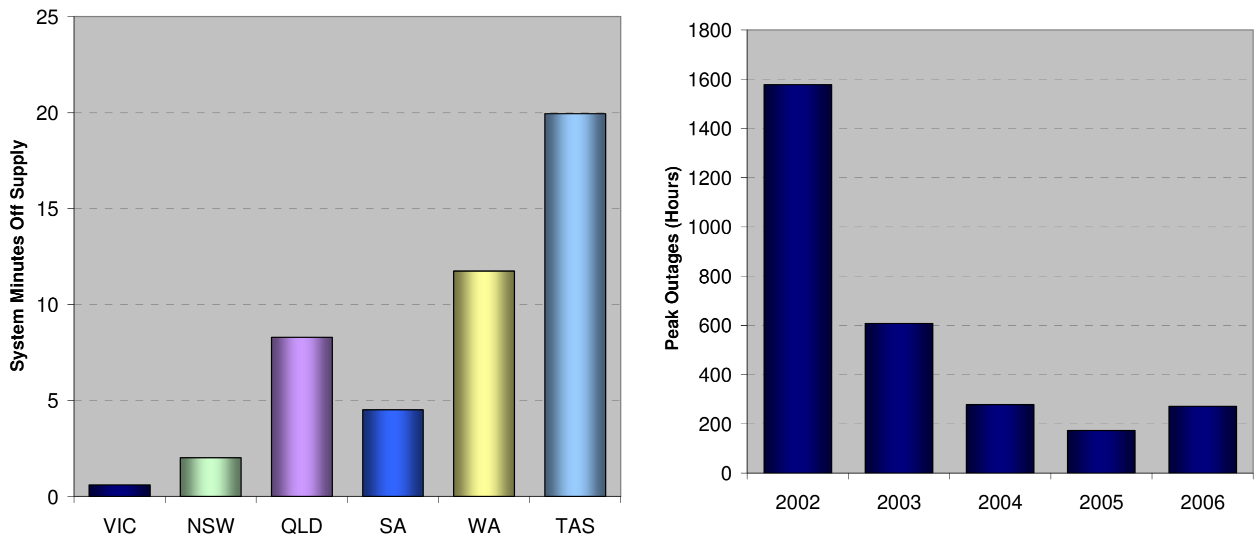
- being linked closely to actions which are controllable by the Transmission Network Service Providers;
- broadly reflecting desirable market and end-user outcomes;
- encouraging flexibility to modify outages in response to changing or unexpected events; and
- rewarding improved performance while penalising poor performance.

Figure 1.4 below illustrates the performance improvements achieved by SP AusNet over the current regulatory period, and the superior reliability of the Victorian transmission network.

Figure 1.4: Reliability and Availability

System Minutes Lost 1999/00 to 2004/05 (average per annum)

Peak Period Outages, SP AusNet, 2002 to 2006 (per annum)



Source: ESAA, SP AusNet.

1.5 Efficient Asset Management and Performance

The asset-related expenditure needs for the next regulatory period form a key component of this revenue proposal. It should be noted that SP AusNet's expenditure plans cover only the replacement capital expenditure requirements and existing regulated networks' operating expenditure, as SP AusNet does not plan augmentation of the transmission network.

SP AusNet's objective is to continue to provide transmission services in an efficient, safe, reliable and secure manner for its customers and the national electricity market, while complying with its other statutory obligations (such as environmental legislation).

As can be seen from the successful delivery of the expenditure program from the previous regulatory period, SP AusNet takes its capital expenditure program very seriously and it is an integral part of our business plan and performance objectives.

Accordingly, SP AusNet's Asset Management Strategy has been significantly enhanced to support the delivery of the following key outcomes for the customers of the Victorian Transmission Network:

- maintaining a stable and sustainable network asset failure risk profile to ensure the maintenance of supply reliability in accordance with customers' needs and preferences;
- meeting operational performance targets for network reliability and availability;
- complying both with occupational health and safety (OH&S), environmental and security legislation, codes and regulations and with operational codes and regulations; and
- optimising total capital, operating and maintenance costs over the asset life cycle.

To produce these outcomes, the asset management strategy facilitates SP AusNet's efficient management of the single most significant challenge in controlling risk and maintaining performance levels – the asset failure risk associated with the ageing of Victoria's transmission network. The asset management strategy also highlights the assets that require replacement before failures occur, based on a rigorous risk and asset condition assessment process, which identifies key asset replacement or maintenance needs.

Asset replacement is the largest single factor driving the nature and cost of the proposed expenditure plans.

SP AusNet's best-practice asset management processes enable the company to perform extremely well in terms of capital expenditure delivery and operational efficiency. Indeed, the efficiency and robustness of the company's Asset Management Strategy and related processes have been recently confirmed, through an independent review of risk management processes by Jervis Consulting[1].

SP AusNet's innovative asset management processes have enabled the company to deliver its planned capital program over the 2003 – 2007 / 08 regulatory control period within 9 percent of the allowance set at the last revenue cap review, despite a number of unanticipated major works. This assists to demonstrate the capital expenditure over the current regulatory period has been prudent and efficient.

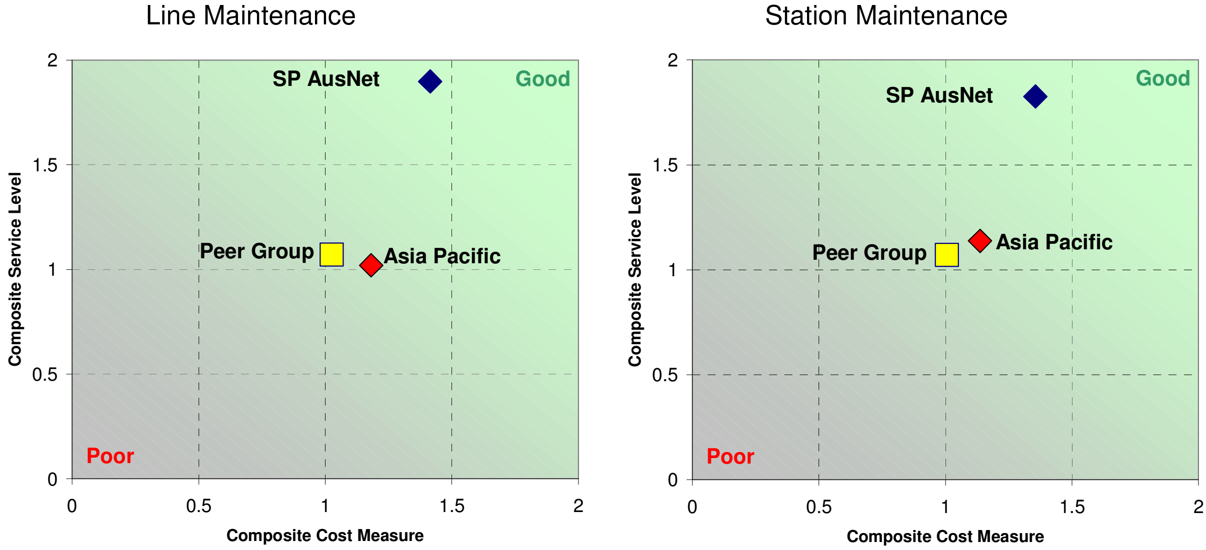
Looking forward to the forthcoming regulatory period, the Asset Management Strategy will continue to provide an effective framework to facilitate the efficient delivery by SP AusNet of a safe, reliable and secure network for customers, while also ensuring compliance with all statutory obligations.

[1] Jervis Consulting Report (Appendix A)

Benchmarking studies confirm that SP AusNet's operational effectiveness places the company at the forefront of the transmission sector in Australia and the world. SP AusNet participated in the latest round of international benchmarking – International Transmission Operations and Maintenance Study (ITOMS 2005). The results of this study indicate that SP AusNet remains one of the most cost-efficient transmission entities.

Figure 1.5 favourably compares SP AusNet's performance with the averages of international peers (companies with similar asset profiles to SP AusNet) and Asia Pacific peers (including Australia and New Zealand) in transmission line maintenance and station related maintenance.

Figure 1.5: Benchmarking



Source: ITOMS 2005 Report

SP AusNet's strong performance provides further substantiation of the prudency and efficiency of SP AusNet's asset management processes, and its work delivery processes.

1.6 Capital Expenditure Requirements

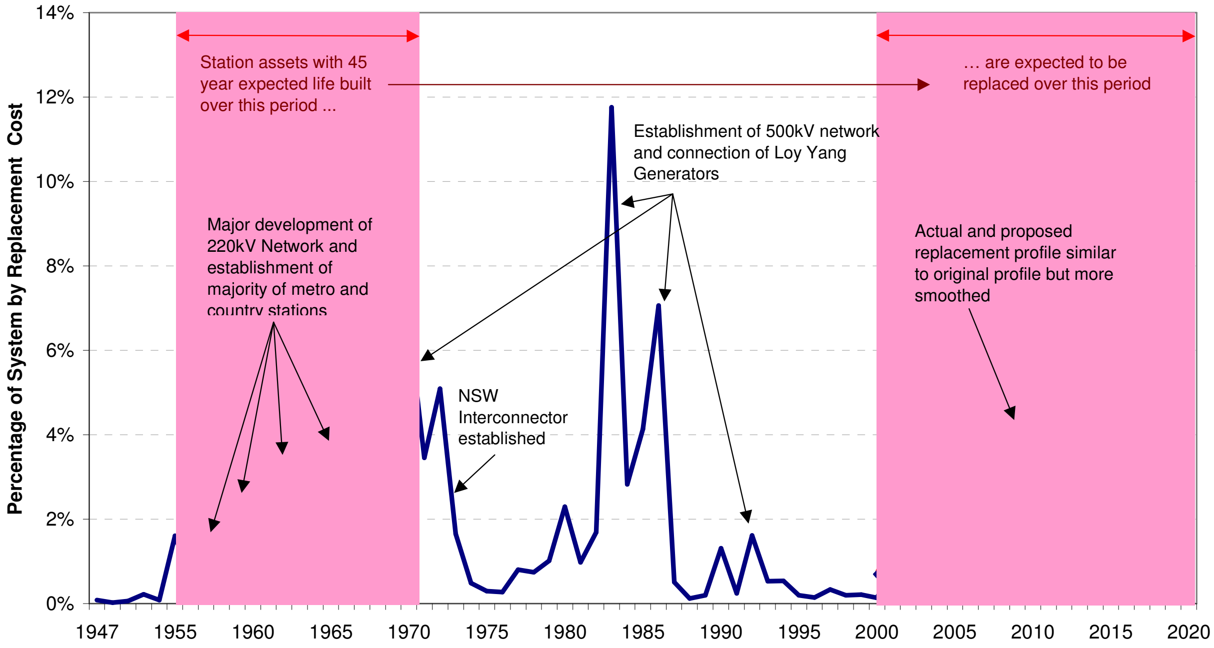
The capital expenditure program in this proposal is predominately based on the replacement of existing assets as their condition or performance deteriorates, to ensure the ongoing reliability and security of the transmission network.

The majority of SP AusNet's 220 kV system and associated 22 kV and 66 kV connection assets at terminal stations were built between 1955 and 1970. Primary Terminal Station assets are expected to last 45 years on average, with a range between 40 - 50 years, depending on the actual condition of the asset.

SP AusNet does not simply replace like with like, but coordinates and integrates asset replacement with augmentation and customer initiated proposals. This is to ensure capital expenditure to meet demand forecasts is optimised.

Figure 1.6 highlights the increasing need for the replacement of aged and unreliable assets based on the initial service dates of the key transmission stations and lines that make up the Victorian transmission network.

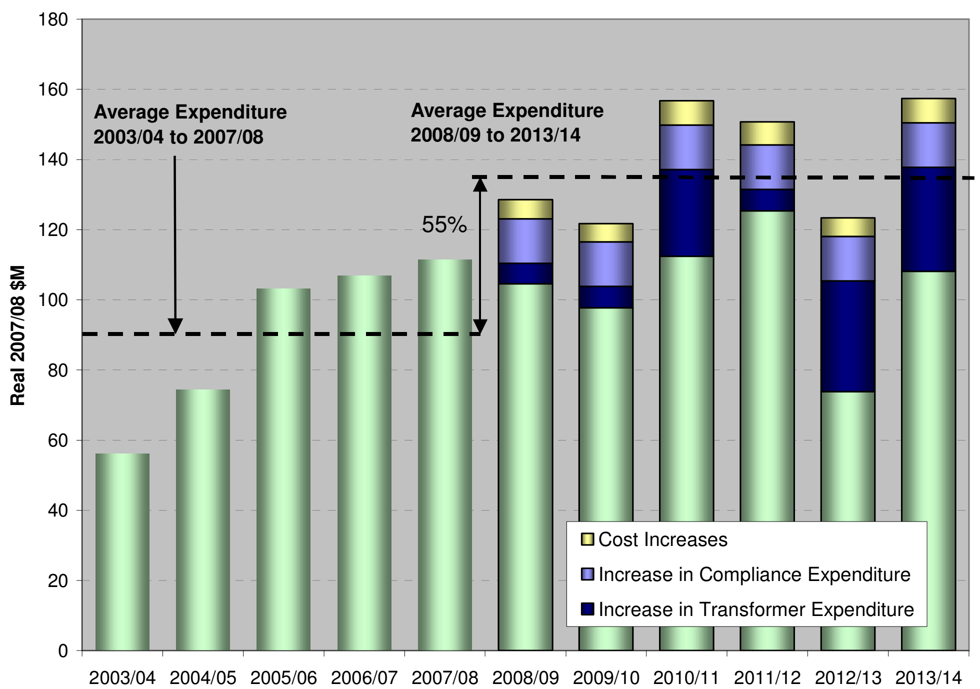
Figure 1.6.1 Relationship Between System Development and Replacement



Source: SP AusNet

The proposed non-augmentation capital expenditure program represents a 55 percent real increase in the capital program for the period 2008 / 09 to 2013 / 14 (refer Figure 1.6.2).

Figure 1.6.2 Non-Augmentation Capital Expenditure 2003/04 to 2013/14 (Real 2007/08 $m)



* Actual to December 2006, forecast to 2013/14.

Note: Capital expenditure as commissioned (6 months IDC excluded)

Source: SP AusNet

Additional factors driving the increase in capital expenditure in the forthcoming regulatory control period include:

- more difficult and complex rebuilding work at confined city sites, where supply must be fully maintained throughout the renewal work, and conversion to more expensive compact gas-insulated switchgear to allow room for asset expansion at these confined sites to meet future demand;
- a substantial increase in the number of transformers being replaced over the period, which will rise from 12 to 40; and
- more demanding safety, environmental and security requirements. Consumer, workforce and public expectations in each of these areas continue to reflect higher standards, requiring utilities to provide additional facilities to meet these requirements.
- high material and equipment costs associated with increased commodity prices and increasing demand pressures from worldwide infrastructure investment; and
- strong competition for skilled labour associated with the substantial growth in infrastructure and resource development in Australia.

The proposed capital expenditure (capex) program for the forthcoming regulatory period continues and builds on the successfully completed capex program for the current regulatory control period. In fact, the company's previous revenue cap application in 2002 clearly foreshadowed the need for increasing levels of capital expenditure in future regulatory periods.

Representing an optimal balance of the costs of asset replacement and maintenance on one hand, and the risk and costs of deteriorating reliability and asset performance on the other, the capital expenditure program is aimed at ensuring the ongoing maintenance of network reliability and service in accordance with customers' needs, whilst minimising the total life cycle cost of service.

1.7 Operating Expenditure Requirements

SP AusNet has delivered considerable efficiency savings during the current regulatory period, which will flow to consumers during the forthcoming period. SP AusNet's operating expenditure (opex) from the current regulatory period averaged 11.9 percent below the AER benchmark. Much of the efficiency saving was driven by one-off synergy benefits from the merger of SP AusNet's transmission and distribution businesses. As such, savings of this magnitude are unlikely to occur in the future.

SP AusNet also achieved substantial savings for recurrent routine maintenance costs as the replacement capex program was rolled out, averaging 24.5 percent below the AER benchmark. These savings have been generated through changed work practices and investment in improved systems. Again, the easiest efficiency gains have been achieved and are unlikely to occur in the future at this rate.

In addition, a range of major repair programs have been identified as necessary during this six-year period, that are not of a recurring nature. These major operational expenditure programs cannot be benchmarked against the previous period, and have therefore been separately costed.

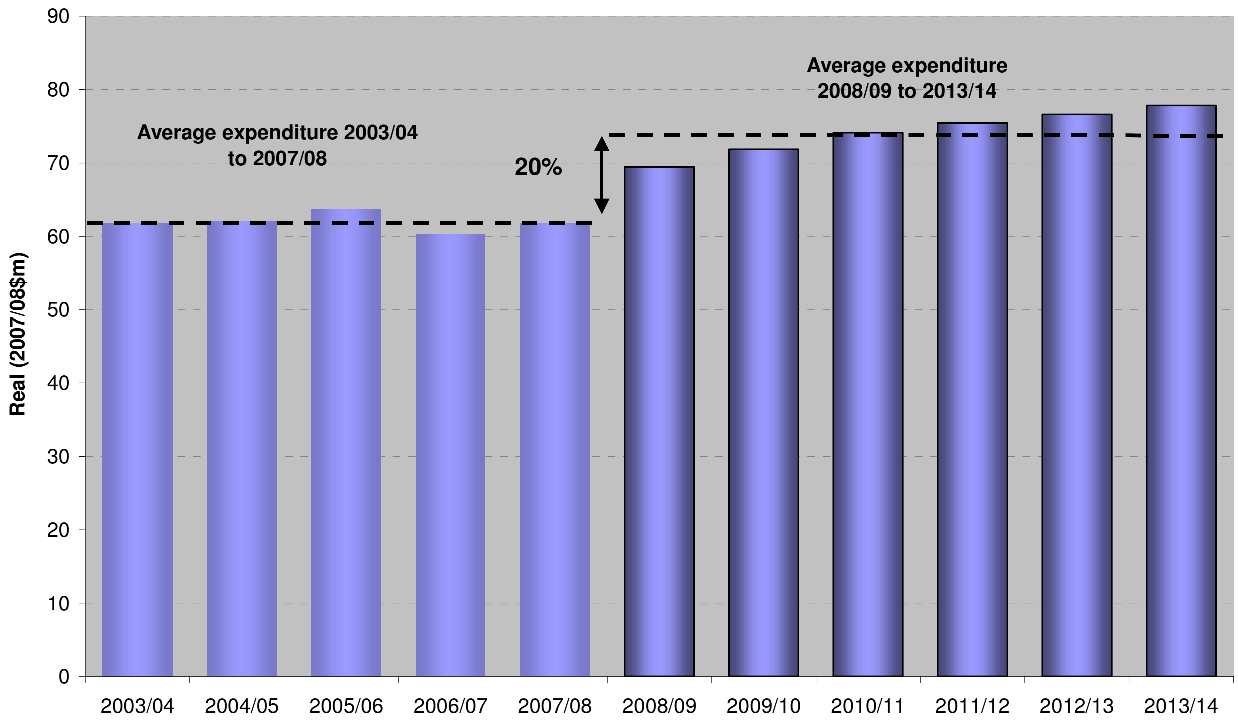
The asset works program between 2008 / 09 and 2013 / 14 will continue to focus on managing operational risk to within an acceptable band through:

- repair and prevention of tower corrosion through painting and component replacement;
- significant repair or refurbishment projects for switchgear, gas insulated switchgear refurbishment and repairs to power cables and instrumentation;
- reduction in occupational health and safety and environmental risk, through asbestos removal programs, switchyard resurfacing, removal of lead contamination and repair of transformer oil leaks; and
- infrastructure maintenance, advanced condition monitoring and miscellaneous works.

The present strong competition for skilled labour due to the resource and construction boom will continue to place upward pressures on the costs of efficiently procuring and deploying operating and maintenance resources. Despite these pressures, SP AusNet plans to deliver an efficient overall opex program in the forthcoming regulatory period at a total cost that represents a modest increase on the actual opex incurred in the current period.

Expenditure for the forthcoming regulatory period is only expected to increase by 20 percent in real terms. In addition, it is noteworthy that opex benchmarking analyses outlined in section 1.5 demonstrate SP AusNet's operational efficiency. This provides additional confidence that the proposed opex for the forthcoming regulatory period is efficient and consistent with delivering appropriate compliance and service outcomes. Figure 1.7 illustrates the opex profile over the current and future regulatory period.

Figure 1.7 Total Operating Expenditure 2003/04 to 2013/14 (Real 2007/08 $m)



* Actual to December 2006, forecast to 2013/14

* From 2003/04 to 2007/08 excludes easement tax, glide path for opex, debt and equity raising costs and rebates, from 2007/08 to 2013/14 excludes easement tax, glide path for opex, debt and equity raising costs and rebates, however, it includes SP AusNet's claim for self-insurance.

Source: SP AusNet

1.8 Easement Land Tax

In 2004, the Victorian Government extended land tax to electricity transmission easements owned by electricity transmission companies in Victoria. This revenue proposal includes a forecast for the land tax for each year of the regulatory period. However, any positive or negative variation between the actual tax paid and the forecast adopted by the AER will be recovered or reimbursed, as appropriate, through the pass-through mechanism outlined in Clause 6A.7.3 of the National Electricity Rules (NER). Therefore, SP AusNet will only recover the actual tax paid over the period.

This is consistent with the undertakings given by the Victorian Government at the time the tax was introduced, and the process was established by the Australian Competition and Consumer Commission (ACCC) in treating this issue during the previous regulatory period.

1.9 Return on Capital

The importance of the rate of return for a capital-intensive business with long-lived assets underpins the application of a conservative approach where there is uncertainty surrounding the estimation of the rate of return. In the longer term, consumers' interests are protected by ensuring adequacy and consistency in the rate of return available to investors in Australian energy infrastructure.

SP AusNet notes that there is a substantial body of regulatory precedent in relation to the rate of return applied to Australian infrastructure assets. This has been reflected in the methodology and parameters for this review, which are prescribed in Chapter 6 of the National Electricity Rules.

The Weighted Average Cost of Capital (WACC) is calculated according to those prescribed methodology and parameters. The nominal vanilla WACC used for the proposal is 8.85 percent. The equivalent real vanilla WACC is 5.66 percent. These values will be updated to reflect prevailing capital market conditions at the time of the AER's Final Decision on SP AusNet's revenue cap.

1.10 Return of Capital (Depreciation)

Under Clause 6A.6.3 of the National Electricity Rules, depreciation schedules must use a profile that reflects the nature of the category of assets over the economic life of that category of assets.

SP AusNet has depreciated each asset category in the Regulated Asset Base (RAB) on a straight-line basis over the economic life proposed. As per Clause 6A.6.3, SP AusNet has followed standard practice by assigning a regulatory life to assets that equate to their expected economic or technical life. In general, the regulatory, economic and technical lives of an asset coincide.

In this revenue proposal SP AusNet has modified the regulatory lives in some asset categories from those used in the previous regulatory control period. The intention is to better reflect the true economic life of the secondary asset base by shortening the economic life from 25 years to 15 years, consistent with other Transmission Network Service Providers. This is driven by:

- the substantial replacement of analogue secondary equipment;
- the shorter life of "off the shelf" digital equipment; and
- the SCADA systems and Remote Terminal Units (RTU) in the secondary asset base having a technical life closer to 10 years.

SP AusNet has also aligned the regulatory and statutory lives for information technology and business support costs to better reflect realistic expectations of asset lives.

1.11 Conclusion

This proposal outlines the revenue requirement for SP AusNet to operate its transmission business and provide its transmission services to customers.

The revenue requirement has been carefully determined to ensure continuing high levels of asset performance and reliability, whilst optimising the mix and timing of expenditure to ensure that total life cycle costs are minimised. Victoria's average transmission prices will remain stable and the most competitive in Australia.

The annual revenue requirement has been constructed using the post-tax nominal building block approach in accordance with Chapter 6 of the National Electricity Rules and the relevant AER Guidelines and Models.

The forecast for each of these components is presented in the Table 1.11, together with the CPI - X smoothed revenue requirement.

Table 1.11 Revenue Requirement, 2008/09 to 2013/14 (nominal $m)

$M Nominal	**Financial years ending 31 March**					
	2008/09	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**
Return on capital	197	206	214	223	232	241
Depreciation	*111*	*121*	*130*	*139*	*147*	*144*
Indexation	*-67*	*-70*	*-73*	*-76*	*-79*	*-82*
Net Economic Depreciation	44	51	57	63	68	62
Opex	82	87	92	97	101	105
Glidepath	9	7	6	4	2	0
Net tax allowance	14	14	15	15	16	15
Total Revenue (Net of ELT)	**345**	**365**	**384**	**402**	**419**	**423**
Easement Land Tax (ELT)	84	90	96	103	111	119
Total Revenue (Inclusive of ELT)	**429**	**455**	**481**	**505**	**530**	**542**
Smoothed revenue requirement	**420**	**446**	**474**	**504**	**536**	**570**

Source: SP AusNet forecasts

NOTE: NUMBERS IN TABLES MAY NOT ADD TO TOTAL DUE TO ROUNDING.

2 Introduction and Background

2.1 Purpose, Structure and Coverage of this Document

This document sets out the revenue proposal for the Victorian electricity transmission network assets owned and operated by SPI PowerNet Pty Ltd (trading as SP AusNet), which provide prescribed transmission services.

This revenue proposal covers the regulatory control period commencing on 1 April 2008 and ending on 31 March 2014. A six-year period will smooth the future workload of both SP AusNet and the Australian Energy Regulator.

For the avoidance of doubt, the prospective costs and revenues associated with any non-contestable network augmentations undertaken over the regulatory control period commencing on 1 April 2008, fall outside of the revenue cap which is the subject of this revenue proposal.

This revenue proposal is submitted in accordance with, and complies with the requirements of Chapter 6A – Economic Regulation of Transmission Services – of the National Electricity Rules (NER) and relevant Guidelines issued by the Australian Energy Regulator (AER). All numbers presented in this proposal are calculated on a GST exclusive basis.

The structure of this document is as follows:

- The remainder of this chapter provides: an overview of the transmission system in Victoria; a brief description of the role of SP AusNet in the Victorian transmission sector; and an outline of the organisational arrangements adopted by SP AusNet to maximise its business efficiency. This background information is intended to enable a clear understanding of the context in which this revenue proposal is made.
- Chapter 3 explains SP AusNet's asset management practices, that the capital expenditure has been efficient and prudent and demonstrates its overall cost and service performance against international benchmarks.
- Chapter 4 describes the service outputs to be delivered and the compliance obligations that must be addressed in the forthcoming regulatory control period.
- Chapters 5 and 6 describe SP AusNet's capex and opex proposals in light of recent expenditure levels and future network requirements.
- Chapter 7 calculates the regulated asset base for the forthcoming regulatory control period.
- Chapter 8 describes the depreciation allowance.
- Chapter 9 explains SP AusNet's capital financing costs and taxation.
- Chapter 10 applies an efficiency gain sharing mechanism in respect of opex efficiencies achieved during the current regulatory control period.
- Chapter 11 presents SP AusNet's total revenue requirement for the forthcoming regulatory control period and the resulting transmission price path.

2.2 Overview of the Victorian Transmission System

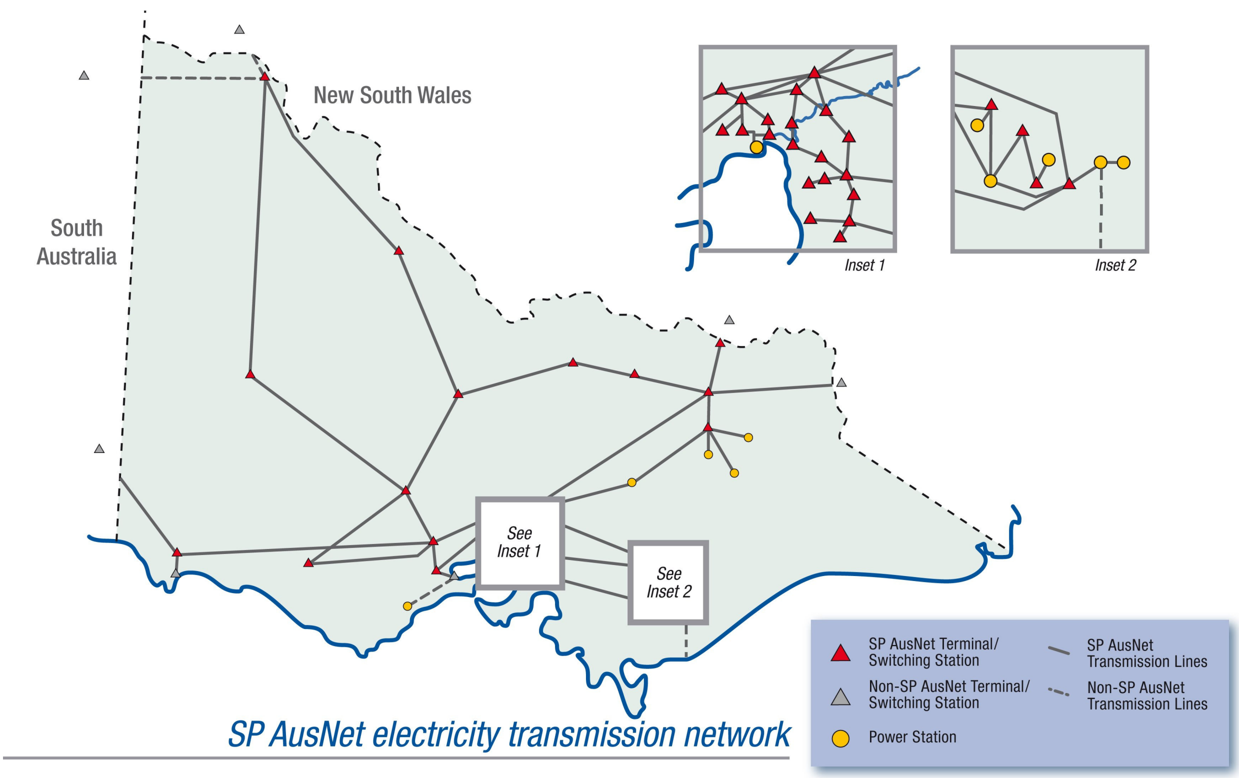
SP AusNet's electricity transmission network interconnects generators, distributors, high voltage customers and the transmission systems of the neighbouring States of New South Wales, South Australia and Tasmania. This network serves all of Victoria, covering an area of approximately 227,600 square kilometres and a population of over 5 million people[2].

In Victoria, the major transfer of power is between the coal and gas-fired generators in Gippsland, hydro-electric generators in the Victorian Alpine Region and the significant load centres of Melbourne, Geelong and the Portland aluminium smelter.

As illustrated in Figure 2.2.1, a 500 kV network backbone, running from the Latrobe Valley through to Melbourne and across the south-western part of the state to Heywood, serves the major load centres. This network is reinforced by:

- A 220 kV ring around Melbourne supplying 220 kV / 66 kV / 22 kV terminal stations;
- Inner and outer rings of 220 kV / 66 kV / 22 kV terminal stations in country Victoria supplying the regional centres; and
- Interconnections with New South Wales, South Australia and Tasmania

Figure 2.2.1 SP AusNet's transmission network – Victoria



Source: SP AusNet

Metropolitan Melbourne is served by 500 kV and 220 kV networks which receive power from major generators in the Latrobe Valley, the Victorian hydro-electric power stations, the gas-fired Newport power station and the interstate links.

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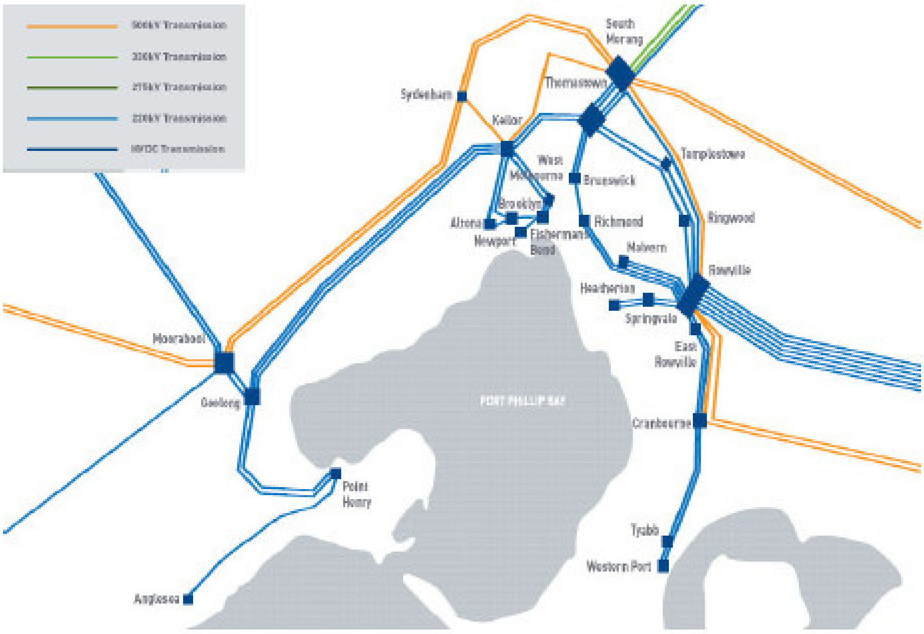
[2] Australian Bureau of Statistics, June 2006

The Melbourne metropolitan area transmission network is illustrated in Figure 2.2.2.

Figure 2.2.2   SP AusNet transmission network – metropolitan Melbourne



Source: SP AusNet

The Latrobe Valley to Melbourne transmission link comprises four 500 kV lines and six 220 kV lines. The 500 kV network supplies power from Loy Yang and Hazelwood power stations to Keilor, South Morang, Rowville and Cranbourne Terminal Stations. The 220 kV network transfers power from the Hazelwood and Yallourn generation units into the eastern metropolitan area at Rowville Terminal Station.

The 500 kV / 220 kV transformation added at Rowville Terminal Station in 1999 and Cranbourne Terminal Station in 2006 have provided the additional network capacity needed to service the continuing demand of the south-eastern metropolitan growth corridor.

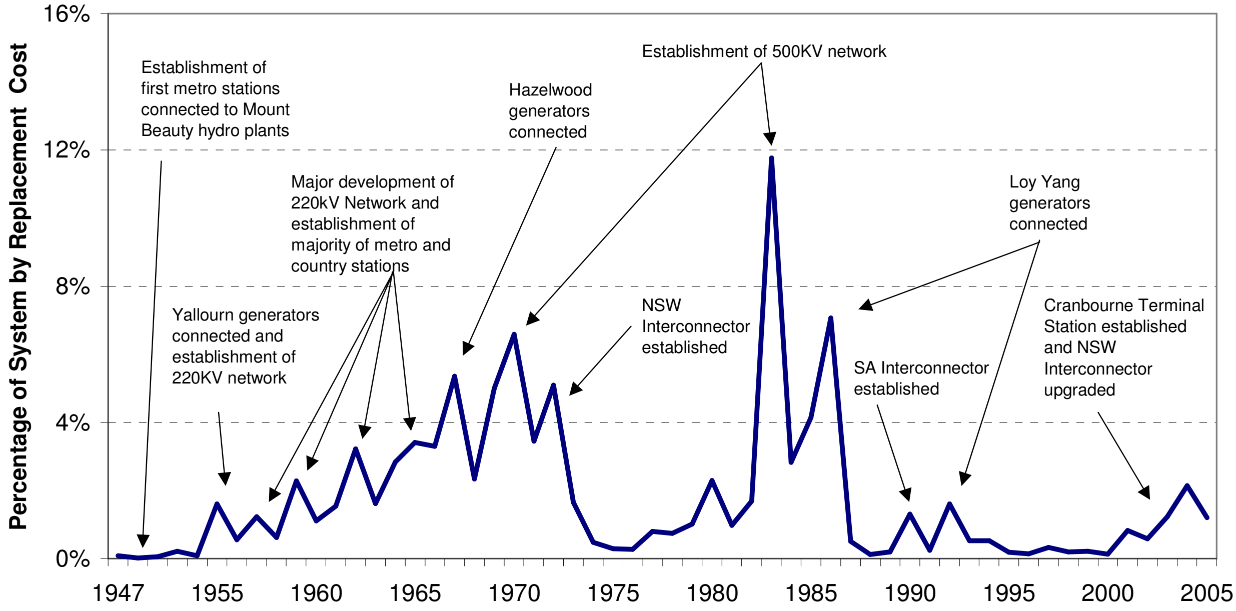
Supply from New South Wales and the Snowy Mountains generators is via two 330 kV lines from Dederang Terminal Station in Victoria's north-east to the South Morang Terminal Station on Melbourne's northern perimeter. A 220 kV system connects the Southern Hydro generators at Kiewa, Eildon and Dartmouth to Thomastown Terminal Station.

Springvale, Heatherton, East Rowville, Tyabb and Malvern Terminal Stations derive their supply from radial single tower, double-circuit 220 kV transmission lines to minimise the amount of land required for energy transmission in the metropolitan area.

Transmission links between Newport Power Station and Fishermen's Bend Terminal Stations and between Brunswick and Richmond Terminal Stations have increased the number of supply routes for the inner suburbs and the Central Business District.

The historic development of the SP AusNet transmission network is shown in Figure 2.2.3. The major development milestones are also highlighted. Figure 2.2.3 shows the relatively large amount of network development and investment that took place in the 1960s through to the early 1970s. Many of these assets installed over this period are approaching the end of their technical lives, and this will lead to an increasing need for the asset replacement expenditure over the next decade and beyond.

Figure 2.2.3 Historical Development of Victorian Transmission System



Source: SP AusNet

2.3 Transmission Arrangements in Victoria

Under the disaggregation and privatisation of the Victorian Electricity Industry during the 1990s, responsibility for transmission was split between:

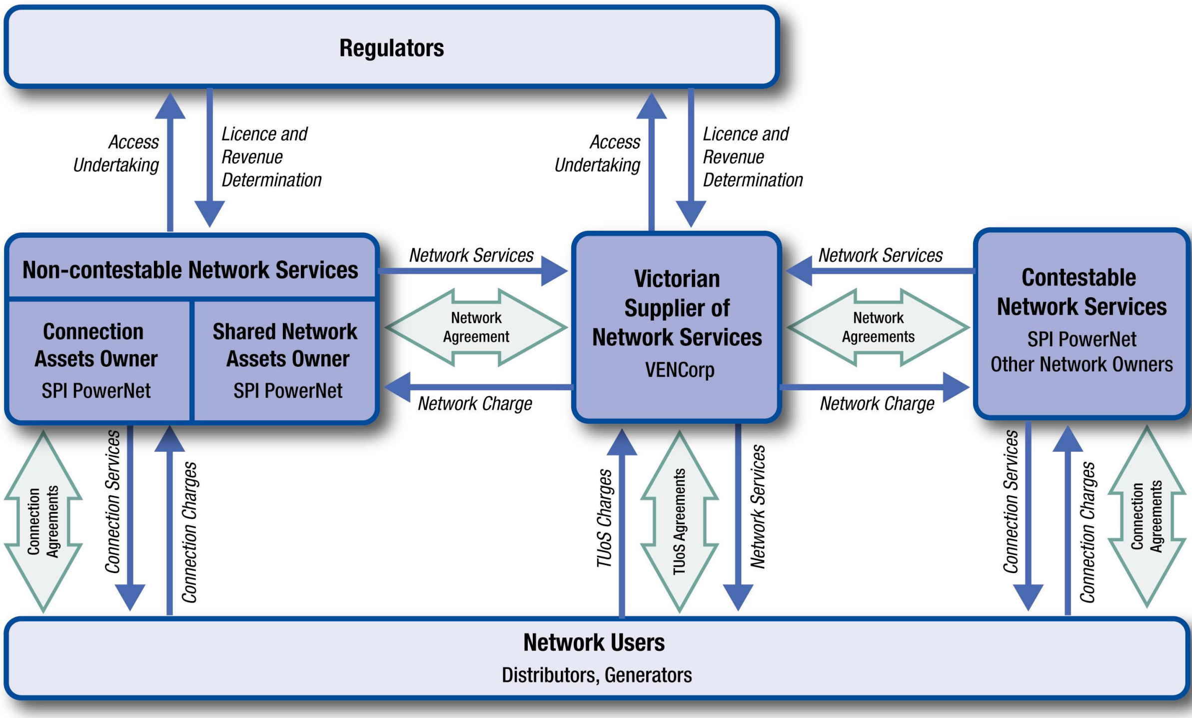
- VENCorp (then VPX), which is the body solely responsible for planning the shared network[3] and procuring network support and shared network augmentations;
- the asset owner, SP AusNet (then PowerNet Victoria); and
- the transmission customers (distribution companies, generation companies and directly-connected industrial customers) which are responsible for planning and directing the augmentation of their respective transmission connection facilities.

These arrangements differ from other states in Australia, where planning and responsibility for augmentation is not separated from the incumbent transmission company (although independent planning oversight occurs in South Australia). These arrangements have implications for the definition of SP AusNet's prescribed services, which are subject to the revenue cap proposed in this document.

[3] The shared transmission network is the main extra high voltage network that provides or potentially provides supply to more than a single point. This network includes all lines rated above 66 kV and main system tie transformers that operate between two voltage levels above 66 kV.

The relationships between these parties and the Regulators are shown in Figure 2.3.1.

Figure 2.3.1: Regulatory and commercial relationships



Source: SP AusNet

VENCorp is a government-owned organisation responsible for:

- procuring bulk shared network services from SP AusNet and other providers;
- Providing transmission use of system services to transmission customers (including administering transmission pricing); and
- planning and requisition of augmentation to the shared transmission network.

The responsibilities of the parties within the Victorian structure for electricity supply are set out in Victorian legislation, the licences, guidelines and codes administered by the Essential Services Commission and Victorian derogations in Chapter 9 of the National Electricity Rules (NER). Together these describe the Victorian model for procurement and provision of transmission services in Victoria.

A feature of the regime is the ability for significant augmentations to be sourced on a competitive basis by the parties responsible for planning and directing the augmentation of the transmission network. In these circumstances, SP AusNet competes with other providers for the right to construct, own and operate the augmentation. Any transmission service provided by SP AusNet on a contestable basis is a “non-regulated transmission service” and, pursuant to clause 6A.1.1 of the NER, these services are not subject to regulation under Chapter 6A of the NER.

Many transmission network augmentations are not suited to being procured on a contestable basis because of their high level of integration with the existing network. In such cases, the planner and director of augmentation (namely, VENCorp or a distributor) requests SP AusNet to provide the augmentation on a non-contestable basis.

The scope, specification and timing of these services is not the responsibility of SP AusNet and these are established by SP AusNet in accordance with the Victorian arrangements and are not prescribed services in respect of SP AusNet under Chapter 6A of the National Electricity Rules (NER). Therefore, costs and revenues associated with any non-contestable augmentations that are undertaken within a regulatory control period sit outside the revenue cap for that regulatory period.

However, in other respects these services satisfy the definition of prescribed services, and NER clause 11.6.21 has been included during the recent development of new Rules for the regulation of transmission revenues. It provides for these non-contestable projects, developed within a regulatory period, to be added to the Regulatory Asset Base (RAB) at the commencement of the subsequent regulatory period, so that from that time they then form part of SP AusNet's revenue capped prescribed services. Chapter 7 outlines the non-contestable prescribed services that are to be added to the RAB for the forthcoming regulatory control period.

2.4 Organisational Arrangements

2.4.1 Management Company

'SPI Management Services', a wholly owned subsidiary of Singapore Power International Pte Ltd has entered into a Management Services Agreement with SP AusNet Networks (Transmission) Ltd and SP AusNet Networks (Distribution) Ltd. This agreement is to last for ten years but includes rights of termination to all parties under certain circumstances.

The Management Company provides the following services to SP AusNet[4]:

- Employee management;
- Business management;
- Evaluation of business opportunities;
- Management of regulatory compliance and relations with regulators;
- Financial and accounting management;
- Asset Management Strategy;
- Management of information technology;
- Management and coordination of maintenance & engineering services;
- Public and investor relations;
- Legal and company secretarial services; and
- General administration and company reporting.

This structure is designed to allow flexibility and the strategic ability to undertake new projects as and when they arise in the future. However, all the costs incurred in this management services agreement are costs that would be incurred by any transmission service provider.

The management company is reimbursed for the costs of providing these services through the service fee and receives further revenues under incentive arrangements. It is only elements of the service fee that are passed through into the regulated costs. None of the incentive arrangements result in a cost to the transmission business.

[4] As per SP AusNet Prospectus and Product Disclosure Statement

SP AusNet has allocated only the costs related to the provision of services to the transmission business into the regulatory accounts and not the price of the contract itself. This is to ensure that only appropriate costs are included within the base from which the forecast for the next regulatory period is developed.

2.4.2 Related Party Contracts

SP AusNet's only contract with a related party is the Management Services Agreement, as outlined above. As noted, SP AusNet reports costs on the basis of actual costs allocated to and associated with the provision of prescribed transmission services. These costs are clearly disclosed in the information provided as part of this revenue proposal for the forthcoming regulatory control period. The efficiency incentives that form part of the AER's economic regulatory framework allow the AER and stakeholders to be confident that SP AusNet's revealed costs are efficient.

Outsourcing arrangements are undertaken only where careful analysis demonstrates that such arrangements can be expected to result in a lower cost of service delivery than could be achieved from the provision of these services in house, or where the requirement for program services exceed internal capacity.

The extent of the cost reductions achieved by SP AusNet and revealed in the regulatory accounts demonstrates that the efficiency incentives are working to ensure the delivery of services to customers in accordance with their needs and preferences, at the lowest sustainable cost.

2.4.3 Allocation of Costs between Networks

The regulatory accounts relating to the electricity transmission business include only the share of SP AusNet's total costs that relate to the transmission business. Where possible this is done on a direct causal basis. Where shared costs cannot be directly attributed to the transmission network then an appropriate driver is used, given the nature of the cost, to allocate the shared cost between SP AusNet's networks (for example, relative RAB value, relative employee numbers).

2.4.4 Allocation of Costs between Regulated / Unregulated Segments

The regulatory accounts relating to the electricity transmission business only include regulated costs. All unregulated costs are allocated to unregulated activities at the time of deriving the regulatory accounts for the electricity transmission business.

3 Efficient Asset Management and Performance

3.1 Introduction

This chapter demonstrates that SP AusNet's advanced asset management processes enables the company to perform effectively in terms of capital expenditure allocation, delivery and benchmarking. As noted in further detail in this chapter:

- SP AusNet's sound asset management processes have enabled the company to deliver its planned capital program over the 2002 / 03 – 2007 / 08 period, ensuring that the network continues to meet the high standard of performance expected by customers. This has been achieved within 9 percent of the allowance set at the last revenue cap review, despite a number of unanticipated major works identified through the ongoing review of key network needs. This demonstrates the prudence and efficiency of the company's actual capex over the 2002 / 03 – 2007 / 08 period; and
- The effectiveness, efficiency and robustness of the company's Asset Management Strategy and related processes have been recently confirmed through an independent review of risk management processes by Jervis Consulting.

The chapter is structured as follows:

- Section 3.2 provides an overview of SP AusNet's approach to asset management, including its Asset Management Strategy;
- Section 3.3 outlines SP AusNet's asset management documentation and process;
- Section 3.4 demonstrates that SP AusNet's asset management processes benchmark well compared to other transmission companies;
- Section 3.5 provides a high-level description of the capital projects completed during the current regulatory control period, in accordance with the Company's asset management strategy and plans. This information is intended to assist the AER in conducting its review to enure that expenditure has been prudent; and
- Section 3.6 concludes the chapter by presenting cost and service benchmarking information that confirms SP AusNet's strong operational performance and efficiency, thereby providing further evidence of the company's prudent and efficient asset management and operational practices.

3.2 Overview of SP AusNet's Approach to Asset Management

3.2.1 Background

The overall reliability and security of the transmission network is critically dependent on the continuous and trouble-free operation of all the individual items of plant that, together, form the transmission network. The design of the transmission system generally allows an outage of a single item of plant without any impact on reliability (supply to customers). However, such an outage will impact on security (the ability of the system to withstand further events).

Unexpected plant failures at times of system stress, or during other plant outages, may lead to customer outages or prolonged periods of reduced security. An equipment failure can place substantial load at risk (reducing system security) or even result in loss of supply arising directly from the failure itself, or because of the need to shed load to return the system to a secure operating state. Explosive failures of plant are of particular concern because of obvious health and safety risks, and because it can also result in failure of adjacent plant, often rendering it unavailable for service on a prolonged basis, due to damages sustained in an explosion.

In view of these considerations, a key purpose of the asset management strategy is to identify necessary equipment replacement actions in advance of any such potential failure. This is achieved through a careful assessment of the potential risk of failure for each plant item, and repairing or replacing deteriorating equipment before a failure occurs.

Every asset on the system has a risk of failure related to condition. The risk associated with each plant item depends on the possibility that the individual asset may fail, and the impact on the network and network users in the event that the failure did occur. The possibility that an item of plant may fail depends on the age and condition of the equipment, while the impact of a failure will vary substantially depending on its location and the loading of the transmission network.

3.2.2 SP AusNet's Asset Management Strategy

SP AusNet's vision is to be the best network business. To achieve this vision, SP AusNet aims to provide transmission network services in the most reliable, efficient, safe and environmentally responsible manner as possible.

The company recognises that it must continually seek to improve its performance to achieve this vision. Accordingly, SP AusNet is clearly focused on continual performance improvement. The Asset Management Strategy provides the framework within which specific actions can be planned and executed to ensure that the company achieves its objective of reliable, efficient, safe and environmentally responsible service provision.

Specifically, the Asset Management Strategy aims to deliver the following key outcomes for the Victorian transmission network and its customers:

(1) maintaining a stable and sustainable network asset failure risk profile to ensure supply reliability in accordance with customers' needs and preferences;

(2) meeting operational service targets for network reliability and availability;

(3) complying with operational codes and regulations and with occupational health and safety, environmental and security legislation, codes and regulations; and

(4) optimising total capital, operating and maintenance costs over each asset's entire life cycle.

3.2.3 Efficient Risk Management Approach to Asset Management

SP AusNet has adopted a rigorous approach to identifying necessary asset replacement. This approach recognises that while asset age is a key indicator of the need for replacement, the key determinant is the condition of the asset. Asset condition will deteriorate with age, but may also depend of other factors, including for example the location of the assets, and specific operating requirements or duty cycles that differ from normal.

The development of the asset replacement program takes into account both the condition of the asset, and the implications of failure.

3.2.3.1. Consequence

The impact of failure of each particular asset within an asset class may differ considerably and it may impact very differently on customers. As an example, where there is redundancy in the network design, an outage may be tolerated without any customer outages, while in the case of dedicated plant items an outage would result in outages for customers that are supplied from the dedicated plant item.

Consequence of failure models are constructed for each individual asset based on its location within the overall network and the credible outcomes that would arise from a major failure in terms of reliability, availability, health, safety, environment and code compliance. Consequence models are calibrated to the outcomes of recent failures as recorded in System Incident Reports.

3.2.3.2. Asset Condition and Probability of Failure

Assigning an accurate probability of failure to each individual asset is achieved through the following process:

- Standard probability of failure (PoF) curves are defined, which relate the probability of failure to the length of time an asset has been in service. These curves are developed for each class of asset based on a variety of information and experience. A “base” curve is established which represents the characteristic for a “typical” asset within the category operating in a “typical” environment. At least, in principle, it could be expected that the service period on this curve that aligned to the point at which the probability of failure reaches an unacceptable level, would be the technical life that is assigned to this asset class.
- A family of curves are developed to cover circumstances where asset condition degrades at different rates to the typical case. Differences may arise where the operating environment differs from average for different operating requirements, as a result of a specific incident that impacted on the particular item of plant, or through type or design problems that emerge for the plant item.
- Curves are established which show the impact where the above factors have combined to result in more rapid degradation of asset condition (a more rapid increase in the probability of failure than would be typical for this asset) or a slower degradation of asset condition (reflected through a slower increase than average in the probability of asset failure). This results in failure probability curves for each asset fleet which may be viewed as a “short life” asset failure curve and a “long life” asset failure curve, with intermediate curves defined as required.

An assessment is made for each individual plant item based on maintenance records, system incident reports, equipment defect reports, the experience of SP AusNet’s engineers, information from manufacturers and advice from other transmission utilities.

This information is used to identify the appropriate probability of failure curve to be used as the basis for the condition assessment. It is then possible to assess each asset to determine whether or not it is approaching the point where the probability of failure becomes unacceptably high.

It is important to recognise that the point where the probability of failure becomes unacceptable may differ for individual assets within an asset fleet or class, depending on the potential impact of the failure. This information is taken into account when making the assessment of whether the probability of failure has reached the “critical” point for each particular asset.

The probability of failure curves are developed from experience and understanding of the performance and life of the relevant plant items. This is augmented by a calibration process where the “mean time between failure” which is predicted by the curve is calibrated with the outcomes from historical outage information for the asset fleet.

3.2.4 Optimising Total Life Cycle cost

One of SP AusNet’s key objectives is to provide transmission network services in the most efficient manner (consistent with other objectives) by optimising total life cycle costs. SP AusNet’s Asset Management Strategy ensures that its overall expenditure and work plans minimise life cycle costs using detailed cost-benefit analyses.

SP AusNet’s cost-benefit analyses use discounted cash flow analysis techniques (in accordance with the reliability limb of the regulatory test), for all major projects where costs can reasonably be estimated (estimation declines in accuracy towards the end of the forecast regulatory period). These costs include capital costs, operational risks and operating and maintenance costs. The assessment includes a quantitative estimate of the value of reliability, taking the risk of plant failure and the consequences of unserved load (namely, the cost to consumers of involuntary supply interruption), and reduced network performance into account as part of each asset management decision.

In addition to developing least-cost options for addressing specific equipment issues, careful attention is paid to ensure that overall program costs are minimised when specific solutions are consolidated into overall opex and capex plans. These plans incorporate additional work scheduling efficiencies for the entire planning period by integrating projects, where possible.

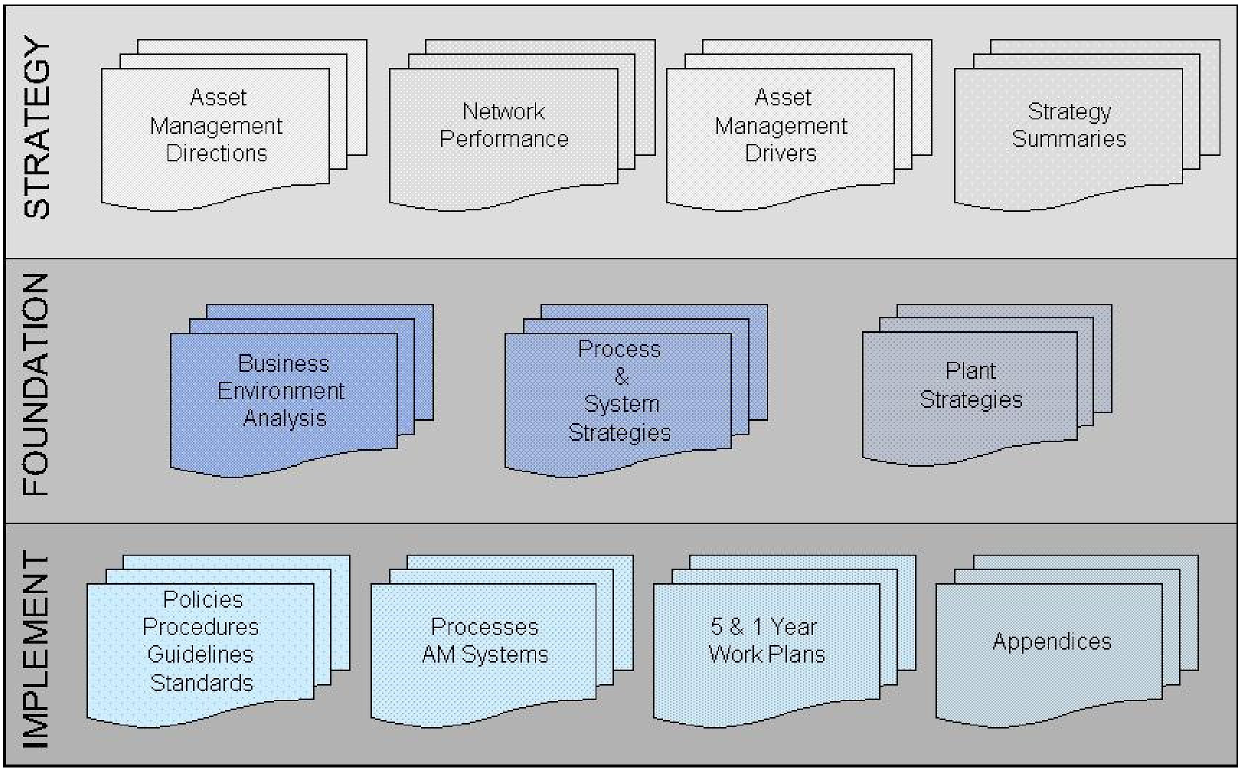
As well as co-ordinating the various SP AusNet-initiated replacement projects, the Asset Management Strategy also integrates replacement plans with the augmentation plans of VENCorp, the distributors and the generators. This approach:

- minimises project delivery costs by optimising engineering effort and resource utilisation; and
- enhances network performance by minimising the number of outages required to carry out the full work program.

3.3 Asset Management Documentation and Process

SP AusNet has developed a three-tiered documentation structure to guide and support its asset management processes. At the apex of this structure is the Asset Management Strategy, which is central to the asset management process. This document is supported by two levels of resource documents, one focused on the analytical foundation to the strategy and the other on implementation of the strategy. The hierarchy of this structure is illustrated in Figure 3.3.1.

Figure 3.3.1. Asset Management Strategy Documentation

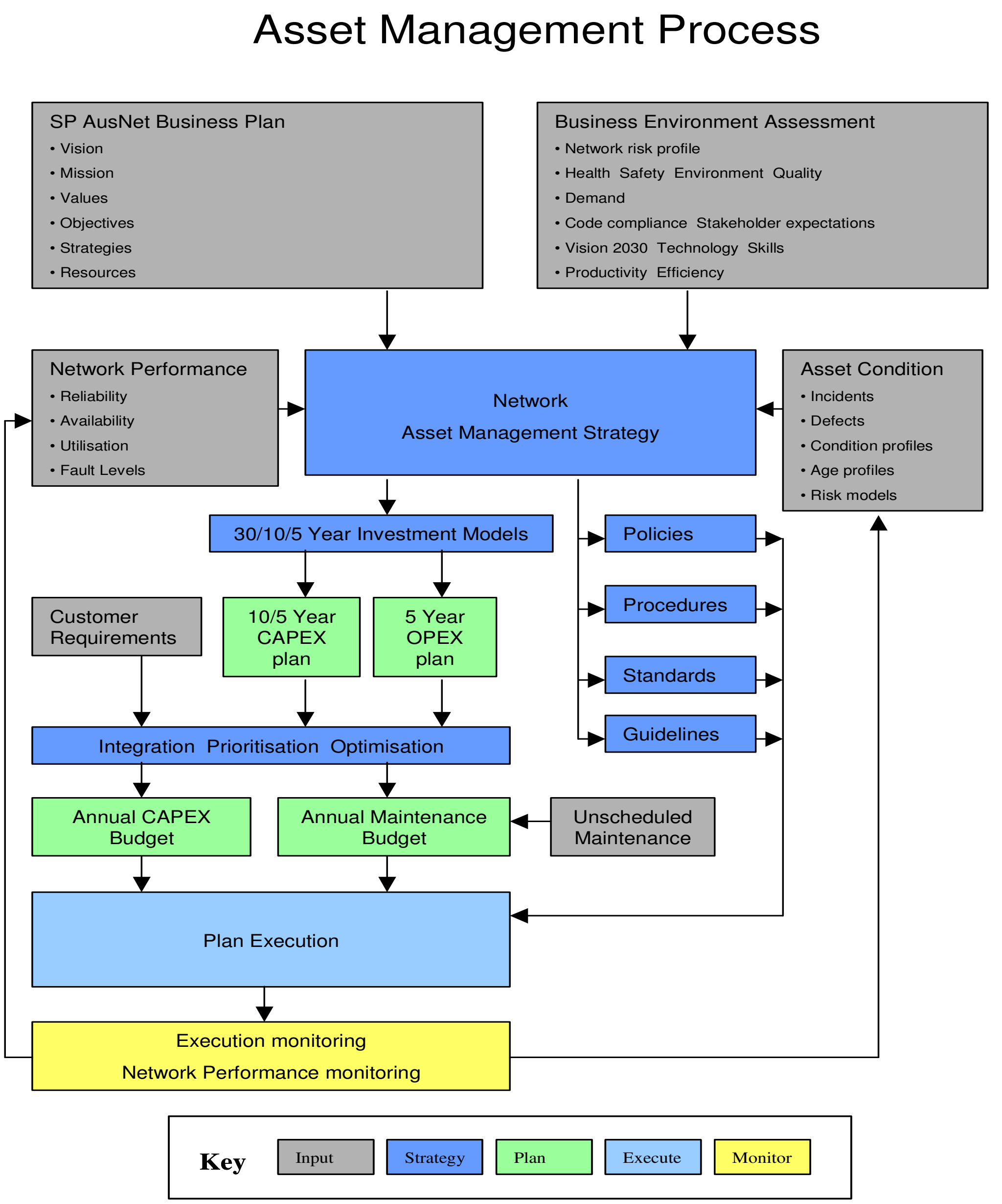


Source: SP AusNet

The asset management process ensures that the strategy and its supporting documentation is informed by inputs from the SP AusNet business plan, assessments of the external environment, asset condition, network performance and the future augmentation requirements of customers. The asset management process also ensures that the strategy feeds into the implementation plans and internal budgeting process.

The asset management process is an iterative one, and it involves updating the Asset Management Strategy and associated documents and actions required when conditions and information change. The asset management process showing the inter-relationships between inputs, strategy, planning and implementation is illustrated in Figure 3.3.2.

Figure 3.3.2 Asset Management Process



3.4 Benchmarking of SP AusNet's Risk Management Processes

SP AusNet commissioned Jervis Consulting to prepare a report on SP AusNet's transmission risk management processes, and to benchmark those processes against the United Kingdom's gas and electricity utilities.

In completing the review, Jervis Consulting referred to the results of the UK Regulator's *2002 Office of Gas and Electricity Markets (Ofgem) Asset Risk Management Survey*. This survey included the 14 large UK electricity and gas network operators, and it was used by the UK regulator to assess the quality of "medium and long term asset risk management practices".

The Jervis Consulting Report's key conclusion was:

> SP AusNet is undertaking its asset risk management activities in a structured and sound manner and is at or better than most best practices identified in the UK Ofgem study.

More specifically, Jervis Consulting found that[5]:

- in terms of Business Strategy and Direction, SP AusNet's performance was generally equal to the average. Business strategy and direction includes clear aims and objectives, identification of key issues for risk management, clear structures and accountabilities, integration of information, analysis and operations, good risk assessment and decision making and good review processes;
- in relation to Asset and Network Strategy, SP AusNet outperforms the average in all categories. Asset and network strategy includes good policies and procurement practices, defining asset life and sustainability, recording asset information, innovation and new technology, security of supply and asset utilisation and compliance with legislation; and
- in Asset Life Cycle Management, SP AusNet again shows superior performance in all segments. Asset life cycle management includes procurement and project delivery practices, asset register contents, utilisation, use of contractors and suppliers, inspection and maintenance regimes, risk assessment and decision-making.

The report findings provide independent confirmation that SP AusNet has effective risk management processes in place at the core of its asset management strategy, which accords with good industry practice, and which facilitates the efficient delivery of a safe, reliable and secure network for customers while also ensuring compliance with all applicable statutory obligations[6].

[5] Jervis Consulting Report (Appendix A)
[6] These compliance obligations are described in Chapter 4.

3.5 Delivery of Prudent and Efficient Capital Expenditure

3.5.1 Introduction

The Asset Management Strategy has been employed over the current regulatory period to assist SP AusNet to determine, amongst other things, the level of asset replacement expenditure over that period. SP AusNet's Asset Management Strategy and related processes ensure that the company undertakes only those projects that are required to maintain network performance and reliability in accordance with customers' needs, at the lowest total life cycle cost. Accordingly, SP AusNet is confident that all capital expenditure undertaken during the current regulatory period is prudent and efficient.

It is important to remember that prudent asset management is a dynamic process with continual revision and updating of the underlying analysis as new information or problems come to light. Therefore, it is inevitable that there are differences between the forecast and delivered capital programs as asset management priorities change to ensure the most critical work is completed.

This is an important consideration because the AER's *Statement of Regulatory Principles* (SRP) provides for a test by the Regulator to determine if the actual the capital expenditure by SP AusNet during the current regulatory is "prudent" before that expenditure is permitted to be included in the Regulatory Asset Base[7].

Accordingly, the AER must make an assessment of the of SP AusNet's capital expenditure to determine if it was prudent before the opening asset base value (that will apply at the start of the forthcoming regulatory control period) can be set.

SP AusNet understands that the test to determine prudency involves a systematic examination of a TNSP's decisions in selecting and delivering investments. The purpose of the examination is to establish whether the TNSP made decisions at each stage of the investment process that were consistent with good industry practice. The examination consists of three sequential stages and is applicable to projects regardless of whether or not they have undergone the regulatory test. The three stages are:

(1) Assess whether there is a justifiable need for the investment. This stage examines whether the TNSP correctly assessed the need for investment against its statutory rules and obligations. The assessment focuses on the need for investment, without specifically focussing on what the correct investment to meet that need is. An affirmation of the need for an investment does not imply acceptance of the specific project that was developed.

(2) Assuming the need for an investment is recognised, assess whether the TNSP proposed the most efficient investment to meet that need. The assessment reviews whether the TSNP objectively and competently analysed the investment to a standard that is consistent with good industry practice.

(3) Assess whether the project that was found to be the most efficient was developed, and if not, whether the difference reflects decisions that are consistent with good industry practice. This assessment examines the factors that caused changes in the project design and/or delivery, and assesses how the TNSP responded to those factors relative to what could be expected of a prudent operator.

[7] These arrangements are preserved as a transitional rule in Clause 11.6.9 of Chapter 11 of the National Electricity Rules.

SP AusNet has examined the AER's recent Draft Decision on the Queensland transmission network revenue cap[8] to obtain a more detailed understanding of the AER's approach to conducting these reviews. Page 17 of the Draft Decision stated:

> "In consultation with the AER, PB's approach in conducting its detailed reviews involved selecting a sample of projects, which consisted of large and small commissioned projects from all of Powerlink's investment categories. These included projects that were commissioned either under or over the original budget. Several large augmentation projects were selected to assess whether Powerlink properly applied the regulatory test. Several small projects were also selected to assess the prudency of low value investments, since these projects comprise a significant proportion of Powerlink's commissioned projects. This approach also provided PB with the opportunity to review whether Powerlink was properly implementing its specified capex policies."

SP AusNet anticipates that the AER will adopt a similar approach in reviewing this revenue proposal.

3.5.2 Assessing SP AusNet's Historic Capital Expenditure Program

SP AusNet's management of its capex program across the six-year period from 1 April 2002 to 31 March 2008 is relevant to the current review. This period includes the forecast for the last nine months before the commencement of the current regulatory period, which is necessary for calculating the opening RAB (on 1 January 2003) for the current period.

The completed program has not been identical to that approved in the 2002 Decision as priorities, problems and solutions have changed. Nonetheless, the majority of the program forecast in 2002 has been rolled out. The comparison between forecast and actual capex over the period is shown in Table 3.5.1.

Table 3.5.1: Capital Expenditure 2002/03 to 2007/08 (Nominal $m)

Year	2002/03	2003^	2003/04	2004/05	2005/06	2006/07*	2007/08*	Total
Decision (CPI Adjusted)	73.1	17.7	73.4	69.0	58.7	82.0	85.2	441.5
Actual Capex	38.2	30.4	52.4	71.2	102.1	108.9	116.3	489.1
Actual Disposals	-0.8	-0.7	-1.0	-2.2	-1.6	-0.8	-0.8	-7.1
Actual Net Capex	37.4	29.7	51.4	69.0	100.5	108.1	115.6	481.9
Difference	**-35.7**	**11.9**	**-22.0**	**0.0**	**41.7**	**26.1**	**30.3**	**40.5**

^ Stub period from 1 January to 31 March 2003.

* Forecasts

Source: SP AusNet Roll-forward Model

While the quantum of capital expenditure forecast has been spent in total, the profile has differed from what was forecast to achieve a managed increase in the capex program. This was done to:

- allow the lessons learnt from managing some of the initial station rebuilds to be used in later projects. This was important, as rebuilds had not been performed on the system before 2000. In particular, new standards and processes had to be developed and tested on early projects before being rolled out across the program;

[8] AER Draft Decision, Powerlink Queensland Transmission Network Revenue Cap 2007-08 to 2011-12, 8 December 2006

- allow a steady increase in resourcing to help maintain a competitive environment for service providers of design and construction services. This avoided large jumps in tendered work which can increase supplier pricing power;
- allow rescheduling to incorporate new higher priority work programs not forecast at the last reset, i.e. the tower safe access program addressing newly identified health and safety risks and resulting standards; and
- allow rescheduling to integrate the program with the modified augmentation plans of VENCorp and the Distributors, i.e. the Kerang Terminal Station refurbishment was delayed so it could be integrated with a Powercor transformer augmentation;

These initiatives reduced the overall cost of the program. Therefore, the net result of SP AusNet's management of its capex program has resulted in a lower inflation adjusted RAB. This lower RAB results in permanently lower prices for customers in the future.

Importantly, there has not been any net deferral of work between periods (which would simply mean price rises in future) once the inclusion of unforecast work is accounted for.

To assist the AER in conducting its prudency review, a list of the major capital projects undertaken during the current regulatory period, together with a summary of the actual/forecast cost for each project is provided in Table 3.5.2. The list also indicates whether or not the project was foreseen (and budgeted for) at the time of the last revenue cap review in 2002.

Table 3.5.2: Largest Projects or Programs by Capitalisation (>$10M)

Station Switchyard	Business Case	Forecast in 2002	Status	Actual/Forecast Costs*
Malvern Terminal Station Redevelopment	$36.5M	Yes	Ongoing	$38.6M
Optical Fibre Ground Wire Installation Program	$33.0M	Yes	Complete	$29.9M
Brunswick Terminal Station Refurbishment	$21.5M	Yes	Complete	$22.1M
Water and Oil Management Program	$17.7M	Yes	Ongoing	$17.6M
Terang Station Refurbishment	$16.2M	Yes	Complete	$17.6M
Tower Safe Access Program	$18.0M	No	Ongoing	$16.8M
Station Security Upgrade	$17.1M	No	Ongoing	$15.4M
Redcliffs Terminal Station Refurbishment	$11.1M	Yes	Complete	$15.0M
Ballarat Terminal Station Refurbishment	$15.5M	Yes	Complete	$14.6M
Bendigo Terminal Station Refurbishment	$14.8M	Yes	Complete	$14.5M
Mount Beauty Terminal Station Redevelopment	$12.3M	Yes	Complete	$12.1M
Eildon Power Station Switchyard Rebuild	$11.1M	Yes	Complete	$10.7M
Shepparton Terminal Station Refurbishment	$10.7M	Yes	Complete	$10.5M
Horsham Terminal Station Redevelopment	$9.9M	Yes	Complete	$10.3M
Instrument Transformer Replacement Program	$12.7M	No	Ongoing	$10.2M
Kerang Terminal Station Refurbishment	$9.9M	Yes	Complete	$10.1M

Note: actual/forecast cost includes project IDC.
Source: SP AusNet

The following sections provide a brief description of the planned and unanticipated capex programs undertaken during the current regulatory period.

3.5.3 Planned Station Rebuild and Refurbishment Program

This program constituted the major part (45 percent) of SP AusNet's planned capex program for the current regulatory period. In its 2002 revenue cap proposal, SP AusNet proposed the replacement or major refurbishment of switchyards at twelve stations. The detailed program is listed in Table 3.5.3.

After completing detailed engineering analysis of each proposed station rebuild or refurbishment, SP AusNet has delivered the program approved by the ACCC for the 2002 / 03 to 2007 / 08 period. SP AusNet has achieved this positive outcome through:

- various cost control measures including increased use of long-term purchasing contracts with suppliers, partnering with various providers, and optimising the mix of insourcing and outsourcing of resources in response to quoted prices;
- improvements to asset management systems and processes; and
- close integration of the program with customer augmentation where possible to achieve cost synergies.

The deferral of the Dederang terminal station refurbishment was shown by detailed engineering studies to be the most economically efficient action to take in that particular case.

Table 3.5.3 Station Refurbishment Program proposed by SP AusNet in 2002

Station Switchyard	22 kV	66 kV	220 kV	Status
Eildon Power Station Switchyard			Y	Complete
Kerang Terminal Station		Y	Y	Complete
Brunswick Terminal Station	Y		Y	Complete
Ballarat Terminal Station		Y	Y	Complete
Shepparton Terminal Station			Y	Complete
Horsham Terminal Station		Y	Y	Complete
Dederang Terminal Station			Y	Deferred
Bendigo Terminal Station		Y	Y	Complete 2007/08
Redcliffs Terminal Station		Y	Y	Complete 2007/08
Terang Terminal Station			Y	Complete 2007/08
Mount Beauty Terminal Station		Y	Y	66 kV Complete 220kV Complete 2007/08
Malvern Terminal Station	Y	Y	Y	Underway

Source: SP AusNet

3.5.4 Other Planned Programs

Other key programs that SP AusNet planned to undertake and were completed during the current regulatory period, are outlined below.

Installation of Optical Fibre Ground Wire	The optical fibre ground wire installation program incorporated the integrated replacement of transmission line overhead ground wires and power line carrier equipment with new optical fibre embedded in transmission line overhead ground wire (OPGW), between various terminal station sites and central control and monitoring locations. The installation of OPGW represented the least cost solution to: ▪ provide the critical communications signals for protection and control for parts of the network, ▪ ensure compliance with the operational requirements of the National Electricity Rules; and ▪ enable enhanced monitoring and information management at terminal station sites.
Water and Oil Management Program	This environmental program facilitated the improvement of civil infrastructure to reduce the possibility of escape of oil or contaminants offsite or into groundwater in the event of an emergency. These works ensured that SP AusNet complies with relevant legislation, regulation, statutory policy and good environmental management practices for the management of oil and water at sites. The scope of work included the installation of drainage, storm water, oil containment and oil collection and treatment at terminal stations and other sites where oil is handled or stored.
Circuit Breaker Replacement Program	The circuit breaker replacement program covered various projects for the replacement of 220 kV and 66 kV circuit breakers due to their condition or performance. The projects covered replacement of circuit breakers at sites where station refurbishments were not required for a number of years, and where it was more cost effective to replace these selected circuit breakers on an individual basis. In some cases the replacements were also used to provide critical spares to keep other circuit breakers of the same type in service, thereby extending the life of these remaining assets.

3.5.5 Major Unanticipated Projects

SP AusNet has had to address unforeseen events in its capital program over the current period, and has undertaken the required expenditure within its existing allowance without compromising its forecast replacement program. This is not unexpected in a large complex transmission network, and capital expenditure allowances must be flexible enough to recognise the changing priorities that may occur in expenditure over a five-year period.

SP AusNet's asset management and capital management processes allow these projects to be incorporated into the work plans on a continual basis.

The major unanticipated projects completed over the current regulatory period are listed below.

Tower Safe Access Program	In 2001, an SP AusNet worker suffered a fatal injury during line work. The subsequent inquiry identified a design weakness on some of SP AusNet's older towers, which resulted in an unacceptable health and safety risk to its linesmen. In response, SP AusNet initiated the Tower Safe Access program, which included an additional **$16.8 million** of unanticipated and unbudgeted expenditure over the current period. This program covered a group of projects required to ensure that line-workers can safely access transmission line towers without encroaching on electrical safety clearances. The work involves the installation of signs, access ladders, safety screens and anti fall devices on transmission line towers. The work has been designed to conform to the National Guidelines for safe approach distances to electrical apparatus. This program is expected to continue into the next regulatory control period.
Richmond Terminal Station	The Richmond Terminal Station 22 kV switchyard was not scheduled for major replacement works during the 2003 - 2008 period. However, in 2004, investigations by geotechnical consultants revealed the 22 kV Switchyard to be subsiding. This has required the rebuilding of the 22 kV Switchyard at an alternative location on the site at a cost of **$6.0 million**.
Station Security Upgrade	In response to world events since September 11 in 2001, critical infrastructure such as the transmission system has become a focus of security assessments. These assessments have resulted in the *National Guidelines for Protecting Critical Infrastructure from Terrorism* and *ENA/ESAA Guidelines for Prevention of Unauthorised Access to Electricity Infrastructure*. In response, SP AusNet initiated a capital program in order to comply with these new guidelines. This program consisted of **$15.8 million** of capital expenditure to upgrade fencing, access and monitoring of transmission sites. This program is expected to continue into the next regulatory control period.
CT replacement program	This program covered the replacement of high voltage oil filled instrument transformers due to deterioration of primary insulation. Failures, including explosive failures at some stations, and test results showed some unexpected and serious problems with particular fleets used on the SP AusNet network. A replacement program was put in place to remove the fleets from service. As a result, an extra **$10.1 million** was committed to this program. This program is expected to continue into the next regulatory control period.

3.5.6 Prudent Capital Expenditure: Concluding Remarks

SP AusNet is confident that the AER's review will confirm that actual capital expenditure undertaken over the current regulatory period has been prudent, and meets the requirements for incorporation into the regulatory asset base. As noted in further detail in Chapter 5, SP AusNet has substantially delivered its planned capex program within 9 percent of the expenditure allowance provided in the revenue cap, despite upward cost pressures and unforeseen demands on capital during the current regulatory control period. At a detailed level it can be demonstrated that SP AusNet:

- has a best-practice Asset Management Strategy in place which ensures that planned investment achieves the objective of providing network services in accordance with customers' needs at the lowest possible total cost;
- has robust and effective systems for the detailed assessment and approval of each project;

NOTE: NUMBERS IN TABLES MAY NOT ADD TO TOTAL DUE TO ROUNDING.

- has robust systems in place for the tracking and control of project implementation costs. Upon completion of a project, the scope for process improvements are identified for future projects, and the improvements are implemented; and
- can provide detailed cost data to reconcile any differences between expenditures and outcomes approved in a business case and actual project outcomes.

As noted in further detail in Section 3.6, SP AusNet performs well compared to its peers against a range of partial performance indicators and benchmarks. Whilst these measures focus on maintenance costs, SP AusNet's good performance against such measures further substantiate that SP AusNet's asset management processes and its work delivery processes are prudent and efficient.

3.6 Benchmarking

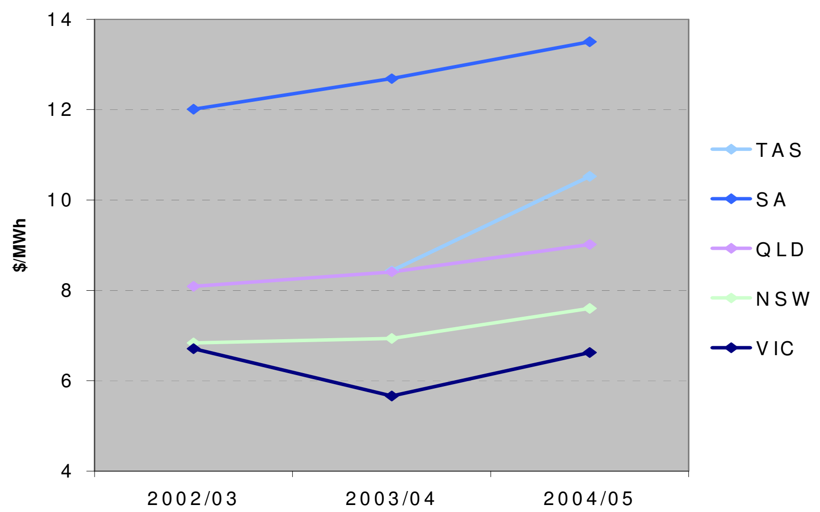
SP AusNet continues to deliver a low-priced, high quality transmission service through strong cost-control and high levels of network performance. The evidence presented below is assembled from internal sources and external industry surveys and confirms that SP AusNet's operational performance places it at the forefront of the transmission sector in Australia. It also provides confidence to stakeholders that the proposed expenditure in the forthcoming regulatory period is efficient, and consistent with delivering appropriate compliance and service outcomes.

3.6.1 Transmission Price Benchmarks

The price of transmission in Victoria per megawatt hour (MWh) is currently the lowest in Australia, and on the basis of this revenue proposal, will continue to be the lowest. The Victorian electricity customer is unquestionably reaping the rewards of:

- the State's long-standing commitment to a well-designed and well-maintained transmission network; and
- SP AusNet's prudent and efficient asset management and operational practices.

Figure 3.6.1 Transmission Charge 2002/03 to 2004/05 (Nominal)



Note: effects of the Victorian easement land tax are excluded.

Source: SP AusNet using AER TNSP Comparison Reports.

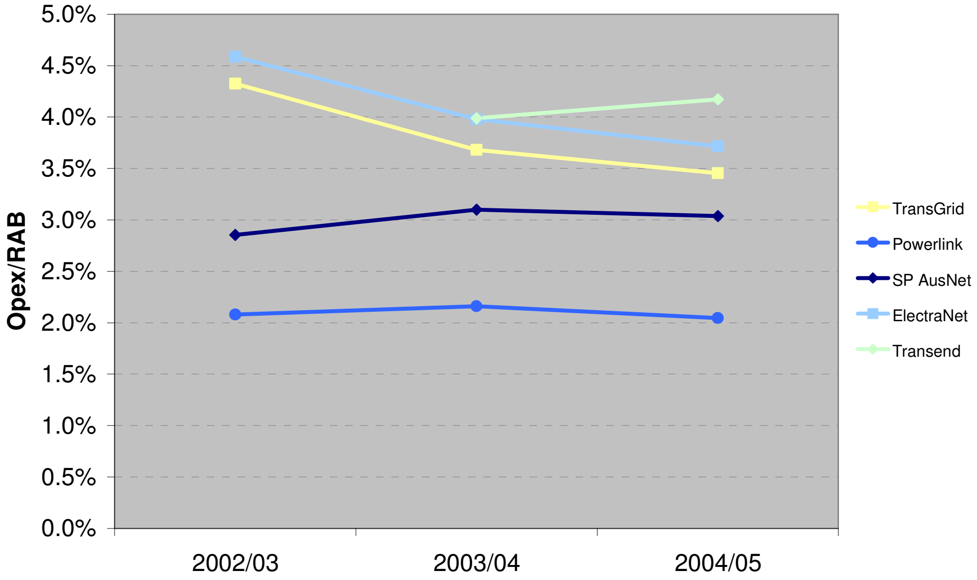
3.6.2 Operating Expenditure Cost Benchmarks

There has been increasing prominence given to benchmarks by the AER in more recent revenue decisions. However, the AER has also recognised that:

> comparisons based on partial measures are not very meaningful. Nevertheless, different measures used in combination can help to assess whether a TNSP's opex is reasonable.[9].

The AER reviews the performance of each TNSP, and provides stakeholders with access to comparative data on the financial and service performance of each respective TNSP. Using the information from the AER's comparative reports SP AusNet has determined partial measures on: opex/RAB, opex/GWh, opex/line length and opex/substation for each respective TNSP between the years 2002 / 03 to 2004 / 05. Figures 3.6.2 and 3.6.3 illustrate SP AusNet's strong performance on the opex/RAB and opex/GWh measures.

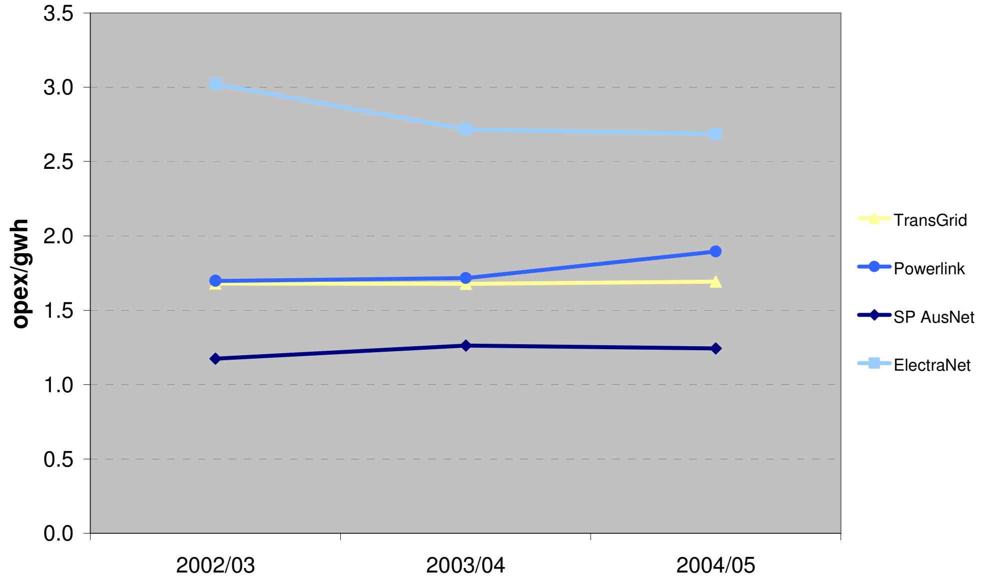
Figure 3.6.2 Opex/RAB (Nominal)



Source: SP AusNet using AER TNSP Comparison Reports.

[9] The NSW and ACT Transmission Revenue Cap TransGrid 2004/2005 to 2008/09: Draft Decision (page 33)

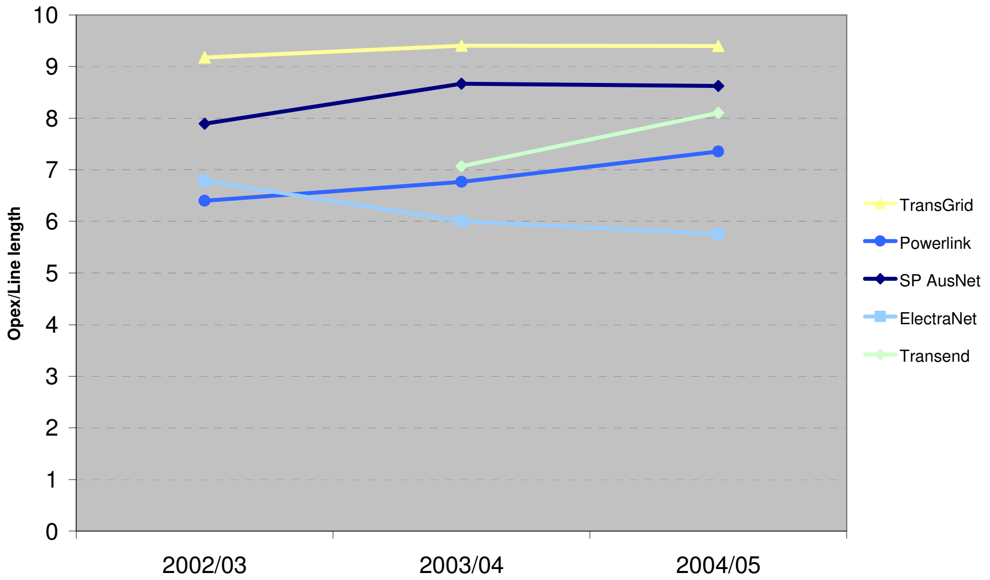
Figure 3.6.3 Opex/GwH (Nominal)



Source: SP AusNet using AER TNSP Comparison Reports.

Figure 3.6.4 illustrates SP AusNet's performance on the opex/line length ratio. SP AusNet has a highly meshed network and denser energy usage patterns compared to other TNSPs which means that opex costs are spread across far fewer kilometres of lines to transfer power from generators to customers. Therefore, SP AusNet does not perform as well on this ratio.

Figure 3.6.4 Opex/Line length (Nominal)



Source: SP AusNet using AER TNSP Comparison Reports.

An equivalent measure to the opex/line length ratio would be SP AusNet's opex performance on non-line assets such as opex per number of maintenance units installed (CBs, transformers, reactive plant) and/or opex per nominal MVA capacity of transformers installed.

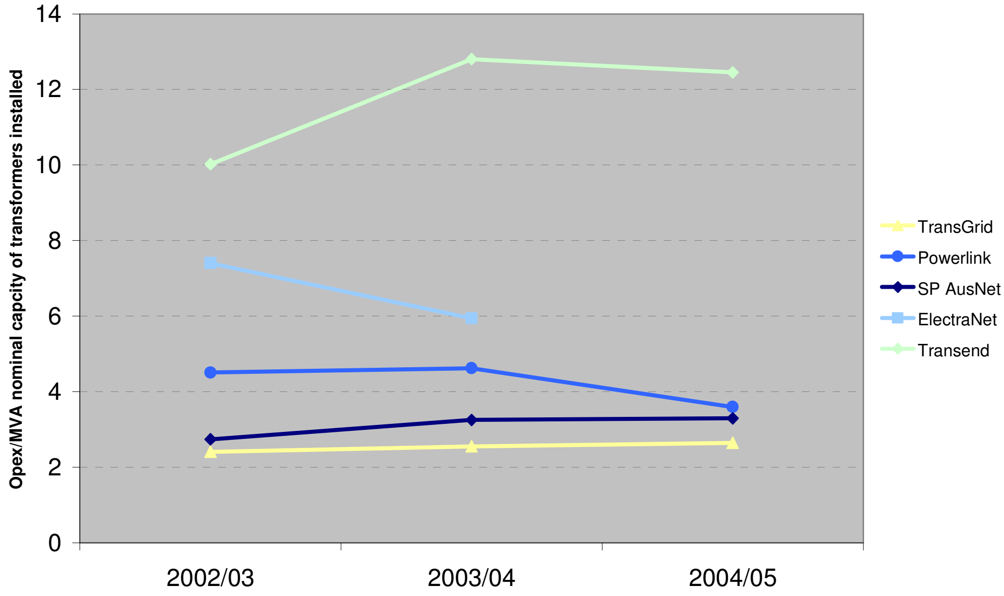
However, the AER has adopted the opex/substation ratio as an equivalent measure. SP AusNet does not believe that the number of substations provides an appropriate representation of the opex requirements of a TNSP in maintaining its substation assets and therefore this measure does not provide a meaningful metric of costs incurred by a TNSP.

Substations differ markedly in size between TNSPs, reflecting the location of load centres, the load density in various States, and decisions regarding the optimum sizing to meet security needs in the desired manner. The number of substations is not a particularly robust measure as a basis for assessing operating cost requirements. Operating expenditure is more closely related to actual numbers of individual items of equipment or the actual capacity of the equipment, which are required to be maintained.

Operating expendirture per maintenance units installed, however, is not publicly available, and hence comparisons between businesses cannot be made. A potential surrogate measure, which involves publicly available information, is opex per nominal MVA capacity of transformers installed. This information is contained in the ESAA publication of *Electricity Gas Australia 2006*.

Figure 3.6.5 clearly illustrates that SP AusNet performs far better using the measure of opex per MVA capacity of transformers installed.

Figure 3.6.5: Opex/Nominal MVA capacity of transformers installed (Nominal)



Source: SP AusNet using AER TNSP Comparison Reports and ESAA Electricity Gas Australia 2006

3.6.3 International Cost / Performance Benchmarks

SP AusNet has for some time now participated in the International Transmission Operations & Maintenance Study (ITOMS) conducted by a consortium of international transmission companies as a means of comparing performance and practices within the transmission industry worldwide. The most recent ITOMS study in 2005 includes SP AusNet data for its 2004 / 2005 financial year.

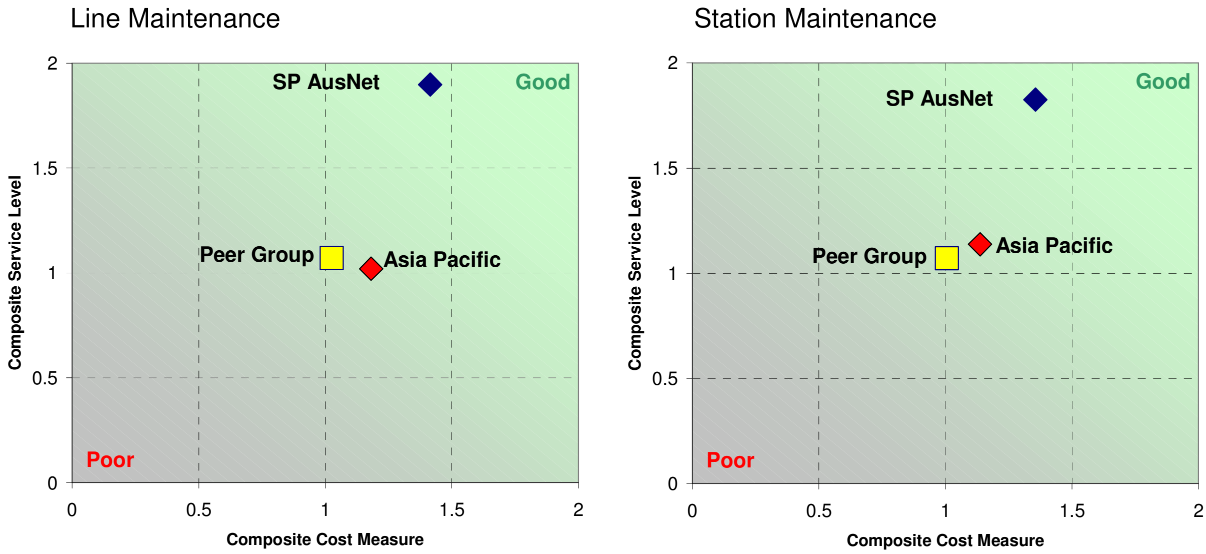
The independent study involves companies from the Asia Pacific, Europe and North America. It focuses on competing indicators of cost (operations and maintenance) and service performance (network reliability). Benchmarking results are presented as a cross plot of reliability and cost.

This benchmarking recognises that cost and reliability cannot be considered in isolation. As indicated in Figure 3.6.6, SP AusNet delivers a high level of network reliability, whilst also ensuring low costs. The level of reliability is the highest in Australia.

The study confirms SP AusNet's continuing 'top quartile' performance in transmission line related maintenance and terminal station related maintenance amongst international TNSPs.

Figure 3.6.6 compare SP AusNet's performance with the averages of international peers (companies with similar asset profiles to SP AusNet) and Asia Pacific peers (including Australia and New Zealand) in transmission line maintenance and station-related maintenance respectively.

Figure 3.6.6 Transmission Line and Station Maintenance



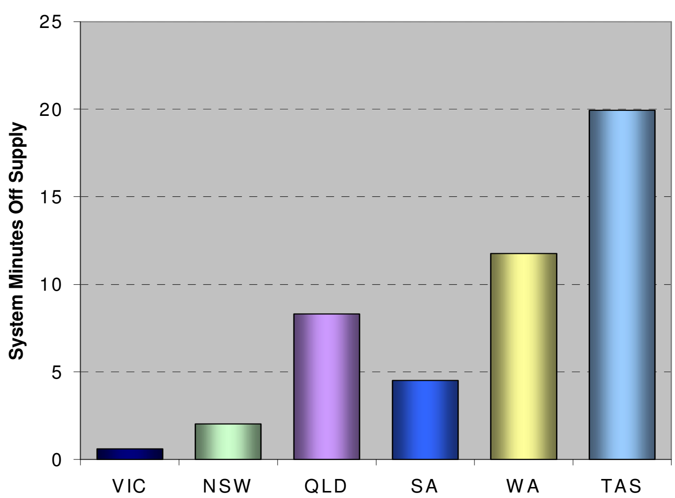
Source: International Transmission Operations & Maintenance Study (ITOMS)

3.6.4 System Reliability Benchmarks

While SP AusNet's business operations are extremely cost-efficient, the company recognises that overall efficiency must also be gauged by observing service delivery performance.

Benchmarking studies confirm that SP AusNet's reliability and network service performance has not been diminished as a result of its low cost of operations. The reliability of SP AusNet's network is best measured by reference to system minutes off supply. Figure 3.6.7 illustrates that SP AusNet has achieved the lowest system minutes off supply on average in Australia over the period 2001 / 02 to 2004 / 05.

Figure 3.6.7 System minutes off supply on average 2001/02 to 2004/05



Source: ESAA, SP AusNet

4 Operational Service Outputs and Compliance Obligations

4.1 Introduction

This chapter describes:

- the operational service targets that SP AusNet is planning to deliver during the forthcoming regulatory control period; and
- the mandatory obligations with which SP AusNet must comply during the forthcoming regulatory control period.

These service targets and mandatory compliance obligations effectively define the outputs that SP AusNet will deliver over the forthcoming period. The quality and level of these outputs is an important determinant of the capital, operating and maintenance costs that the company expects to incur over the forthcoming period[10].

In relation to service standards, it is noted that clause 6A.7.4 of the National Electricity Rules (NER) requires the Australian Energy Regulator (AER) to establish a service target performance incentive scheme. The AER has indicated that it will continue to use the measures used for the performance incentive scheme that has applied in the current regulatory control period. In setting new targets for these measures, it has proposed some modifications that will apply for the forthcoming regulatory control period.

In addition, SP AusNet has continued the availability incentive scheme with its major customer, VENCorp, entered into in 2002. Under this agreement, SP AusNet pays VENCorp an availability rebate for outages of main transmission network elements on the shared network.

The remainder of this chapter is structured as follows:

- Section 4.2 describes SP AusNet's performance under the existing scheme for the current control period;
- Section 4.3 describes the AER's mandated changes to the scheme;
- Section 4.4 sets out SP AusNet's proposed targets and weightings for the incentive arrangements to apply for the forthcoming regulatory control period;
- Section 4.5 provides a description of the availability scheme agreed with VENCorp, which will continue to apply during the forthcoming regulatory control period;
- Section 4.6 concludes the chapter by providing an overview of the mandatory standards and obligations with which SP AusNet must comply.

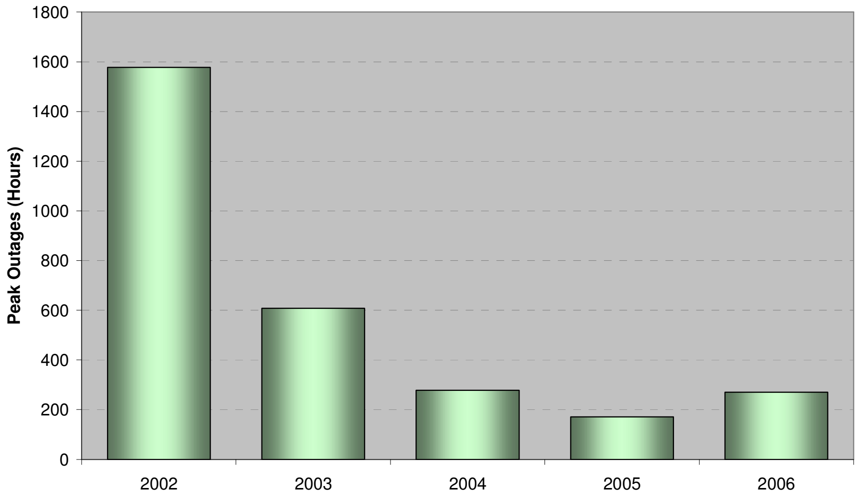
4.2 Current Performance Against AER Service Standards

SP AusNet is strongly committed to achieving the highest possible operational performance when implementing its opex and capex programs. SP AusNet was the first Transmission Network Service Provider (TNSP) to implement an incentive scheme on outage management in 1994 and was the first TNSP to be subject to the AER service standards scheme in 2003. The company has responded to these incentives with improved outage management and planning, ensuring less disruption and risk to customers from maintenance and construction activities.

[10] Capital and operating expenditure forecasts (based on the application of the asset management processes described in Chapter 3, and the planned service outputs and compliance obligations (described in this Chapter 4) are set out in detail in Chapters 5 and 6, respectively.

Since their introduction, the AER scheme and the more targeted VENCorp availability incentive scheme have driven desirable outcomes in operational performance. For example, peak outage hours (during the summer demand peak) have fallen dramatically since the introduction of both schemes in 2003 (refer Figure 4.2.1). This illustrates the importance SP AusNet places on ensuring the transmission system capacity is available during times that are most likely to be important to the National Electricity Market, therefore, helping minimise market prices at these times and greatly improving the security of supply to customers.

Figure 4.2.1: Peak Outages

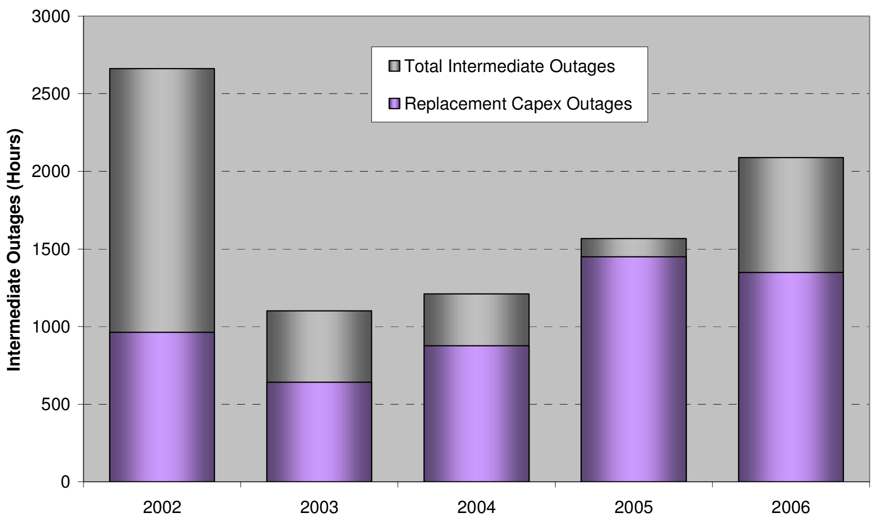


Source: SP AusNet

However, SP AusNet has faced increasing challenges in the intermediate period (the winter demand peak). After an initial fall in outages in response to the incentives in the scheme, the increasing capex program combined with increasing network utilisation has impacted on intermediate outages (refer Figure 4.2.2).

In particular, the increasing capex program for both replacement of assets and customer augmentation has meant that outage windows in off-peak periods are becoming fully utilised. This means, SP AusNet has had no choice but to intentionally push some outages into intermediate periods.

Figure 4.2.2: Intermediate Outages

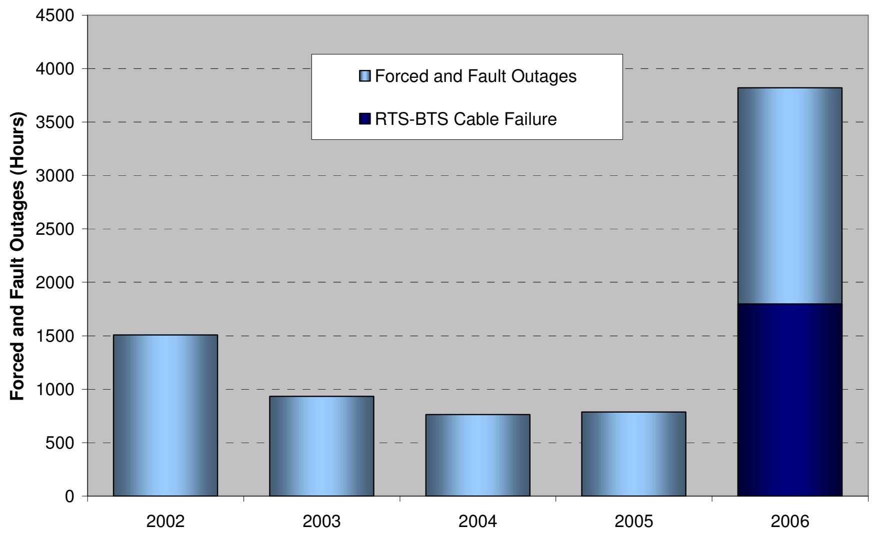


Source: SP AusNet

NOTE: NUMBERS IN TABLES MAY NOT ADD TO TOTAL DUE TO ROUNDING.

It should also be noted that the number of forced outages has fallen, indicating that SP AusNet's performance against targets is not attributable to a reduction in reliability (refer Figure 4.2.3). The exception to this observation is 2006, which was affected by a single major fault on the Richmond to Brunswick 200 kV cable. The large amount of time associated with the excavation work required to locate and repair this fault accounted for 47 percent of 2006 forced outage hours.

Figure 4.2.3 Forced and Fault Outages



Source: SP AusNet

Under the existing scheme for the current regulatory control period, SP AusNet has 0.5 percent of its revenue at risk spread across five availability measures and two average forced outage duration measures. SP AusNet also reports performance against two thresholds for the loss of supply event frequency index. These measures, the associated targets, and SP AusNet's performance against them, are shown in Table 4.2.1.

A number of availability targets have not been met in the current period because additional planned outages have been required in order to undertake the increased capital expenditure and maintenance work programs. The performance targets established by the ACCC in 2002 for the current regulatory control period were based on historic data from a period with substantially lower levels of capital and maintenance works.

Table 4.2.1: Performance incentive scheme – performance against targets

	Target	2003	2004	2005	2006	Weight
Availability Measures	%					%MAR
Total Circuit Availability	99.20	99.323	99.269	99.341	99.257	0.1
Peak Critical Availability	99.90	99.787	99.974	99.945	99.878	0.075
Peak Non-critical Availability	99.85	99.841	99.571	99.857	99.787	0.025
Intermediate Critical Availability	99.85	99.479	99.804	99.745	99.556	0.025
Intermediate Non-critical Availability	99.75	99.338	99.394	98.21	98.765	0.025
Loss of Supply Event Index	**No.**					
>0.05 min per annum	2	3	2	5	5	0
>0.3 min per annum	1	0	0	2	3	0
Average Outage Duration	**hours**					
Lines	10	9.978	2.73	7.542	33.379	0.125
Transformers	10	7.659	4.862	6.644	7.692	0.125

Source: SP AusNet

4.3 AER Mandated Changes to the Existing SP AusNet Scheme

SP AusNet currently excludes all outages associated with augmentation of the network from its measures. The exclusion of planned outages in this way is consistent with the basis on which the initial targets for the scheme were set. This was considered appropriate because SP AusNet is not responsible for planning the augmentation of the Victorian transmission network or the outages associated with these construction projects.

The AER has requested that the definition of exclusions under the SP AusNet scheme be brought into alignment with that of the other Transmission Network Service Providers.

Therefore, SP AusNet's service standards targets for the forthcoming regulatory control period will include:

- predicted planned outages of shared network associated with VENCorp augmentation;
- predicted planned outages of shared network outages requested by connected parties; and
- an allowance for other planned third party-initiated outages.

As a result, availability targets for the new period will be lower than for the current period, as new categories of outages are included in the scheme.

SP AusNet proposes continuing current practice under which revenue (for the purposes of determining revenue at risk under the scheme) is defined as excluding the easement tax due to the exogenous nature of that tax.

4.4 Proposed Operational Service Standards

Under Clause S6A.1.3 of the NER, SP AusNet must propose targets for the AER's service target performance incentive scheme. This section sets out the targets proposed by SP AusNet for the forthcoming regulatory control period, and describes the derivation of those targets. The methodologies applied to derive the targets are in accordance with the NER and the AER's Service Standards Guidelines.

4.4.1 Availability Measures

Transmission circuit availability is the percentage of time that each transmission element is available during the year. An element of plant may be unavailable due to:

- planned outages required to enable SP AusNet to perform maintenance or construction (capex); or
- unplanned outages related to faults on equipment.

Planned outages represent the majority of outage time for the Victorian transmission system.

Targets for availability are calculated from a combination of the average historical availability from 2002 to 2006 and forecast outages arising from the capex and opex proposals, including allowances for outages required by VENCorp, connected parties and other third parties. The category of outages and the method of calculation are outlined in Table 4.4.1.

Table 4.4.1: Calculating availability targets

Type of outage	Method of calculation
Planned routine maintenance outages	2002-2006 historical average
Forced and fault outages	2002-2006 historical average
SP AusNet planned asset works outages	2002-2006 historical average (with specific exclusions)
SP AusNet planned capex outages	Forecast from capex plans
Augmentation capex outages	Forecast from VENCorp and customer capex plans

Source: SP AusNet

Outages from these categories are summed and compared with total plant hours available to generate the total availability targets for each year of the forthcoming regulatory control period. Outages are then classified into critical and non-critical categories and distributed into peak, intermediate and off-peak periods using historical patterns. The transmission network work program is planned to ensure the maximum availability of the network at peak times, to minimise the impact on customers.

To achieve this, work is scheduled first by filling up the off-peak periods available, then the intermediate period, and finally, the peak period. This approach reflects the importance of the peak and intermediate periods to customers compared to the off-peak period.

Caps are placed above the target by an amount equal to one standard deviation from the historical average, while collars are placed below the target by an amount equal to two standard deviations from the historical average. The asymmetry reflects the fact that performance is already high and therefore improvements are more difficult to achieve than performance reductions.

This asymmetry was recognised by the AER (ACCC) in its 2003 *Final Decision on Service Standards Guidelines*:

> "… the ACCC recognises that TNSPs may already be operating at a high-level of performance. For example, most TNSPs in Australia have a circuit availability rate of more than 99 per cent. At this level, for a particular TNSP, improvements of a certain magnitude could be harder than a similar deterioration. Therefore the gradient of the reward would be greater than that of the penalty" (p 10)

The proposed availability targets are set out in Table 4.4.2.

4.4.2 Loss of Supply Event Index

The *Loss of Supply Frequency Event Index Measures* directly impacts on customers from a TNSPs operational performance. This performance measure captures the number of events that result in a moderate loss of supply (0.05 system minutes) and a large loss of supply (exceeding 0.3 system minutes). It is a direct measure of the impact of network performance on network reliability. SP AusNet's thresholds are lower than other TNSPs as the Victorian network delivers higher levels of reliability.

SP AusNet has not previously placed revenue at risk on this measure due to concerns over the quality of its historical data. For this regulatory period, reliable data has been reported to the AER for 2003 to 2006. This has formed the basis of new targets, against which, SP AusNet is confident placing revenue at risk[11].

The proposed targets are calculated using the historical average adjusted for the increase in the capex program. This adjustment is justified, as there is a direct relationship between the amount of work performed on the network and interruptions to supply.

As for the availability measures, caps are placed above the target by an amount equal to one standard deviation from the historical average, while collars are placed below the target by an amount equal to two standard deviations from the historical average. The proposed targets for the loss of supply event frequency index are set out in Table 4.4.2.

4.4.3 Average Outage Duration Measures

The average outage duration measures the average amount of time SP AusNet takes to return a piece of plant to service after a fault. The targets for the current regulatory control period were chosen to match the benchmarks set out in the Victorian Transmission System Code, they were established using long-term historical data.

SP AusNet's proposed targets have been set using the historical data from 2002 to 2006. The Company is also proposing a cap on individual events (events above the proposed cap have been excluded from the data used to set the historical averages). This cap ensures that one event cannot dominate the measured performance, therefore destroying the incentive properties of the measure. The cap has been set at one week (168 hours).

As for the availability measures, caps are placed above the target by an amount equal to one standard deviation from the historical average while collars are placed below the target by an amount equal to two standard deviations from the historical average.

The proposed targets for the Average Outage Duration measures are set out in Table 4.4.2.

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[11] This relationship was recognised in the Powerlink Draft Decision.

4.4.4 SP AusNet Proposed Weightings

The AER requires that a minimum of 1 percent of revenue be placed at risk on the measures in the scheme. This is an increase from the current 0.5 percent of revenue at risk during the current regulatory control period.

SP AusNet believes weightings or the amount of revenue at risk for each measure should reflect both the reliability of data underlying the measures and the relative importance to customers of each measure. Therefore, the highest weighting has been placed on peak critical availability and the peak non-critical availability weighting has been increased. This is appropriate, since peak outages have the highest potential impact on customers. The weighting of total availability has also been increased as it reflects overall availability performance of the network.

SP AusNet has placed weightings on the loss of supply event frequency index measures for the first time. As explained above, these measures are important, as they are directly related to end customer performance. The proposed weightings are set out in Table 4.4.2.

Table 4.4.2 Performance incentive scheme – new targets for the forthcoming regulatory control period

	Collar	Target	Cap	Weight
Availability Measures		**%**		**%MAR**
Total Circuit Availability	98.38	98.68	98.84	0.200
Peak Critical Availability	98.51	99.28	99.67	0.200
Peak Non-critical Availability	98.87	99.36	99.60	0.050
Intermediate Critical Availability	97.11	98.49	99.19	0.025
Intermediate Non-critical Availability	97.25	98.62	99.30	0.025
Loss of Supply Event Index		**No.**		
>0.05 min per annum	7	4	3	0.125
>0.3 min per annum	4	3	2	0.125
Average Outage Duration		**Hours**		
Lines	12	7	4	0.125
Transformers	10	7	6	0.125

Source: SP AusNet

4.4.5 SP AusNet Proposed Specific Exclusions

In addition to existing jurisdiction exclusions on reactors, SP AusNet is proposing several further exclusions to the scheme that are specific to the Victorian jurisdiction. These exclusions are necessary, due to the specific planned maintenance outages that are large and unusual in nature, and the inclusion of augmentation outages for the first time and explained below:

Brunswick to Richmond 220 kV Cable Outages	SP AusNet is planning to carry out significant planned maintenance work on its Richmond to Brunswick 220 kV cable over the forthcoming regulatory control period. The asset is underground and has to be excavated for such work to proceed, resulting in substantial outage times. Therefore, years containing such work would have maintenance outages substantially above the historical average.

Large and uncertain VENCorp and Customer Works	These works include: ▪ Fault level mitigation works ▪ Line up-rating ▪ Interconnector upgrades ▪ Switchyard busbar up-rating VENCorp has identified substantial fault level mitigation works in its *Annual Planning Report* in the forthcoming period but has not specified the scope or location of these works as it has not completed a strategy to address this issue. Potential solutions have significantly different outage requirements. Therefore, it proposed that outages associated with any such works are excluded, as it is not possible to make a reasonable estimate of outages for this work. It is also proposed to exclude fault level mitigation works associated with new customer connections for the same reason. Interconnector upgrades or line up-rating where replacement of line conductors is required are generally very large projects with substantial outage requirements. No projects of this nature are specifically forecast by VENCorp for the next regulatory period, therefore, if such projects arise it is proposed to exclude outages for this work. Busbar up-rating works requested by VENCorp may also be significant depending on the relevant station configuration. As there is no definite forecast works, it is proposed to exclude outages for this work.

4.5 VENCorp Availability Incentive Scheme

The Network Agreement between SP AusNet and VENCorp includes an Availability Incentive Scheme (AIS) that provides for rebates to be paid to VENCorp when network elements are not available for service. The objectives of the scheme are:

- to encourage SP AusNet to seek plant outages at times when the expected cost to wholesale electricity market participants of an outage is minimal;
- to encourage asset management practices which assist in ensuring that the actual cost borne by market participants due to unavailability of transmission assets is minimised; and
- to encourage asset management practices which assist in ensuring that over the long run, targets for performance are achieved.

This scheme has been in place since 1994 and was expanded at the time of the last revenue determination in 2002 with increased targeting of critical plant and higher rates (revenue at risk).

The AIS assigns an individual rebate rate to each specific item of plant depending on the time of the outage and the criticality of the plant to maintaining supply. Therefore, it provides a more focused incentive than that provided under the average targets in the AER Scheme and, as such, continues to provide additional benefits to customers over and above those arising under the AER Scheme.

The scheme has been very successful; with the incentive encouraging SP AusNet to develop new and sophisticated scheduling techniques that have reduced the level of planned outages in peak periods (refer Figure 4.2.1), greatly improving the security of supply to customers. The incentive scheme has been reviewed jointly with VENCorp, and given its success, both parties have agreed to continue the scheme through the forthcoming regulatory period.

Therefore, SP AusNet's revenue proposal provides for a continuation of the allowance to fund the expected value of the rebate payments made to VENCorp under the AIS. Good performance under the AIS means an amount less than the allowance will be paid back to VENCorp in rebates (resulting in a net gain to SP AusNet), while poor AIS performance results in higher payments than the allowance (resulting in a net loss being borne by SP AusNet).

As noted above, the expected costs have been included in the opex proposal detailed in Chapter 6.

The scheme is described in more detail in Appendix B.

4.6 Mandatory Compliance Obligations

SP AusNet is required to comply with its Licence conditions and National and State Electricity Industry Legislation, Rules and Regulations. In particular, the National Electricity Rules (NER) and the National Electricity Market Management Company (NEMMCO) requirements in relation to system protection, communication and metering result in various significant secondary system capex programs (which are defined in Schedule S5 of the National Electricity Rules and operational requirements set by NEMMCO). There are also specific performance obligations regarding the provision of services to VENCorp that are specified in the Network Agreement.

SP AusNet is also required to comply with significant new health and safety, environmental and security obligations in addition to its existing obligations. These obligations and internal standards cover matters such as:

- safe access for work on towers;
- management of fire hazards;
- changes to the Occupational and Safety Act 2004 requiring additional reviews of safety issues at the design stage of a project and additional liability (and therefore cost) for designers;
- management of various pollutants and environmental effects (oil discharge, noise and greenhouse gas emissions);
- vegetation management;
- mitigation of visual intrusion;
- electro-magnetic fields;
- physical security; and
- management of risk associated with unauthorised access to SP AusNet assets.

The key instruments that set out SP AusNet's mandatory compliance obligations are listed in section 5.6 of this revenue proposal. As noted in Chapter 5 (Capital Expenditure Proposal) and in Chapter 6 (Operating Expenditure Proposal), these obligations have a substantial bearing on the level of forecast expenditure for the forthcoming regulatory control period. Moreover, compliance with these obligations is not a discretionary matter for SP AusNet, so it is important that the revenue cap for the forthcoming regulatory control period contains adequate allowances for all of the capital and operating costs associated with meeting these various obligations.

5 Capital Expenditure Proposal

5.1 Introduction

Clause 6A.6.7 of the National Electricity Rules (NER) requires SP AusNet to present its capex requirements for the forthcoming regulatory control period in order to:

- meet the expected demand for prescribed transmission services over that period;
- comply with all applicable regulatory obligations associated with the provision of prescribed transmission services;
- maintain the quality, reliability and security of supply of prescribed transmission services; and
- maintain the reliability, safety and security of the transmission system through the supply of prescribed transmission services.

In addition, Schedule 6A.1.1 describes the type of accompanying information that SP AusNet must provide in order to explain and justify its forecast capex. In light of these requirements, this Chapter provides:

- a brief description of the asset management drivers and forecasting methodology employed and the assumptions underpinning the capex forecast;
- an overview of historic and forecast capital expenditure;
- a description of external factors that will affect input cost in the forthcoming regulatory control period;
- a detailed presentation of SP AusNet's forecast capex, for each of the following categories;
    - *system replacement capex;*
    - *compliance-related capex;*
    - *non-system capex;*
- comments on the deliverability of program; and
- concluding comments.

As noted in Chapter 2 of this revenue proposal, all transmission network augmentation in Victoria is planned and contracted by VENCorp or the relevant connected party. Therefore, SP AusNet's capex proposal does not include augmentation capex.

5.2 Asset Management and Capital Expenditure Forecasting Methodology and Assumptions

In accordance with Schedule 6A.1.1, this section describes the methodology used for developing the capex forecast, and the key assumptions that underlie the forecasts. The capex forecasts presented in this chapter reflect, and are consistent with the implementation and efficient execution of SP AusNet's Asset Management Strategy.

The principal factors underpinning the capex proposal set out in this chapter are:

- the key drivers identified in SP AusNet's Asset Management Strategy and cost estimation processes, discussed below;
- the service and compliance outcomes detailed in Chapter 4 of this proposal;
- the project cost and scoping estimation factors that are expected to influence costs in the forthcoming regulatory control period and beyond, including the impact of external factors that are beyond SP AusNet's control as discussed in Section 5.4.

Chapter 3 of this revenue proposal explained SP AusNet's approach to asset management in detail. In summary, SP AusNet's Asset Management Strategy delivers the following key outcomes for the Victorian Transmission Network and its customers:

- maintaining reliability levels for customers by creating a stable and sustainable network asset failure risk profile to ensure reliability of supply for customers;
- meeting operational performance targets for network reliability and availability;
- complying with operational Codes and Regulations and with occupational health and safety, environmental and security legislation, codes and regulations; and
- optimising life cycle costs.

To give effect to these objectives, SP AusNet has identified the following drivers of expenditure for the Victorian Transmission Network over the next 20 years.

- Asset Performance and Failure Risk;
- Increasing Network Utilisation;
- Increasing Fault Levels;
- Operational Availability and Reliability Performance;
- Compliance with Legislation, Rules and Regulations; and
- Technological Change.

Many of the drivers flow directly from the aims and outcomes of the Asset Management Strategy (Appendix E), or are challenges and obstacles that must be taken into account to achieve them. The implementation of the Asset Management Strategy results in the development of detailed projects and work plans which underlie the capex proposal in this chapter and the opex plans outlined in Chapter 6.

All major projects are individually developed, scoped and costed using SP AusNet's cost estimation database, supplier information and escalation rates established from the forecast information discussed in Section 5.4. The scope and costs of capital works are specific to the location of those works; therefore, where difficult working conditions are expected, such as restricted space, this is reflected in the costs, or where substantial temporary works are required to maintain supply, this is reflected in the scope of work. These project specific costs are then tested against internally established 'standard bay' costs as a final check.

In summary, SP AusNet believes that the capex proposal as detailed in this chapter is a prudent and efficient work program that is strongly focused on meeting the company's compliance obligations and the needs of its customers whilst minimising total life cycle costs.

5.3 Overview of Historic and Forecast Capital Expenditure

An overview of SP AusNet's historic and forecast capex is provided in Table 5.3.1 and Figure 5.3.1. In summary, this information indicates that total capital expenditure must increase significantly in the forthcoming regulatory control period if SP AusNet is to satisfy its compliance obligations and the needs of its customers.

Table 5.3.1 Total Capex 2008/09 to 2013/14 – by Asset Class (real 2007/08$)

	Average 2003/4 to 2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	Total
Secondary	21.7	26.8	20.1	27.5	21.8	14.3	9.9	120.5
Switchgear	22.6	40.9	36.2	49.3	48.5	35.7	70.4	281.0
Transformers	6.0	11.8	12.1	30.7	12.1	37.5	35.6	139.7
Reactive	1.9	7.1	1.2	4.3	10.0	1.4	12.0	36.0
Towers and Conductors	9.3	2.6	4.8	2.9	6.3	7.8	5.2	29.6
Establishment	11.6	20.5	33.3	19.0	29.4	16.0	12.5	130.7
Communications	4.2	7.6	2.3	14.8	13.4	0.0	1.8	39.9
Non System	13.2	11.3	11.8	8.3	9.1	10.6	10.0	61.1
Total	**90.4**	**128.6**	**121.7**	**156.8**	**150.8**	**123.3**	**157.4**	**838.6**

Note: Capex as commissioned (6 months IDC excluded)
Source: SP AusNet

The proposed capex program continues and builds on the successfully completed capex program for the current regulatory control period. In fact, the company's previous revenue cap application in 2002 clearly indicated the need for increasing levels of capital expenditure in future regulatory control periods[12]:

> "SPI PowerNet is at the beginning of a major asset replacement program. For example, the network has reached the stage where significant sections of terminal stations must be replaced. This refurbishment program commenced in 2001 and is expected to continue until 2017."

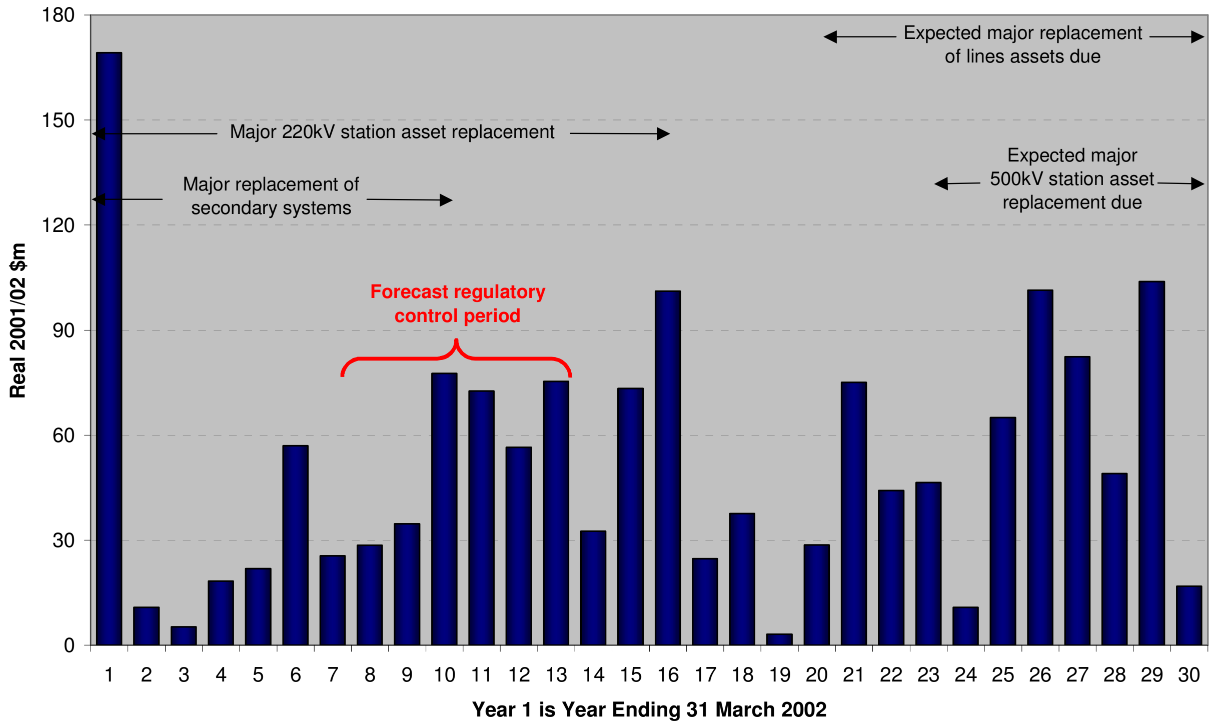
The 2002 revenue cap application further explained that the company's capital replacement model identified those assets that were at the end of their expected technical lives.

> "The average model forecast expenditure over the 30-year period is $51.6 million per annum and the average over the 2001/02 to 2010/11 period is $44.9 million per annum. By comparison, planned system asset replacement excluding communications, averages $38.4 million per annum (in 2001 dollars) over the period 2003 to 2007/08."

The model outputs (from the 2002 revenue cap application reproduced in Table 5.3.1), combined with equipment condition analysis, defect and incident reports, and performance information, indicated that replacement capital expenditure would need to increase in the forthcoming regulatory control period.

[12] SPI PowerNet's revenue application, for the period 1 January 2003 to 31 March 2008, pages 31 and 33.

Figure 5.3.1 Major replacement programs driving capex forecasts (from Figure 4.1 in 2002 Application)



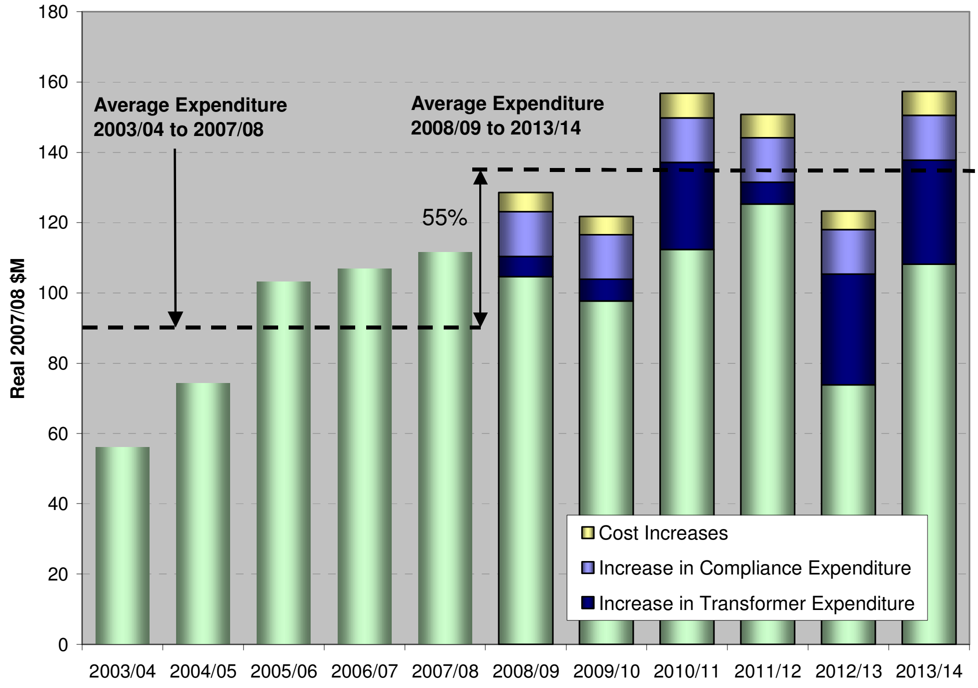
Source: SP AusNet

In light of the company's 2002 revenue cap application, the requirement to increase capital expenditure in the forthcoming regulatory control period is not unexpected. The increased volume of capital work planned for the forthcoming regulatory period is driven by:

- the continued roll out of the major terminal station rebuild projects, including more difficult and complex work in confined city sites, where supply must be fully maintained throughout the renewal work, and conversion to expensive, more compact gas-insulated switchgear is required, to allow for expansion of capacity to meet future demand;
- a substantial increase in the number of transformers being replaced over the period, (expected to rise from 12 to 40); and
- further increases in the amount of compliance expenditure required to meet safety, environment and security needs. Consumer, workforce and public expectations in each of these areas continue to reflect higher standards, forcing utilities to provide additional facilities to meet these needs. In most cases, these increased standards are reflected in the mandatory compliance requirements described in Section 5.6.

In addition to this anticipated increase in the volume of capital work, a number of external factors relating to input prices will exacerbate the required increase in capital expenditure. These factors are described in more detail in Sections 5.4 and 5.5.

Figure 5.3.2 Non-Augmentation Capex 2003/04 to 2013/14 (Actual and Proposed) (Real 2007/08 $M)*



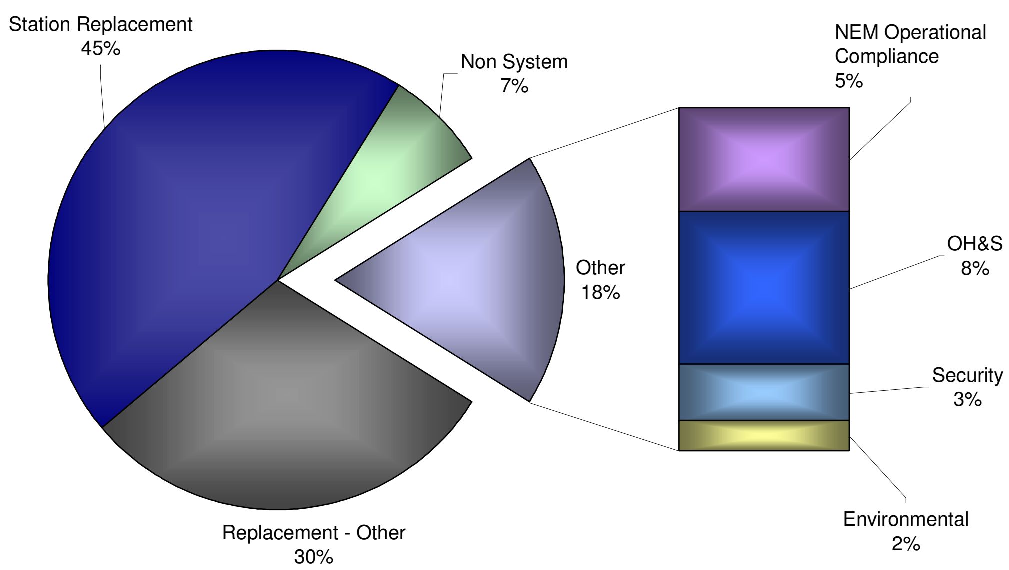
* Actual to December 2006, forecast to 2013/14.

Note: Capex as commissioned (6 months IDC excluded)

Source: SP AusNet

The breakdown of SP AusNet's proposed capex is shown in Figure 5.3.2. The majority of capex (75 percent) is related to replacement of network assets. This is associated either with substantial rebuilding and refurbishment of terminal stations (45 percent), or stand-alone programs addressing specific plant items or fleet problems (30 percent). The remainder of the expenditure is linked to compliance either with operational requirements of the NEM or related to occupational health and safety, environmental or security obligations (18 percent) or non-system IT and business support programs (7 percent).

Figure 5.3.2 Capex Program by Category of Expenditure



Source: SP AusNet

5.4 External Factors Affecting Input Costs

Since 2005, SP AusNet has been observing increasing cost pressures. This has been particularly noticeable, as the current long-term supply contracts have started to expire. Therefore, for the future period, SP AusNet is forecasting increased costs.

SP AusNet's capex program is made up of over 600 projects and many of these projects are of a long duration or scheduled to commence some years in the future. Therefore, it is vital that the ex-ante capex allowance approved by the AER allow for the increases in costs already occurring and predicted in the future.

In 2006, SP AusNet commissioned Sinclair Knight Merz (SKM) to examine the factors affecting input costs in the electricity transmission sector to provide an independent check on the internal costs estimates. A copy of SKM's report, *Escalation Factors Affecting Capital Expenditure Forecasts*, is provided as Appendix C to this revenue proposal.

SKM's principal conclusion was:

> "After a prolonged period where costs used for the development of capital expenditure forecasts have increased generally in line with movements in the Australian Consumer Price Index (CPI), market cost pressures particularly over the last three years have grown substantially in excess of CPI."
>
> …
>
> The results of SKM's research indicate that there are a number of factors driving the rapid rises in capital infrastructure costs, namely:
>
> - the increase in world wide commodity prices that has occurred since 2002 / 03;
> - subsequent increases in the purchase price of plant, equipment and materials, both locally produced and imported, although these increases are noted to lag increases in commodity prices by a period of 1 to 2 years;
> - increases in the cost of local labour and related increases in construction industry costs; and
> - general increases in the market price for contracted works in Australia caused by the current demand/supply imbalance and shortages in skilled labour and construction resources." (pp 1-2)

In estimating its future costs, SP AusNet has used costs from its 2006 / 07 cost estimation database to construct project specific costs. The 2006 / 07 expenditure reflects the increase in costs observed towards the end of the current regulatory control period, therefore, where 2005 / 06 costs have been used to generate the 2006 / 07 database, they have been escalated at a rate higher than Consumer Price Index (CPI). Different escalation factors were used for different types of assets but were on average 4.7 percent above CPI.

This is a more conservative assumption than the increase observed in the SKM Report, which estimated that substation switchbay costs exceeded CPI by 5 percent and transformer bay costs exceeded CPI by 6 percent (the majority of work during the forthcoming regulatory period is at substations).

For the forthcoming regulatory control period, these costs are maintained in real terms.

Again, this is more conservative than with the SKM report, which estimates substation costs will track slightly above CPI over the some period (1 - 2 percent over the period from 2007 to 2013).

To explain in more detail the specific factors affecting SP AusNet's cost estimation assumptions in the forthcoming regulatory control period, the remainder of this section provides further information in relation to commodity and equipment prices, labour rates and their influence on installation costs.

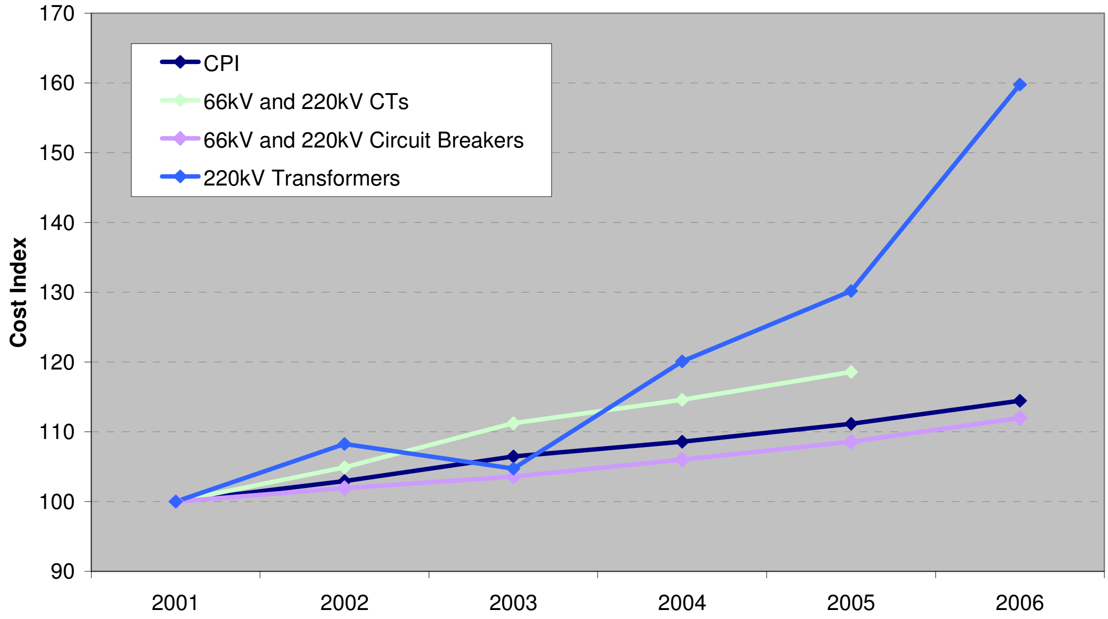
5.4.1 Commodity and Equipment Prices and Labour Costs

Commodity and equipment prices have increased during the current regulatory control period at a much faster rate than CPI. By the end of 2006, copper prices were almost 400 percent above their 2003 levels, while steel and aluminium prices were 150 percent above their 2003 levels. These higher commodity prices flow into equipment costs and construction costs, usually with a 1 - 2 year lag.

SP AusNet manages the risk of changes to input costs by negotiating long-term purchase agreements with suppliers. However, as agreements expire and are replaced by new agreements, SP AusNet is unable to avoid the impact of higher commodity and equipment prices.

Figure 5.4.1 shows SP AusNet's observed increases in contract prices for transformers and switchgear.

Figure 5.4.1 Cost Increases for Key Equipment



Source: SP AusNet

Evidence from the SKM Report also supports this steep rise from 2005, especially for transformers and conductors.

> "Some significant observations that may be made [from SKM's asset valuation and estimating database are]:
>
> - Power transformer costs were relatively stable over the period 2002 to 2004, but began to rise significantly in 2005, increased by 9.29% in 2006 and are expected to rise by more than 10% in 2007;
> - Costs of equipment that are more technology or manufacturing driven rather than commodity price driven (eg. circuit breakers, cable joints / terminations, voltage transformers) tended to be relatively stable during the period;
> - Aluminium cable costs were stagnant between 2002 and 2004 (decreasing slightly in 2003), but have risen 27% over the past two years;
> - Copper cable costs were also consistent between 2002 and 2004 (dropping slightly in 2003), but have increased 50% in the past two years; and
> - AAC and AAAC overhead conductor costs were stagnant between 2002 and 2004 (decreasing slightly in 2003), but have risen by 27% in the past two years, with most of this increase occurring in 2006." (p 14)

SKM calculated the normalised effect of commodity prices (given the share in the final product) on finished asset transmission assets between 2002 and 2006. It was estimated:

- substation bay costs exceeded CPI by 5 percent;
- transformer bay costs exceeded CPI by 6 percent;
- transmission overhead line costs exceeded CPI by 16 percent;
- aluminium cable costs exceeded CPI by 12 percent; and
- copper cable costs exceeded CPI by 24 percent.

SKM noted that these cost trends are expected to continue due to the lag between rises in commodity prices and equipment prices:

> "It is of interest to note from the price trends shown, that there appears to be a significant time lag between the rapid increases in commodity prices (which occurred for copper and aluminium between September / December 2003 and June 2005) and the time at which finished product prices began to rise. …
>
> This suggests that the contract prices for finished product, such as transformers, cables and conductors, will continue to rise well beyond the predicted peaks in commodity prices and likely into 2008. This view has been reinforced anecdotally through discussions with equipment manufacturers and suppliers"

SP AusNet has also experienced labour cost increases, as strong competition for skilled labour has led to unprecedented increases in labour rates in the utility sector. The economic boom in the construction and mining sectors has exacerbated the strong growth in the demand for skilled labour. SP AusNet has assumed that the strong growth in labour costs will continue.

SKM's conclusions on labour rates support this, noting that average weekly income has exceeded CPI by around 2 percent per annum between 2002 and 2006. Using projections from the Commonwealth Treasury, SKM has estimated that the rate of increase is likely to continue over the upcoming period. In particular, it has estimated that between 2006 and 2013:

- general labour will exceed the CPI by 11 percent; and
- site (construction) labour will exceed CPI by 18 percent.

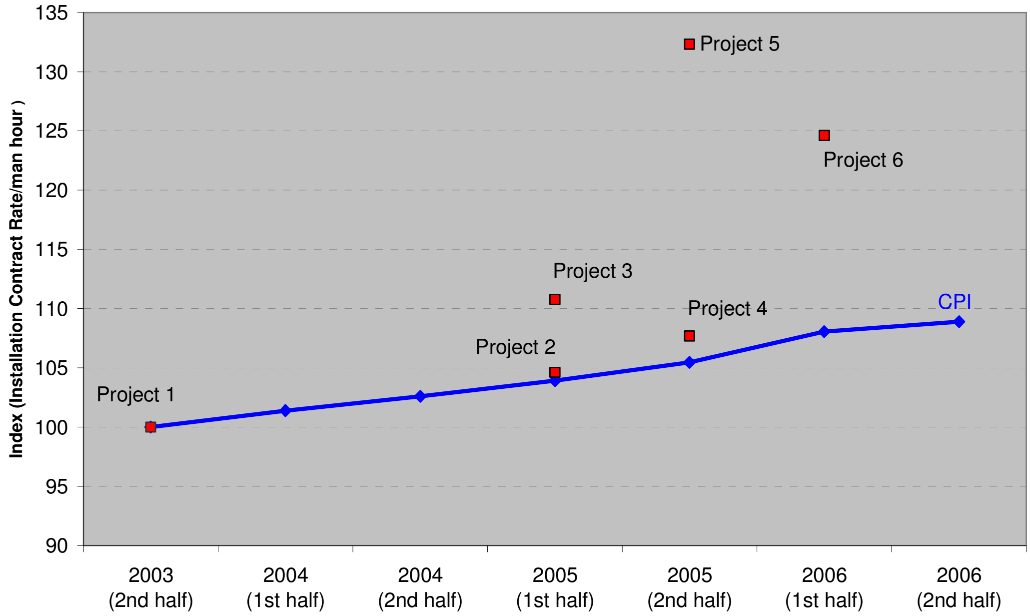
This acceleration in labour rates has also been acknowledged in the recent Access Economics Report[13] commissioned by the AER:

> "… after remaining close to the expected "long-term" rate of 4¼% until 2003 - 04, wage growth in the utilities sector has leapt sharply in the past few years, even as productivity levels have reversed … wages growth in the first few years [from 2005 / 06] is likely to remain relatively strong due to the current skills shortages prevalent in the utilities sector. These shortages are not caused solely by growth in the sector itself, but have flowed from the strength in other sectors - notably construction - in recent years and a similar shortage in the mining sector."

5.4.2 Higher Installation Costs

As a consequence of the rising commodity and equipment prices and labour costs outlined in Section 5.4.1, SP AusNet has observed substantial increases in contractors' installation costs for subcontracted construction work, as installation costs also reflect the increases in commodity prices, equipment costs and higher labour rates. For example, Figure 5.4.2 shows the increase in the contractor rate (expressed in dollars per man hour) between 2003 and 2006 for the construction of major projects. As shown, the rate increased by an average of 21 percent over that period compared with an increase in the CPI of only 11 percent.

Figure 5.4.2: Increases in Contractor Rate for Major Construction Projects



Source: SP AusNet

13 Access Economics Pty Limited, Wage growth forecasts in the utilities sector, November 2006, page i.

Again the SKM Study supports these observations:

> "Over the period of time 2002 - 2006, the cost of installed structural steelwork has almost doubled. Applying data from Rawlinson's Australian Construction Cost Handbook, the movement in erected steelwork was in excess of 80%. This number is supported by an increase in Longs Steel index over this same period.
>
> A similar review of Rawlinson's data for concrete foundations, suggests that this component of the bay structure has increased by approximately 24.2% over this period.
>
> Data from the Australian Bureau of Statistics indicates that non-residential construction costs have been increasing more rapidly than CPI. … over the past 8 years the average Australian costs have risen almost 20 percent more than CPI. Victoria's increases have lagged behind the national average over the past year, resulting in increases about 8 percent more than CPI over the 8 year period."

5.5 System Replacement Capital Expenditure

5.5.1 Overview of Historic and Forecast Replacement Capital Expenditure

An overview of the total annual historic and forecast capex is set out in Table 5.5.1.

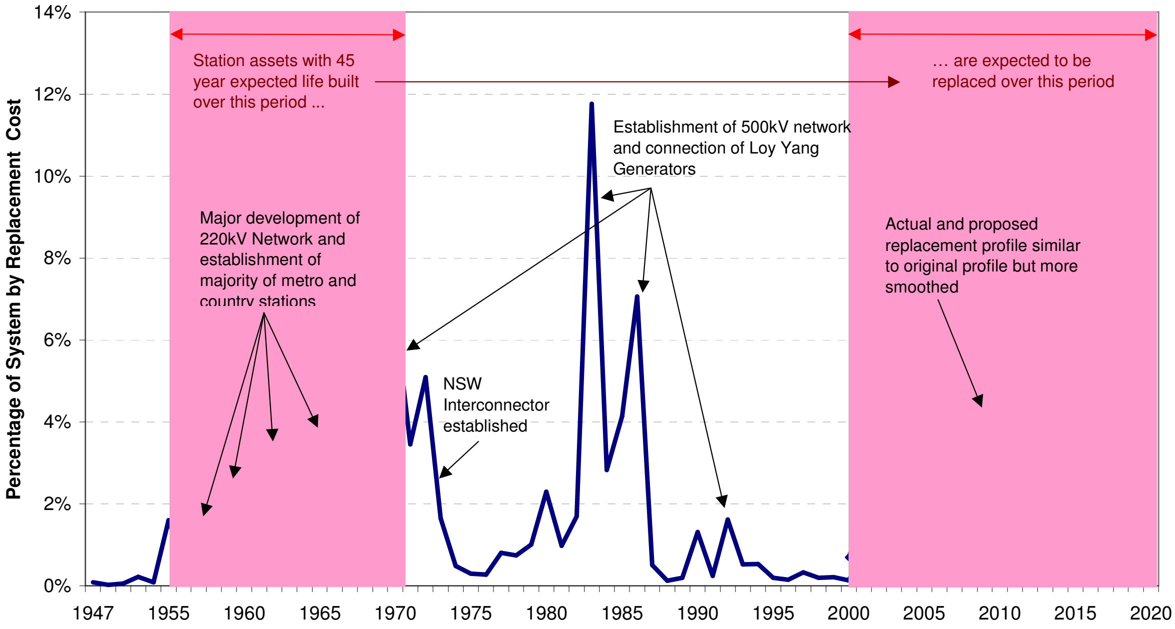
Table 5.5.1 Historic and forecast system replacement capex 2003/04-2013/14 (Real 2007/08 $M)

	Average 2003/4 to 2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Replacement - Stations	37.3	39.5	54.5	69.4	51.2	66.6	96.5
Replacement - Other	27.8	47.7	34.1	39.6	55.4	31.8	42.3
Total	**65.1**	**87.1**	**88.6**	**108.9**	**106.6**	**98.5**	**138.7**

Note: Capex as commissioned (6 months IDC excluded)
Source: SP AusNet

As indicated in Figure 5.5.1, the majority of SP AusNet's 220 kV system and associated 22 kV and 66 kV connection assets at terminal stations were built between 1955 and 1970. The primary assets at terminal stations are expected to last 45 years on average, although the range is generally between 40-50 years, depending on the actual condition of the asset. Therefore, SP AusNet's replacement capex plans anticipate the majority of these assets will have to be replaced during the 20 years between 2000 and 2020.

Figure 5.5.1 Relationship Between System Development and Replacement



Source: SP AusNet

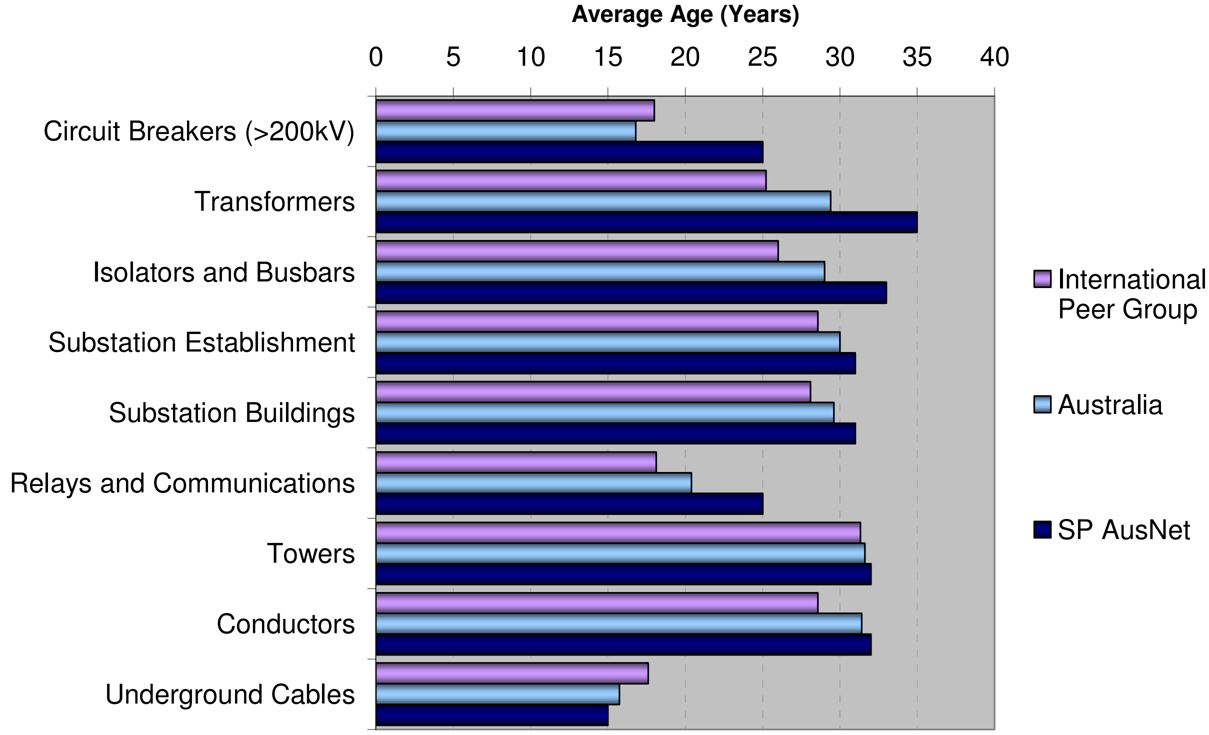
This pattern of historical development of the Victorian transmission network means that SP AusNet has an old network relative to both Australian TNSPs and international transmission networks in other developed nations.

As described in Chapter 3, the International Transmission Operations & Maintenance Study (ITOMS) benchmarking is conducted by a consortium of international transmission companies as a means of comparing performance and practices within the transmission industry worldwide. The most recent ITOMS study allows a comparison to be made between the average age for various equipment types between SP AusNet, Australian TNSPs and the International sample.

As illustrated by Figure 5.5.2, SP AusNet's substation equipment and communications equipment is considerably older than other networks. In particular:

- the average age of SP AusNet's circuit breakers is 8 years above the Australian average and 7 years above the international average;
- the average age of SP AusNet's transformers is 6 years above the Australian average and 10 years above the international average; and
- the average age of SP AusNet's relays and communications equipment is 5 years above the Australian average and 7 years above the international average.

Figure 5.5.2 Average Asset Age, SP AusNet, Australia and International Sample



Source: ITOMS 2005 Report

Replacement capex constitutes the core of the proposed capex program for 2008 / 09 to 2013 / 14. The planned replacement capex program is derived from SP AusNet's Asset Management Strategy (described in Chapter 3) that addresses, amongst other things, asset failure risks on the network associated with the ageing asset base.

Asset and terminal station replacement also provides an opportunity to address some of the other drivers identified in the Asset Management Strategy including:

- fault level mitigation, as newer equipment has higher fault ratings; and
- utilisation, future availability and reliability, as new better designed switching arrangements are possible and small incidental increases in capacity result.

Efficient new technology is also introduced into the asset base via the replacement program, particularly in the secondary and communication areas.

It is important to recognise that transmission investment is inherently lumpy in nature (as Figure 5.5.1 clearly illustrates) when reviewing actual expenditure in the current period and the forecasts for the upcoming period. While work programs are developed to allow some smoothing of work effort, expenditure will be subject to significant annual variation as major plant items are purchased. This is particularly the case where the overall program is dominated by a small number of large capital-intensive projects, as is the situation in SP AusNet's current station rebuilding and refurbishment program

The remainder of this section describes in more detail:

- the station rebuilding and refurbishment program; and
- Other major replacement programs.

5.5.2 Station Rebuilding and Refurbishment Program

The station rebuilding and refurbishment program constitutes 45 percent of total capex forecast for the forthcoming regulatory period. SP AusNet plans major work at the Brooklyn, Glenrowan, Geelong, Hazelwood, Keilor, Richmond, Ringwood, Thomastown and West Melbourne terminal stations during the period from 2008 / 09 to 2013 / 14. All these stations have substantial switchyard assets and/or transformer banks that are expected to reach an unacceptable risk of failure due to deteriorating condition during the period. The sections of the stations to be refurbished or rebuilt are outlined in Table 5.5.2.

Table 5.5.2 Station Refurbishment Program Forecast for 2008/09 to 2013/14

Station Switchyard to Rebuilt or Refurbished	22kV	66kV	220kV	500kV	Transformers	Expected status at end of period
Brooklyn TS	Y	Y	Y		Y	Complete
Glenrowan TS		Y	Y		Y	Complete
Geelong TS		Y	Y		Y	Complete
Hazelwood TS				Y		Complete
Hazelwood Power station			Y			Complete
Keilor TS		Y	Y	Y		Complete
Richmond TS		Y	Y		Y	In progress
Ringwood TS	Y	Y	Y		Y	Complete
Thomastown TS		Y	Y		Y	Complete
West Melbourne TS	Y	Y	Y		Y	Design/Procurement

Source: SP AusNet

The majority of terminal stations in the proposed program are metropolitan stations, in contrast to the current period, where the focus was on regional stations. With the risks on the regional network having been largely addressed in the current regulatory control period, the focus of the station rebuild program over next two regulatory periods will be on metropolitan stations.

Metropolitan stations generally supply much higher loads in comparison to regional stations, therefore, while the total number of stations in the proposal has reduced from twelve to eight, the number of bays actually being replaced will increase slightly from 42 to 45 bay replacements per annum for the next regulatory period. The number of transformer replacements will increase from 12 to 40 single phase and 3-phase transformers over the next period. The station rebuilds at Brooklyn, Glenrowan, Geelong, Richmond, Ringwood and Thomastown all involve replacement of one or more transformers at the site.

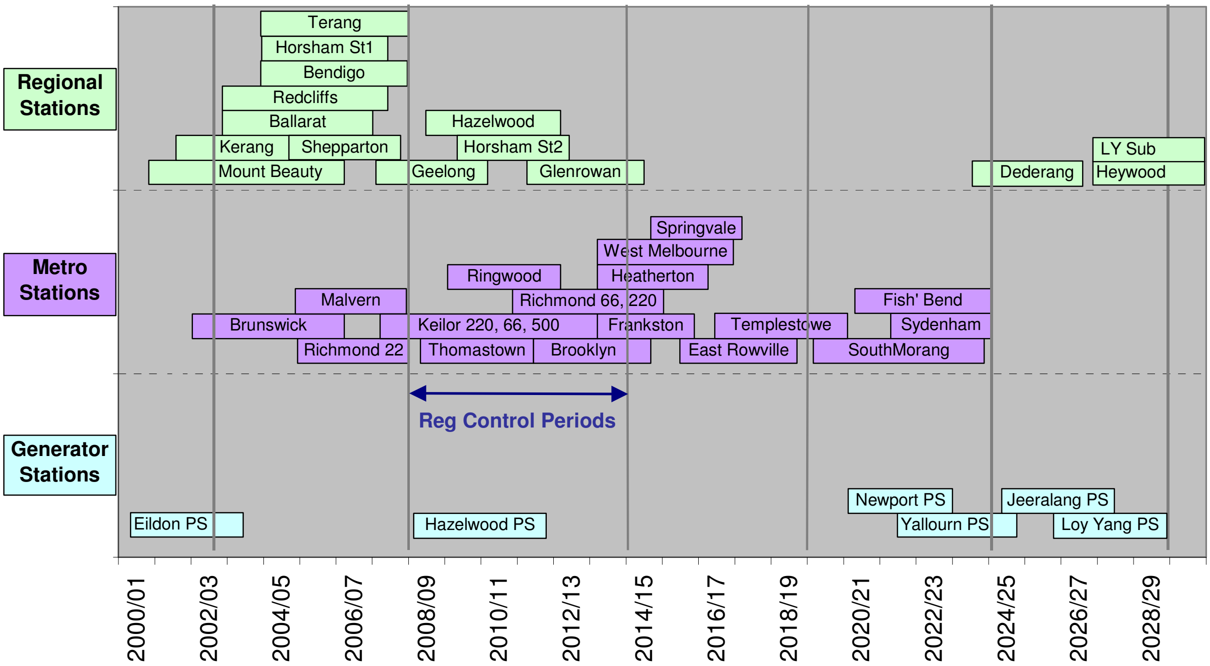
Substantial upgrading and replacement of secondary and communication systems is also included in these station rebuilds to ensure that overall reliability of each station is maintained in accordance with customers' needs and expectations, and to ensure that SP AusNet's network performance targets for the period can be met. Enhanced system capability of modern systems also allows more efficient utilisation of the higher cost primary system assets. Secondary and communications systems provide the core functionality for reliable automatic system operations that enable compliance with NEM operational requirements. Reliability and consistent performance are essential to:

- ensure that fault damage to primary equipment is minimised in the event of a problem on the network; and to
- rapidly isolate faulty equipment in order to maintain system stability.

Figure 5.5.3 provides a summary of the historic and proposed long-term station rebuilding and refurbishment program to illustrate the long-term nature of planning. The long-term station rebuilding and refurbishment program is updated annually as new information is assessed.

The station rebuild projects for the upcoming regulatory period are discussed in further detail in the following pages.

Table 5.5.3 Historic and forecast station rebuilding and refurbishment program, 2000/01 to 2029/30



Note: only major rebuilding projects shown, timing is indicative in later periods.
Source: SP AusNet

Brooklyn Terminal Station

Brooklyn Terminal Station (BLTS) supplies the inner western area of Melbourne. This area is primarily industrial including a dedicated supply to the furnace of a steel recycling mill, Melbourne's main sewerage pumping stations, several chemical plants (which have inherently high quality of supply requirements) and the commercial areas on the Western side of the Yarra River. The station has several interconnections at 66 kV with Altona Terminal Station via the distribution system and the combined load includes supply to regional areas such as Bacchus Marsh.

Brooklyn commenced operation as a 220 kV station in 1963 and has been expanded many times to incorporate developments such as the Newport Power Station connection. The development sequence left the terminal station with divided 220 kV switchyards, a large number of very old single-phase transformers (in fact, the oldest on the Victorian transmission network), and an outdoor 22 kV switchyard. The large number of individual plant items means that the site is very heavily utilised and there is little room for expansion. Furthermore, much of the station equipment is near end of life with 220 kV air-blast CBs, 66 kV minimum oil and bulk oil circuit breakers and transformers showing deteriorated condition, lack of manufacturers' support and no availability of spares.

This project covers the redevelopment of BLTS including the 220 kV, 66 kV and 22 kV switchyards, the replacement of all the transformers at the site and associated secondary equipment and control systems.

Glenrowan Terminal Station

Glenrowan Terminal Station (GNTS) supplies the rural area of north-eastern Victoria, including the cities of Wangaratta and Benalla, and provides back up for the single transformer station at Mt Beauty.

Glenrowan Terminal Station was established in the mid 1960s. The 220 kV air-blast circuit breakers, 66 kV minimum oil and bulk oil circuit breakers and transformers are showing deteriorated condition, lack of manufacturers support and availability of spares. A large number of the 220 kV and 66 kV supporting assets are all in the latter part of their technical lives.

This project includes the redevelopment of the Glenrowan Terminal Station 220 kV and 66 kV switchyards and the replacement of one of the single-phase transformer banks at the site as well as associated secondary equipment and control systems.

Geelong Terminal Station

Geelong Terminal Station (GTS) is the main source of supply for over 124,000 customers in Geelong, Corio, North Shore, Drysdale, Waurn Ponds and the Surf Coast. The terminal station consists of a 220 kV and 66 kV switchyard and three 150 MVA 220 / 66 kV transformers.

A large number of the 220 kV and 66 kV assets at GTS have been in service since its establishment in the mid 1960s and all are in the latter part of their technical lives. In particular, air-blast circuit breakers in the 220 kV switchyard and bulk oil and minimum oil circuit breakers in the 66 kV switchyard require urgent replacement. Transformer assessments also indicate that two transformers will require replacement.

The station refurbishment has been divided into two stages to address the more urgent work in the 220 kV yard during the first stage and replacement of the transformers, and the 66 kV circuit breakers in the second phase. This flexibility allows Stage 2 to be co-ordinated with the future East Geelong Terminal Station customer augmentation project planned by VENCorp and Powercor for the Geelong region as this augmentation will require significant outages at GTS as when the new terminal station is cut into the network.

Hazelwood Terminal Station

Hazelwood Terminal Station (HWTS) is one of the most important terminal stations in the Victorian electricity network. Located in the Latrobe Valley, HWTS is one of the main connection points for generation to the 500 kV transmission network. HWTS effectively comprises two separate switchyards operating at 500 kV, the northern switchyard (developed in the early 1970s as part of the original 500 kV system) and southern switchyard (developed in the early 1980s when the major expansion of the 500 kV system occurred).

In the northern switchyard, the 500 kV airblast circuit breakers and CTs have been in service since the early 1970s. Much of the northern 500 kV switchyard station equipment is near the end of its reliable service life with the air-blast circuit breakers and CTs demonstrating deteriorated condition, lack of manufacturers' support and no availability of spares.

This project covers the refurbishment of HWTS northern 500 kV switchyard including replacement of all 500 kV airblast circuit breakers, and associated CTs, CVTs, secondary and control systems. The station refurbishment will also involve the removal of asbestos.

Hazelwood Power Station

Hazelwood Power Station Switchyard provides the connection point to the transmission network for the associated coal fired power station in the Latrobe Valley. It comprises a 220 kV switchyard.

The station was developed in the early 1960s to allow for the connection of Hazelwood Power Station. Substantial parts of the switchyard were upgraded in the current period as part of VENCorp's augmentation program addressing fault level problems on the network. The remaining 220 kV bulk oil circuit breakers from the 1960s are exhibiting deteriorated condition, lack of manufacturers' support and no availability of spares.

The project comprises a staggered replacement of the 220 kV circuit breakers. The schedule is staggered to align with maintenance outages of the generator units. This work completes the refurbishment of the switchyard.

Keilor Terminal Station

Keilor Terminal Station (KTS) is a very large metropolitan terminal station located in Greater Melbourne's northwest. It was first established in the 1960s, however, it became the first connection point for the 500 kV system for the metropolitan area when the lines were constructed from the Latrobe Valley in 1970. It is comprised of three switchyards operating at 500 kV, 220 kV and 66 kV. It is a major transformation point for the 500 kV system to supply the western 220 kV metropolitan loop including terminal stations located in Geelong, Thomastown, West Melbourne, Brooklyn and Altona. The station also has many 66 kV feeders supplying customers in Airport West, St. Albans, Sunshine, Melton, Woodend, Pascoe Vale, Essendon and Braybrook.

The station's 500 kV airblast circuit breakers and CTs have been in service since 1970. Much of the station equipment is near the end of its reliable service life with the air-blast circuit breakers and CTs demonstrating deteriorated condition, lack of manufacturers' support and no availability of spares. Likewise, much of the 220 kV air-blast circuit breakers, 66 kV minimum oil and bulk oil circuit breakers that have been in service since the 1960s are also exhibiting deteriorated condition, lack of manufacturers' support and no availability of spares.

This project covers the redevelopment of the Keilor Terminal Station (KTS) 500 kV, 220 kV and 66 kV switchyards including replacement of all 500 kV airblast circuit breakers, all CTs, CVTs and associated secondary and control systems and of all 220 kV airblast circuit breakers, and most CTs, CVTs, isolators and associated secondary and control systems.

Richmond Terminal Station

Richmond Terminal Station (RTS) provides the major supply to the Eastern Central Business District and wide-spread inner suburban areas in the east and south-east of Melbourne, including Fitzroy, Collingwood, Abbotsford, Richmond, North Richmond, Hawthorn, Camberwell, Gardiner, Toorak, Armadale, South Yarra, St Kilda, Elwood and Balaclava. The station also provides supply to City Link and public transport railway substations. The Terminal Station site is on the banks of the Yarra River with no spare land available.

The station's 220 kV supply was established in 1964 and the majority of the 220 kV, 66 kV and 22 kV switchyard equipment was installed at this time. The station's antiquated 220 kV switching arrangement means it is possible to lose 2 lines and 3 transformers from a single CB failure. This is no longer appropriate for modern design, planning and maintenance standards at a station supporting a major city's central business district.

The 220 kV switchyard is situated in a very compact area that would require significant disruption if equipment was required to be replaced in situ. There is very little space for access by cranes or mobile plant, which makes replacement work difficult and increases the outages required for the work. In addition, there is no space to increase the station capacity or to improve the switching configuration with the existing arrangement.

The need to maintain highly reliable supplies for the CBD load during construction places high emphasis on minimising outages and risks associated with relocating plant and equipment. These factors require the replacement of the existing 220 kV switchyard with indoor gas insulated switchgear (GIS) equipment that provides independent switching for all lines and transformers. Replacement of ageing 150 MVA 220 / 66 kV transformers with larger 225 MVA units is also required to create more space to facilitate the refurbishment and provide for further capacity expansion.

The 66 kV switchyard was constructed on landfill using driven piles for equipment and rack foundations. There has been significant subsidence at the station and currently the use of mobile plant is restricted. Much of the equipment is original with the majority of the circuit breakers the bulk oil type. Replacement of some early minimum oil 66kV circuit breakers has already been necessary following some failures.

In addition, the towers that transfer the transformer connections to the 66 kV switchyard no longer satisfy health and safety requirements, and any maintenance work required will require additional outages. These factors require the replacement and relocation of the 66 kV switchyard onto land vacated by the dismantling of the old outdoor 220 kV switchyard. This work will be largely completed in the regulatory control period starting in 2014/15.

Significant replacement of protection, control, metering and communications equipment is also required.

Ringwood Terminal Station

Ringwood Terminal Station (RWTS) is an urban terminal station located in the east of Melbourne. The station's supply area spans from Lilydale and Woori Yallock in the north-east; to Croydon, Bayswater and Boronia in the east; and Box Hill, Nunawading and Ringwood more centrally. It is connected to the 220 kV transmission system by overhead lines from both Rowville Terminal Station and Thomastown Terminal Station. It provides supply to the Ringwood and Mitcham areas via SP AusNet's and Alinta's distribution networks.

Ringwood Terminal Station was established in the mid 1960's and consists of 220 kV, 66 kV and 22 kV switchyards and 220 / 66 kV and 220 / 22 kV transformer banks. Many of its assets are approaching the end of their technical lives with increasing risks in terms of performance, cost and reliability.

The proposed capex program covers the redevelopment of the RWTS 220 kV, 66 kV and 22 kV switchyards and the replacement of all the 220 / 22 kV transformers at the site as well as associated secondary equipment and control systems.

Thomastown Terminal Station

Thomastown Terminal Station (TTS) is one of the earlier stations established in the metropolitan area (first commissioned in 1958) and has gradually expanded with the overall growth of transmission network to be a very large station.

The station supplies the Thomastown area and extends to the rural areas of Kilmore, Eildon and Seymour. The station is also a major point of supply for the eastern 220 kV metropolitan loop including Brunswick, Richmond, Templestowe and Ringwood Terminal Stations, and is the connection point for the NSW interconnector via 330 / 220 kV transformation at South Morang Terminal Station. The station now has ten 220 kV lines connected to the station and five 220 / 66 kV transformers supplying the 66 kV switchyard.

Much of the station equipment is near the end of its life. The 220 kV air-blast and bulk oil circuit breakers and 66 kV minimum oil and bulk oil circuit breakers are indicating deteriorated condition, lack of manufacturers support and availability of spares. In addition, assessments of the transformers indicate that two transformers require replacement.

Fault level limits restrict SP AusNet's ability to take outages at the station; therefore, the redevelopment project will be coordinated with the completion of the South Morang Terminal Station augmentation project. This project will reduce the loading on TTS, facilitating the required construction outages. Nonetheless, substantial temporary work will have to be undertaken to avoid long outages that expose customers to an unacceptable risk of losing supply.

This project includes the redevelopment of the TTS 220 kV and 66 kV switchyards and the replacement of the No 2 and No 3 220 / 66 kV transformers, including various associated secondary equipment and systems.

West Melbourne Terminal Station

West Melbourne Terminal Station (WMTS) supplies the western CBD plus the surrounding residential, commercial and industrial area. It is located on a relatively small site that is almost fully developed. The station is supplied at 220 kV and has both 66 kV and 22 kV supplies to Citipower and AGL. There are four 150 MVA, 220 / 66 kV transformers and two 165 MVA 220 / 22 kV transformers. Much of the existing equipment was installed in 1964. Expansion at the site is difficult due to limited space.

The redevelopment is driven by reliability considerations, load criticality and asset performance particularly as there are limited spares available, several faults have already been experienced and the manufacturer has withdrawn further support for many of the circuit breakers.

The redevelopment of West Melbourne Terminal Station will comprise 4 major stages, namely:

- replacement and conversion of the 220 kV switchyard to indoor GIS switching;
- replacement of the 66 kV switchyard;
- replacement of the 22 kV switchroom; and
- replacement of the 220 / 66 kV and 220 / 22 kV transformers.

The need for redevelopment will commence in the forthcoming regulatory period with the 220 kV switchyard. The last three stages will be completed during the regulatory period commencing in 2014 / 15.

The 220 kV switchyard will be rebuilt as an indoor GIS switchyard, allowing for the connection of four lines and seven transformers with 220 kV cable connections from the switchyard to the transformers. Protection and control systems for the 220 kV switchyard will also be replaced and fire systems and auxiliary supplies upgraded.

Implementation of the replacement program will require the transfer of load to adjacent stations to permit adequate outages for the work. This unavoidable requirement leads to considerable additional costs.

5.5.3 Other Major Replacement and Operational Compliance Programs

These programs cover more specific asset replacement and compliance requirements in locations that do not justify a major station rebuilding and refurbishment program. This may occur for a number of reasons, including:

- to address identified fleet problems,
- to replace assets that predate the majority of the station, perhaps due to small scale initial development;
- to replace assets that deteriorate more quickly than the majority of assets at the station. For example, the very high workload of circuit breakers used to switch capacitor banks substantially shortens their effective technical lives; and
- enable compliance with Technical Standards, which are defined in Schedule S5 of the National Electricity Rules and operational requirements set by NEMMCO.

The replacement and operational compliance projects constitute 30 percent and 5 percent of the total capex program respectively. The major programs and projects in this category relate to switchbays, transformers, secondary and communications systems, reactive, and towers and lines. Both programs are shown because the operational compliance program is integrated with the secondary and communication replacement program.

Table 5.5.3 provides a summary of the proposed expenditure in relation to each of these programs.

Table 5.5.3 Other Replacement Capex Programs 2008/09 to 2013/14 (Real 2007/08 $M)

	Average 2003/4 to 2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Secondary		14.6	13.4	11.2	16.9	9.0	7.0
Switchbays		8.7	10.5	16.1	11.0	11.5	1.6
Transformers		9.9	0.0	1.6	5.6	7.1	12.8
Reactive		6.9	1.2	4.3	10.0	1.4	11.2
Towers and lines		3.3	4.8	2.9	6.3	7.8	4.0
Establishment		4.4	3.7	2.0	4.3	1.6	1.3
Communications		0.2	2.1	14.8	13.4	0.0	1.8
Total	**27.8**	**48.0**	**35.6**	**52.8**	**67.5**	**38.5**	**39.8**
Operational Compliance	1.3	9.0	2.3	21.0	13.4	0.0	0.0

Note: Capex as commissioned (6 months IDC excluded)
Source: SP AusNet

Each replacement program is explained in further detail in the remainder of this section.

Switchbays

SP AusNet has a number of terminal stations where there is a variety of circuit breakers, including different types, ages and operating practices or duty cycle. For example, a station switchyard may contain a majority of new breakers installed to address rising fault levels leaving some older air-blast or bulk oil circuit breakers to switch other circuits where the fault duty is not as onerous. Where these remaining breakers present an unacceptable failure risk due to deterioration or rising maintenance cost to keep them in service, a replacement program has been forecast for the forthcoming regulatory control period.

There are also some 500 kV circuit breakers that will not achieve their expected technical life as faults are emerging in the operating mechanisms and high pressure interrupting heads making replacement necessary.

Other items of switchbay equipment such as instrument transformers and surge arrestors also require replacement, in accordance with existing programs aimed at addressing fleet problems. For example, the program covering the removal from service of high voltage oil filled instrument transformers fleets where test results showed serious problems, including an elevated risk of explosive failure (as discussed in chapter 3).

Therefore, these programs largely consist of the replacement or refurbishment of switching equipment, including fleet replacements, outside of the main station replacement program. The main driver of these programs is switching equipment where the forecast asset failure risks on the network or cost of operation are unacceptable usually due to specific fleet problems. The program also targets assets where replacements contribute to VENCorp's fault level mitigation program. Specific projects in this category are:

- replacement of 500 kV circuit breakers at generation connection stations;
- replacement of bulk oil circuit breakers at several stations where other switchyard equipment has already been replaced, either for fault level purposes or they were part of the fleet replacement of air-blast circuit breakers;

- replacement of older 22 kV switchbays where SP AusNet owns the transformer and bus tie circuit breakers, and the feeder switching is owned by distribution businesses;
- replacement of current transformers and voltage transformers; and
- replacement of gap type surge arrestors.

Transformers

Terminal Stations are generally established with one or two transformers of sufficient capacity to meet the initial loading requirements of the station. Transformers are subsequently added to each station in order to meet load growth, until the ultimate capacity of the station is reached. The ultimate capacity is dictated by the constraints of the land area of the station, either to accommodate the number of transformers and associated switchgear, or to allow sufficient space for the number of distribution lines required to provide supply from to the station. Security considerations also dictate that the capacity of stations be limited, so that there is not undue dependence on a supply from single location.

As well as being added progressively, it was also common in the early development of the Victorian transmission network to shift transformers from one station to another. This facilitated more economic development of the system as load increased at each station. For example, a small transformer installed at a station to meet a modest level of initial load could later be transferred to establish another new terminal station, being replaced at the original station with a larger transformer. As a result, it is common for a transformer and its associated switchgear to differ in age from the majority of the other assets at the same terminal station. This practice is not as common now, due to the higher labour costs required to shift existing transformers.

In addition to the station rebuild program which addresses transformers at those stations in the replacement program, this program has been developed to address single transformers and associated equipment that have been identified as requiring replacement. The main driver of this program is the need to ensure asset failure risks on the network are addressed. This program largely consists of the replacement or refurbishment of ageing and deteriorating transformers, bushings and cooling systems.

Specifically, there are two transformers in the regional network where replacement is needed at Dederang and Bendigo Terminal Stations. Two metropolitan transformers are also forecast to need replacement during the forthcoming regulatory period at Heatherton and Ringwood Terminal Stations.

There is a large metropolitan fleet of 150 MVA transformers, purchased in the 1960s that are exhibiting deterioration. Further assessment is required before making specific replacement decisions; however, there will be a continuing transformer replacement program in the future. A number of the transformers in need of replacement will be included in the ongoing main station replacement program.

Secondary and Communications Systems

Secondary systems include protection and control schemes, and associated ancillary equipment that are essential for providing fault and emergency response for the network. As such, these systems provide the core functionality for reliable automatic system operations that enable compliance with Technical Standards, which are defined in Schedule S5 of the *National Electricity Rules* and operational requirements set by NEMMCO.

Reliability and consistent performance of protection and control schemes are essential to automatically minimise fault damage to primary equipment, in the event of a problem on the network and to rapidly isolate faulty equipment, in order to maintain system stability.

The secondary capex program consists mainly of:

- replacement and expansion of the Supervisory Control and Data Acquisition (SCADA) network to improve control and information flow;
- replacement of EHV protection systems on transformers and lines;
- replacement of HV feeder protection systems;
- replacement of station control and metering systems (unsupported technology);
- development of contingency plans and emergency response equipment; and
- replacement and duplication of AC and DC supplies to stations.

Early generations of protection and control equipment do not have the functionality required to meet new compliance standards and SP AusNet asset management requirements. Ensuring compliance with the *National Electricity Rules* in the areas of EHV protection operating speeds and redundancy is a specific focus of SP AusNet's protection programs (Schedule S5).

In particular, expenditure is driven by the compliance requirements of:

- Clause S5.1a.8 – fault clearance times;
- Clause S5.1.2.1 – credible contingency events (particularly section (d) relating to protection reliability);
- Clause S5.1.9 – protection systems and fault clearance times (particularly section (d) which mandates a high level of redundancy within the protection and communications areas); and
- the new NEMMCO Data Communications Standard that was introduced during the current reset period (driving a large component of the SCADA/RTU upgrade works programme).

Traditionally, the focus of secondary systems has been on the protection and control of the system to deal with emergency conditions. The advent of new technology has allowed an increasing tendency for the development of specialised control schemes to facilitate specific responses to system conditions, in order to increase the utilisation of the network, and/or to defer the need for more expensive primary plant augmentation.

As secondary systems mainly involve low current electronics, and more recently, digital technology, this equipment has a much shorter life than the primary plant. More frequent replacement is necessary to ensure continuing reliability of this key equipment, and take advantage of the quantum leap that has occurred both in the functionality and reliability of this equipment. This allows the benefits of new technology to be incorporated into the program to ensure that the schemes that are in place provide a modern and up-to-date facility that can provide the most effective utilisation and control of the system.

The communication network provides the links between the protection schemes at terminal stations and carries SCADA to the Operations Centre, equipment monitoring information and independent telephony. The existing network comprises, optic fibre, radio, powerline carrier (PLC) and copper supervisory systems all with associated terminal equipment.

The communications network also must comply with the NEM operational standards by providing the required level of high-speed communications redundancy for key transmission line protection schemes. As the network grows, the standards and information flows for asset and network performance increases. This creates a need to expand the capacity of the communications network. At the same time, the existing PLC equipment is no longer supported by manufacturers and the replacement of PLC with optical fibre ground wire (OPGW) is a key strategy to achieve the required increased communications capacity and also overcome the supportability issues.

NOTE: NUMBERS IN TABLES MAY NOT ADD TO TOTAL DUE TO ROUNDING.

Therefore, expenditure plans include replacement of some of the PLC equipment that is old and of limited capacity, with OPGW or radio links. SP AusNet also plans to implement serial communications between station devices and replace existing wire control cabling.

All of these proposed expenditures are critical to the maintenance of effective and reliable secondary and communications systems, which in turn are essential to the maintenance of a reliable transmission network. As already noted, in accordance with SP AusNet's Asset Management Strategy, the proposed expenditures are optimised to ensure delivery of the required level of functionality at minimum total life cycle costs.

Reactive Plant

Reactive plant includes capacitor and reactor banks, Static Var Compensators (SVCs), and synchronous compensators. The provision of sufficient reactive plant is critical in allowing the transmission system to support peak demands during summer. Increased air conditioning load is one of the main drivers for the provision of reactive power by the network, since this load consumes high levels of reactive power. VENCorp established a program to install reactive plant over the last 10 to 15 years on a continuing basis to ensure that there is sufficient network capacity to meet the increasing peak summer demands.

Therefore, it is imperative that this plant operates in a highly reliable manner during the peak summer period. Any outages of reactive plant may impact on the ability of the overall system to supply peak summer demand in a secure and reliable manner.

In addition, reactive plant is important to ensure that the overall system may be operated in compliance with the strict voltage limits that are applied by NEMMCO. Any departure from these, as a result of unsatisfactory operation or availability of key items of reactive plant, may result in voltage control problems with the potential to cause widespread voltage collapse and shut down of the system.

Reactive plant provides a location-specific service and it is difficult to supplement shortfalls from a remote location (i.e. through interconnectors) under extreme system conditions, meaning that all reactive plant items are required to operate reliably at times of system peak demand.

This program largely consists of the replacement or refurbishment of reactive plant and its' associated high-use switchgear. The main determinants of expenditure under this program are the following factors:

- equipment assessed with an asset failure risk in excess of the established critical threshold level will be programmed for replacement, and
- there may be opportunities for new technology to be introduced, to significantly improve operational response, and to improve the reliability of the equipment.

A number of the older 66 kV capacitor banks and reactors are time-switch controlled, and operate on a daily or twice-daily cycle. (In contrast, general switchyard equipment is operated only a few times a year). These capacitor banks are showing deterioration with an increasing number of elements failing, and the associated circuit breakers are deteriorating because of the high number of operations involved.

The three large synchronous condensers continue to provide significant operational challenges, as they are around 50 years old, and have exhibited several problems as they continue to be operated beyond their expected their technical life. These include:

- the rotating equipment incurring significant mechanical wear and deterioration due to constant operation;
- ageing insulation is increasing observable faults within the machines; and
- the 1970's vintage control circuits in which functionality does not match current standards.

One major refurbishment to extend the technical life of one of these synchronous condensers is to be completed in the current regulatory period. Refurbishments of the two remaining units are programmed for the forthcoming period. It must be recognised that synchronous condensers are rotating machines – similar to generators – and require substantial maintenance and replacement to ensure reliable operation into the future.

Static Var Compensators (SVCs) provide a similar dynamic reactive response to the synchronous condensers, although this is achieved by rapid switching and continuous control of static reactive plant. They were installed in the early 1980s. The SVCs have thyristor switching for both capacitive and reactive elements, and these are beginning to fail due to ageing and deterioration. The SVCs' control circuitry is the original equipment and was one of the earliest applications of the then new digital technology control systems in the world. Faults are becoming difficult to remedy in the obsolete circuitry particularly when spares are unavailable. It is now economic to replace the SVC thyristor stacks with new technology devices and the control circuitry for the SVCs is scheduled for replacement with modern digital systems in the forthcoming regulatory period.

Towers and Lines

There are essentially three components of the transmission lines:

- towers;
- conductors; and
- insulators and fittings.

The forecast lines program largely consists of the replacement of insulators and fittings on the conductors. The main drivers of this program are compliance with occupational health and safety standards, the achievement of reliability and availability targets, and the forecast failure risks associated with these assets.

There has been a regular program of insulator and fitting assessment and replacement over the past seven years and this is forecast to continue for another 8 to 10 years. This replacement program ensures reliable performance of the lines by avoiding line faults due to insulator failure and hence the possibility of market constraints.

Dropped conductors also can occur as a result of broken fittings or insulators. This risk has particularly high impact on public safety where lines cross private and public land including major highways and railways. Consequently, expenditure is required for:

- the replacement of line insulators and fittings as determined by their condition and loss of electrical or mechanical strength; and
- the securing of lines at major road crossings and rail crossings to minimise the risk of dropped conductors.

5.6 Compliance-related Capital Expenditure

5.6.1 Overview of Historic and Forecast Capital Expenditure

These programs address compliance with specific legislation, rules or standards. The programs relate to:

- occupational health and safety;
- security measures for critical infrastructure;
- environmental obligations

Table 5.6.1 summarises forecast compliance-related capital expenditure.

Table 5.6.1 Non-Replacement Capex Programs 2008/09 to 2013/14 (Real 2007/08 $M)

	Average 2003/4 to 2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
OH&S	4.1	10.3	14.1	12.4	13.6	10.2	5.6
Security	2.8	8.2	3.0	3.2	5.9	2.6	1.5
Environmental	3.9	2.7	1.9	2.9	2.1	1.6	1.6
Total	**10.8**	**21.2**	**19.0**	**18.6**	**21.6**	**14.3**	**8.7**

Note: Capex as commissioned (6 months IDC excluded)
Source: SP AusNet

5.6.2 Occupational Health and Safety

SP AusNet is committed to providing a safe and healthy workplace for employees and contractors. SP AusNet's Occupational Health and Safety Management System (OHSMS) for transmission assets is certified against the AS/NZ 4801 standard and compliance is checked by regular internal and external audits.

Compliance with the new Victorian *Occupational Health and Safety (Prevention of Falls)* regulations require more rigorous job safety assessments and the increased use of ladders, motion control screens, fall restraint systems, mobile plant, scaffolds, handrails and walkways to ensure the safe performance of work at heights greater than two metres. In response, SP AusNet has initiated a 15-year *Tower Safe Access* program, which will include an additional $36.5 million (in 2007 / 08 dollars) of expenditure over the forthcoming regulatory period.

Pending recommendations from the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) on electro-magnetic fields (EMF), SP AusNet expects to be required to implement additional control measures to ensure safe working conditions near energised, extra-high voltage electrical equipment. Expenditure for this possible program has not been included in this proposal, however, future expenditure related to such a change will constitute a "service standard event" for the purposes of Clause 6A.7.3 (cost pass through) of the NER.

5.6.3 Security Measures for Critical Infrastructure

SP AusNet has more than 100 terminal stations, communication installations, depots and offices that require security. Relevant assets include more than 56 km of security fences, 216 buildings, electronic access controls, intrusion detectors, CCTV cameras, alarm systems and communications to the Network Operations Centre. The state and federal governments have designated selected electricity transmission sites as 'Critical Infrastructure'.

The security related expenditure programs ensure that SP AusNet complies with the Victorian Terrorism (Community Protection) Act 2003 and results of assessments undertaken under the *National Guidelines for Protecting Critical Infrastructure from Terrorism* and *ENS/ESAA Guidelines for Prevention of Unauthorised Access to Electricity Infrastructure*. Many of these are a continuation of programs commenced in the current regulatory period.

These programs consist of the progressive introduction, improvement and integration of security measures including, fencing, electronic access controls, intrusion detectors, closed circuit television cameras, security lighting, building exterior hardening and remote alarm monitoring by our Network Operations Centre.

5.6.4 Environmental Obligations

SP AusNet is required to upgrade its facilities to comply with various environmental obligations, particularly for the progressive completion of oil spill containment and site water treatment plants at terminal stations. There will also be minor environmental capex works required during the period for noise abatement and land management. These include:

- installation and upgrading of oil containment facilities to comply with EPA Victoria's 'Bunding Guideline Publication 347', AS1940 and standards on water quality discharges;
- noise abatement works to comply with the State Environment Protection Policy (Control of Noise From Commerce, Industry and Trade); and
- visual intrusion works improving the appearance of existing installations and amending the design of new installations to secure community support.

5.7 Non-system Capital Expenditure

5.7.1 Overview of Historic and Forecast Capital Expenditure

These programs address non-system capex needs in the forthcoming regulatory control period. Non-system capex includes:

- business information technology (IT); and
- other business support investment such as the fit out of premises, and the purchase of tools and vehicles.

Table 5.7.1 summarises historic and forecast non-system capital expenditure.

Table 5.7.1 Non-System Capex Programs 2008/09 to 2013/14 (real 2007/08 $M)

	Average 2003/4 to 2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Business IT	7.3	8.9	9.5	6.0	6.8	8.2	7.6
Support the Business	5.8	2.4	2.4	2.4	2.4	2.4	2.4
Total	**13.2**	**11.3**	**11.8**	**8.3**	**9.1**	**10.6**	**10.0**

Note: Capex as commissioned (6 months IDC excluded)
Source: SP AusNet

5.7.2 Business Information Technology

Outside of the major SCADA upgrade, which is included as part of the secondary systems program, IT expenditure for the forthcoming regulatory period is forecast to be $47 million (in 2007 / 08 dollars). This includes many automation projects and programs in the areas of Network Management and Asset Management. The provision of appropriate IT infrastructure necessary to support and maintain a technically demanding IT environment comes at a significant cost. Furthermore, the essential replacement of desktop and laptop hardware, together with up-to-date servers and systems to host the ever-increasing software demands, is a necessary investment in this industry.

5.7.3 Support the Business

Inventory movement

This covers the expected increase to inventory holdings each year. The increase is consistent with historical levels.

Premises

This program involves the refurbishment of SP AusNet's non-system buildings. Expenditure is below historical levels as the fit out of the consolidated head office was completed during the current regulatory period.

Motor Vehicles and Mobile Plant

This program involves the replacement of the vehicle fleet and specialised mobile equipment to allow safe access to terminal station plant and lines for maintenance and construction. Expenditure is consistent with historical levels.

Other Tools, Equipment and Miscellaneous Assets

This program involves the replacement of tools and equipment required to maintain the network. Expenditure is consistent with historical levels.

5.8 Program Deliverability

The replacement capex program for the forthcoming regulatory period represents a material increase in expenditure from the level undertaken in the current period. As such, it is important to demonstrate that such an increase is achievable.

Therefore, the increased program must be assessed against of the total capex managed by SP AusNet in Victoria. For example, in 2006 / 07, SP AusNet is forecasting to spend $400 million across its gas and electricity networks. Thus, the real increase of 53 percent for non-augmentation capex represents just a 30 percent increase in total transmission capex (including augmentation) and 12 percent of total SP AusNet capex.

SP AusNet has demonstrated during the current period it can successfully manage an increase in capex of this order. The average capex during 2003 / 04 to 2007 / 08 was substantially higher in real terms than the period from 1998 to 2002. SP AusNet's experience in efficiently executing its previous capital expenditure program is reflected in its Project Delivery Model, which is described below.

5.8.1 Program Delivery Model

Program Optimisation

Work arising from SP AusNet's expenditure plans is bundled into projects to ensure that the delivery of this work is cost effective and minimises outages. This optimisation takes into account forecast works across the major categories of primary, secondary and communications equipment.

Design

The provision of design services has been restructured, by tendering standard work packages and selecting a number of service providers based on price, quality and performance. This process results in more efficient specification and delivery of design services at lower costs and within reduced timeframes.

Purchasing

A strategic purchasing group has been established to deliver efficiencies in purchasing due to the volume of works and the price pressures in the market. This is a critical initiative to minimise cost increases and includes forming long-term supplier contracts, where benefits accrue to both parties in the form of more stable pricing. SP AusNet also benefits from the lower pricing offered for increased order volumes.

Installation

Installation services are tendered out on a competitive basis to the installation service provider panel and internal benchmarks are established to provide an indication of fair market rates.

Both capex and maintenance services are provided by internal and external service providers. The decision to use external service providers has been optimised based on the strategic importance of the work and the most efficient delivery model for the services. External work is sourced by competitive tendering.

For internal and external service providers, benchmark measures are established to monitor costs and performance.

5.9 Summary

The proposed capex program continues and builds on the successfully completed capex program for the current regulatory control period.

In light of the company's 2002 revenue proposal, the requirement to increase capital expenditure in the forthcoming regulatory control period is not unexpected. The programmed increase in the volume of capital works is driven by:

- the continued rollout of the major terminal station rebuild projects. This includes more difficult and complex work in confined city sites, where supply must be fully maintained throughout the renewal work and conversion to more expensive, compact gas-insulated switchgear is required to allow for expansion to meet future demand;
- a substantial increase (from 12 to 40) in the number of transformers being replaced over the period; and
- there is further expansion in the amount of compliance-related expenditure required in relation to occupational health and safety, environmental protection and infrastructure security. This expenditure is not discretionary.

In addition to this anticipated increase in the volume of capital expenditure, a number of external factors are acting to put upward pressure on input prices, and this will exacerbate the required increase in capital expenditure.

The capital expenditure program in this proposal is predominately based on the replacement of existing assets, as their condition deteriorates, to ensure the ongoing reliability and security of the transmission network. This is to be expected as the majority of SP AusNet's 220 kV system and associated 22 kV and 66 kV connection assets at terminal stations were built between 1955 and 1970. Primary Terminal Station assets are expected to last 45 years on average, although the range is generally between 40-50 years, depending on the actual condition of the asset.

The capital expenditure program represents an optimal balancing of the costs of asset replacement and maintenance on the one hand and the risk and costs of deteriorating reliability and asset performance on the other. The program is aimed at ensuring the ongoing maintenance of network reliability and service standards in accordance with customers' needs whilst minimising the total life cycle cost of service.

6 Operating Expenditure Proposal

6.1 Introduction

Clause 6A.6.6 of the National Electricity Rules (NER) requires SP AusNet to present its opex requirements for the forthcoming regulatory control period in order to:

- meet the expected demand for prescribed transmission services over that period;
- comply with all applicable regulatory obligations associated with the provision of prescribed transmission services; and
- maintain the reliability, safety and security of the transmission system through the supply of prescribed transmission services.

In addition, Schedule 6A.1.2 describes the type of accompanying information that SP AusNet must provide in order to explain and justify its forecast operating expenditure (opex). In light of these requirements, this Chapter provides:

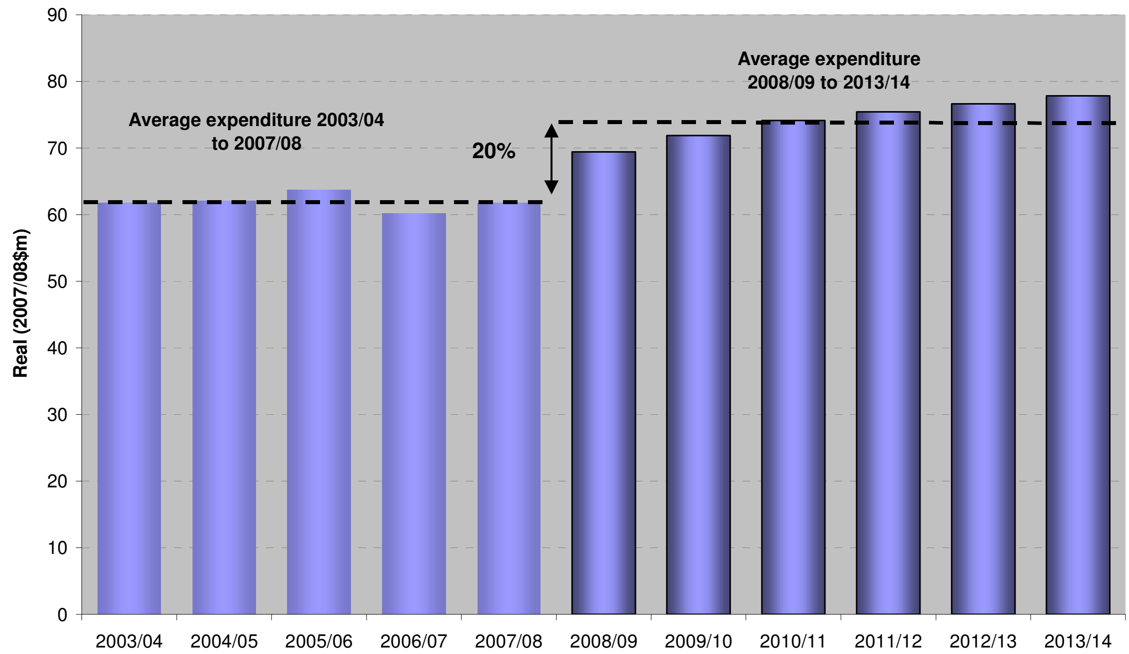
- an overview of historic and forecast opex;
- a description of factors that will affect opex in the forthcoming regulatory control period;
- a brief description of the forecasting methodology employed and the assumptions underpinning the opex forecast;
- a detailed presentation of SP AusNet forecast opex, for each of the following categories;
- routine maintenance;
- asset works;
- corporate costs;
- other costs; and
- concluding comments.

6.2 Overview of Historic and Forecast Operating Expenditure

An overview of SP AusNet's historic and forecast opex is provided Figure 6.2.1. In summary, this information indicates that total operating expenditure must increase in the forthcoming regulatory control period if SP AusNet is to satisfy its compliance obligations and to meet the needs of its customers.

Despite the upward pressures on operating and maintenance expenditure (explained in detail below), SP AusNet will continue to contain expenditure over the forthcoming regulatory control period. Average annual expenditure for the forthcoming regulatory period is expected to increase by 20 percent in real terms compared to the average annual expenditure in current period.

Figure 6.2.1 Real Opex 2003/04 to 2013/14 (Actual and Proposed) (real 2007/08 $m)*



* Actual to December 2006, forecast to 2013/14

* From 2003/04 to 2007/08 excludes easement tax, glide path for opex, debt and equity raising costs and rebates, from 2007/08 to 2013/14 excludes easement tax, glide path for opex, debt and equity raising costs and rebates, however, it includes SP AusNet's claim for self-insurance.

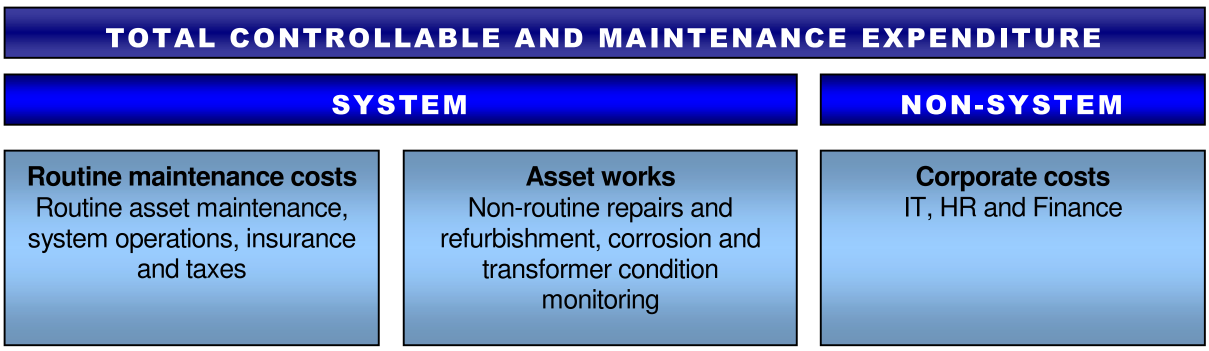
Source: SP AusNet

SP AusNet distinguishes between three principal types of opex for performance monitoring purposes:

- Routine maintenance and operations – system recurrent costs directly attributable to maintaining and operating the transmission network including maintenance and other costs such as insurance and taxes;
- Corporate Support – non-system recurrent costs that encompass activities and services which are not directly related to maintaining or operating the network including finance, Information Technology (IT) and Human Resources (HR); and
- Asset works – non-recurrent system costs that are directed at addressing specific problems on the transmission system.

Figure 6.2.2 provides a framework for categorizing operating expenditure between system and non-system costs.

Figure 6.2.2 SP AusNet's Opex Framework

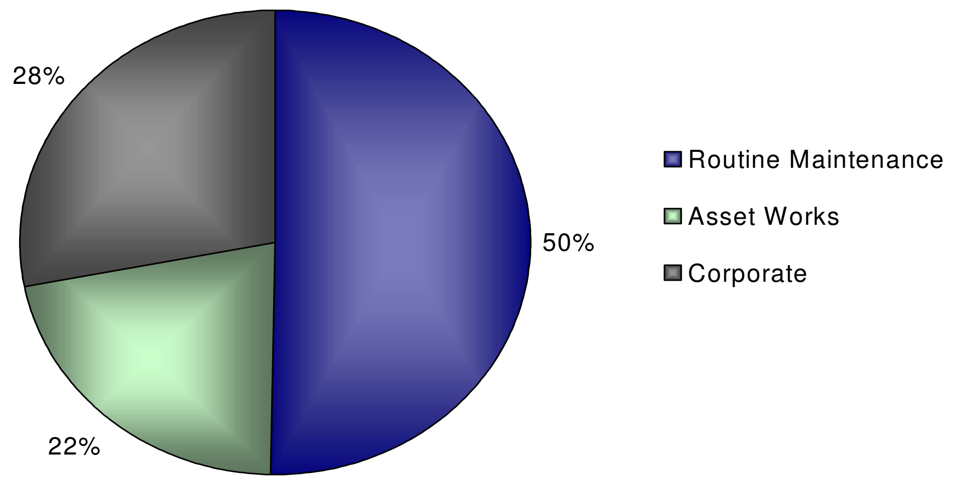


Source: SP AusNet

In addition to these three principal controllable cost categories, SP AusNet has identified a fourth category ("other costs") for the purpose of substantiating its revenue proposal for the forthcoming regulatory period. This category includes debt and equity raising costs, rebates, self-insurance, easement tax and glide path. SP AusNet has separated this category in order to identify the ex-ante cost allowance.

The breakdown of the opex program is shown in Figure 6.2.3. As shown, the majority of opex (50 percent) is related to routine operations and maintenance, (28 percent) is related to corporate costs and (22 percent) addresses asset works expenditure.

Figure 6.2.3 Breakdown of operating expenditure 2008/09 to 2013/14



Source: SP AusNet

6.3 Factors Affecting Future Operating Expenditure

Considerable efficiency savings have been delivered during the current regulatory period, which will flow to consumers in the forthcoming regulatory period. SP AusNet's efficient asset management and performance is described in detail in Chapter 3 of this revenue proposal.

Table 6.3.1 compares SP AusNet's benchmark allowance established by the ACCC's 2002 decision[14] and the company's actual opex (excluding debt and equity raising costs, self-insurance, rebates and easement tax) during the current regulatory control period. SP AusNet's opex from the current regulatory period averaged 11.9 percent below the AER benchmark.

SP AusNet experienced a one-off cost-saving in 2006 / 07 when the SPI PowerNet (transmission) business and the TXU (distribution) business merged. The merger of the transmission and distribution businesses has achieved cost savings through realised synergies such as economies of scale and scope. However, these savings are a one-off and are unlikely to continue in the future regulatory period.

[14] ACCC, Victorian Transmission Network Revenue Caps 2003 - 2008, 11 December 2002.

Table 6.3.1: Opex comparison (real 2007/08 $m)

Year	2003^	2003/04	2004/05	2005/06	2006/07*	2007/08*
Decision (CPI adjusted)	20.6	69.3	70.3	69.7	70.3	71.2
Actual	17.8	61.8	62.1	63.7	60.2	61.7
Difference	**-2.8**	**-7.5**	**-8.3**	**-6.0**	**-10.0**	**-9.4**

^ Stub period from 1 January to 31 March 2003

*Actual to December 2006, forecast to 2007/08

* From 2003/04 to 2007/08 excludes easement tax, glide path for opex and capex, debt and equity raising costs and rebates, from 2007/08 to 2013/14 excludes easement tax, glide path for opex and capex, debt and equity raising costs and rebates, however, it includes SP AusNet's claim for self-insurance.

Source: SP AusNet

Notwithstanding SP AusNet's excellent performance against the regulatory benchmarks for opex in the current period, there are a number of factors that together act to increase the efficient operating expenditure requirement in the forthcoming regulatory control period. These factors include:

- the asset failure risks - and the associated increase in maintenance activity - associated with the ageing asset base;
- increased resource requirements associated with compliance with legislation, rules and regulations;
- increasing labour costs created by skilled labour shortages and the current resources boom;
- the increase in prescribed service opex in the forthcoming regulatory period associated with the rolling-in of non-contestable excluded service assets constructed in the current regulatory period; and
- the inclusion of the Company's self-insurance claim (discussed in section 6.8.1).

Each of above factors, other than self-insurance, is discussed briefly in the following sections.

In relation to material costs, SP AusNet has relied upon the SKM report[15], which models miscellaneous materials to increase in line with CPI. Miscellaneous materials is an appropriate proxy for materials costs as it includes items such as spare parts, equipment etc that are used for opex activities such as maintenance and asset works. The AER considered in the *Powerlink Revenue Cap Draft Decision 2007/08 to 2011/12* that it was appropriate to apply an escalation factor to maintenance materials of CPI.

6.3.1 Asset Failure Risk

SP AusNet has a substantial part of its asset base reaching the end its technical life over the forecast period. As noted in Chapter 3, when assets approach the ends of their technical lives performance starts to deteriorate and the probability of complete failure increases. If the problem is not addressed, then substantial increases in total cost may occur due to factors such as increased monitoring and maintenance needs, generation re-scheduling costs and supply interruption costs triggered by asset failures, and additional costs due to the unplanned or premature replacement of failed assets.

[15] SKM Report (Appendix C)

The assets work program is preventive in nature and can significantly contribute to reducing total life cycle costs associated with asset failure and increased monitoring and maintenance needs. A project management approach is applied to asset works to ensure effective and efficient delivery of all work.

6.3.2 Compliance with Legislation, Rules and Regulations

SP AusNet is committed to complying with its legislative obligations and implements programs to achieve this. As noted in Section 5.6, SP AusNet is required to comply with significant new health and safety, environmental and security obligations in addition to existing obligations. The asset works program, such as SP AusNet's asbestos removal project and lead contamination project, has focused on addressing specific legislative obligations.

SP AusNet's asbestos removal project aims to comply with the *Occupational Health and Safety (Asbestos) Regulations 2003*. The Regulations endeavours to protect persons against the risk of asbestos-related disease resulting from exposure to airborne asbestos fibres. The project involves the development of the asbestos management strategy to test for and remove asbestos containing material including building cladding, tiles, secondary insulation panels and switchboards.

SP AusNet's lead contamination project aims to comply with the *Environment Protection Act 1970*. The *Act* endeavours to ensure sound environmental practices and procedures are adopted as a basis for ecologically sustainable development. The project involves removing lead based paint and repairing any damage to the galvanising underneath from three towers over the Yarra River on the Fishermen's Bend Terminal Station to West Melbourne Terminal Station.

These and other asset works program which focus on addressing occupational health, safety and environmental risks are discussed further in Section 6.7.5. Compliance with these obligations is not a discretionary matter for SP AusNet, so it is important that the revenue cap for the forthcoming regulatory control period contains adequate allowances for all of the capital and operating costs associated with meeting these various obligations.

6.3.3 Labour Cost Increases

The impact of competition for skilled resources has lead to increases in labour costs well above CPI. The economic boom in the construction and mining areas has exacerbated strong growth in the demand for skilled labour.

SP AusNet is forced to seek staff from a limited pool with the appropriate skill set. The average age of the technical workforce is 48 years, with a projected loss of 22 percent of the current workforce over the next five years. In light of the diminishing pool of suitably qualified employees the industry has to draw on, and the transition to retirement of a significant proportion of its workforce, SP AusNet and other infrastructure businesses has had to offer increasingly competitive salaries to attract further numbers of employees into the industry.

There have been a significant amount of consultant studies done on the shortages of labour in the energy sector driving wage growth substantially beyond CPI. These consultancies have concluded different future labour escalation factors for the energy sector; however, all have acknowledged the impact of shortages of skilled resources and competition on increased labour costs.

In the recent Access Economics Report[16] commissioned by the AER and relied upon it in the *Powerlink Revenue Cap Draft Decision 2007/08 to 2011/12*, Access Economics stated:

> "… after remaining close to the expected "long-term" rate of 4¼% until 2003-04, wage growth in the utilities sector has leapt sharply in the past few years, even as productivity levels have reversed … wages growth in the first few years [from 2005/06] is likely to remain relatively strong due to the current skills shortages prevalent in the utilities sector. These shortages are not caused solely by growth in the sector itself, but have flowed from the strength in other sectors - notably construction - in recent years and a similar shortage in the mining sector."

However, Access Economics though recognising the demand pressures will drive wages growth well above longer-term averages for the 2006 / 07, 2007 / 08 and 2008 / 09 financial years, they considered that wages would moderate significantly thereafter.

SP AusNet does not believe the longer term elements of these forecasts are credible, implying as they do, that the skills shortages currently being experienced within the utilities sector will resolve themselves in the space of the next two years and to such an extent that wages growth in the longer term will actually fall, not only below historical averages, but also below wage inflation in the broader economy. This trend is not in line with SP AusNet's experience. As noted the combination of strong employment growth in the utilities industry and competition for like-skilled employees from other sectors of the economy, notably mining and construction, will make it difficult for the energy industry to attract and retain workers without remuneration at least keeping pace with aggregate wages growth.

In contrast the recent BIS Shrapnel report[17] commissioned by SP AusNet, Envestra and MulitNet Gas, concluded:

> "…the anticipated growth in the wage cost index (WCI) for the electricity, gas, water sector will average over 0.8 percent higher than the national WCI growth of 4.0 percent per annum over the seven years to 2012/13. The faster wages growth expected in the electricity, gas and water sector over the next six years in line with historical movements over the past 15 years".

BIS Shrapnel's forecasted wage growth index for the electricity industry in Victoria over SP AusNet's future regulatory period. On average the forecast wage growth index is 2.83 percent per annum above CPI respectively.[18]

SP AusNet considers that BIS Shrapnel's forecasts are far more realistic given the recent historical movements over the last 15 years and further are in line with SP AusNet's experience and expectations. SP AusNet has therefore adopted a 2.83 percent per annum above CPI labour cost escalator.

6.3.4 Increase in Prescribed Service Operating Expenditure

In its 2002 Revenue Cap Application, SP AusNet outlined its proposal for treatment of assets associated with providing non-contestable services that are initially outside the revenue cap (under the Victorian Regulatory Arrangements) for the new regulatory period commencing 1 April 2008. Details regarding the rolling into the prescribed service asset base of previously excluded assets are set out in Section 7.4.

[16] Access Economics Pty Limited, Wage growth forecasts in the utilities sector, November 2006, page i.
[17] BIS Shrapnel Report (Appendix F)
[18] ibid

This roll-in of assets is protected as a transitional arrangement under Clause 11.6.21 of the NER. Therefore, SP AusNet has rolled-in assets associated with the provision of non-contestable services that were commissioned since the cut off date for the previous review.

The major additions will be the non-contestable network and connection works such as interface and connection works at the Cranbourne Terminal Station and non-contestable work on the Snowy Interconnector Upgrade.

The value of those assets that SP AusNet is rolling into the RAB on 1 April 2008 is $2,222.9 million. The impact on the operating and expenditure requirements is 1.03 percent.

SP AusNet acknowledges that the roll-in of the non-contestable projects and connection works will not always increase in a one-for-one increase in opex. This is due to a number of factors such as the existence of economies of scale and different maintenance and replacement requirements for pieces of equipment.

6.4 Operating Expenditure Forecasting Methodology and Assumptions

In accordance with Schedule 6A.1.2 of the NER, this section describes the methodology used for developing the opex forecast, and the key assumptions that underlie the forecasts. In broad terms, the opex forecasts presented in this Chapter are consistent with the implementation and efficient execution of SP AusNet's Asset Management Strategy, and the capital expenditure program described in Chapter 5. A detailed description of SP AusNet's Asset Management Strategy is provided in Chapter 3 of this submission.

In forecasting opex, SP AusNet distinguishes between recurrent and non-recurrent expenditure. For recurrent expenditure, such as routine maintenance and operations and corporate costs, it is possible to apply cost escalation factors to a base year.

It is important that the base year is appropriately scoped so that new functions or activities (perhaps as a result of changes to compliance obligations or service standards) are taken into consideration. SP AusNet has forecasted the opex for recurrent expenditure for 2008 equal to the 2006 actual recurrent expenditure and taken into account the impact of increased labour costs, forecast to grow by 2.83 percent[19] per annum above CPI respectively.

Non-recurrent expenditure is forecast on a program basis, which reflects specific drivers such as asset failure risk and compliance with legislation, rules and regulations, or challenges that must be addressed in the forthcoming regulatory control period.

The key areas of focus for the asset works program for the current regulatory control period have been:

- Tower painting program;
- Corrosion mitigation investigations on towers;
- Refurbishment of SF_6 Breakers;
- Repair of 500 kV GIS Switchgear; and
- Initial work in relation to major flaws in the joints of the Brunswick to Richmond 220 kV cable.

[19] ibid

Given the complex nature of the asset management processes, it is not practical to present a full list of assumptions that underlie the opex forecasts. In broad terms, however, the principal assumptions and considerations underpinning the opex proposal relate to:

- the detailed assessment of cost drivers in the forthcoming regulatory control period and beyond;
- the factors affecting future opex (as discussed in Section 6.3); and
- the availability of suitably skilled internal and external resources.

6.5 Routine Maintenance and Operations

6.5.1 Overview of Historic and Forecast Operating Expenditure

An overview of SP AusNet's historic and forecast routine maintenance opex is provided in Table 6.5.1 and Figure 6.5.2. SP AusNet has made substantial savings during the current regulatory period, with routine maintenance costs averaging 24.5 percent below the AER benchmark.

SP AusNet's operating expenditure on routine maintenance works is expected to increase by an average of 2.79 percent. Despite the impact of increased labour costs, forecast to grow by 2.83 percent[20] per annum above CPI respectively, SP AusNet has and will continue to contain expenditure on routine maintenance costs over the 2008 to 2013 / 14 period.

SP AusNet has achieved its excellent performance through changed work practices and investment in improved systems as outlined in Section 6.5.2 and the merger of the transmission and distribution businesses. The merger of the businesses has achieved cost savings for example through the increase in condition monitoring which has allowed for more targeted maintenance activities and the integration of the distribution and transmission operating centres.

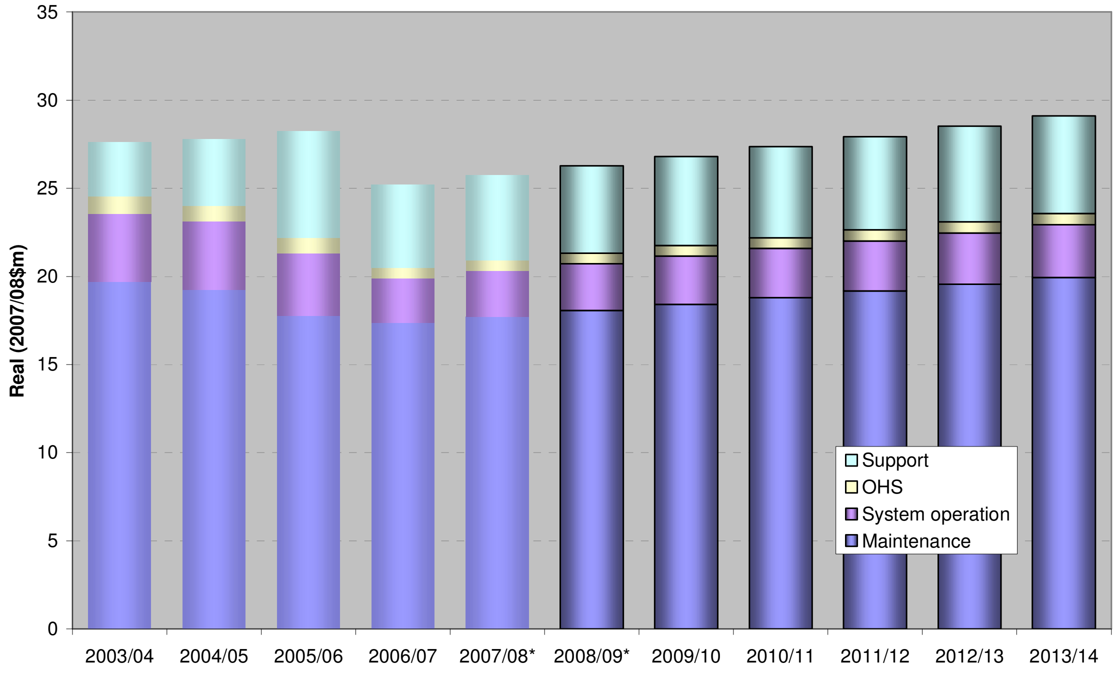
Table 6.5.1 Routine Maintenance Costs 2003/04 to 2013/14 (real 2007/08 $m)

	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08*	2008/09*	2009/10	2010/11	2011/12	2012/13	2013/14
Maintenance	4.6	19.7	19.2	17.8	17.4	17.7	18.1	18.4	18.8	19.2	19.6	19.9
System operation	0.9	3.9	3.9	3.5	2.5	2.6	2.7	2.7	2.8	2.9	2.9	3.0
OHS	0.3	1.0	0.9	0.9	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Support	1.0	3.1	3.8	6.1	4.7	4.8	4.9	5.1	5.2	5.3	5.4	5.5
Total	**6.9**	**27.6**	**27.8**	**28.2**	**25.2**	**25.7**	**26.3**	**26.8**	**27.4**	**27.9**	**28.5**	**29.1**
Benchmark	9.8	34.6	35.7	35.3	35.7	36.3	n/a	n/a	n/a	n/a	n/a	n/a
Difference	**-2.9**	**-7.0**	**-7.9**	**-7.1**	**-10.5**	**-10.6**						

* Actual to December 2006, forecast to 2013/14.
Source: SP AusNet

[20] ibid

Figure 6.5.2 Routine Maintenance Costs 2003/04 to 2013/14 (real 2007/08 $m)



* Actual to December 2006, forecast to 2013/14

Source: SP AusNet

6.5.2 Explanation of Variations between Historic and Forecast Operating Expenditure

During the current regulatory control period, maintenance costs specifically have averaged 26.9 percent below the AER benchmark. These substantial savings have been generated through changed work practices and investment in improved systems, in particular:

- increased condition monitoring has allowed more targeted maintenance activities;
- improved asset management systems and processes have allowed better integration of the capex and opex programs;
- internal benchmarking has facilitated the implementation of work practice improvements in each maintenance area; and
- use of outsourced maintenance has helped to spur efficiency improvements in other internally resourced maintenance areas.

The cost of system operations has averaged 17.5 percent below the AER benchmark over the current regulatory period. Savings have been generated from the integration of the distribution and transmission operating centres.

Expenditure on routine maintenance requirements continues to be stable over the review period. Although the base maintenance program has been fairly stable, the increased complexity of the work and the increase in non-recurrent works (condition assessments, performance assessments and monitoring) has lead to increased use of office-based personnel and increased use of contractors in support roles.

Other system routine maintenance requirements include both insurance and taxes. Insurance costs have averaged 6.5 percent above the AER benchmark largely due to a tightening insurance market at the start of the period. Table 6.5.2 provides an overview of SP AusNet's other system routine maintenance costs.

Table 6.5.2 Insurance and Taxes 2003/04 to 2013/14 (real 2007/08 $m)

	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08*	2008/09*	2009/10	2010/11	2011/12	2012/13	2013/14
Taxes	0.8	4.4	3.7	4.2	4.4	4.4	3.7	3.9	4.0	4.2	4.3	4.5
Benchmark	1.1	4.9	4.9	4.9	4.8	4.9						
Difference	**-0.3**	**-0.5**	**-1.2**	**-0.6**	**-0.4**	**-0.4**						
Insurance	0.7	2.9	3.0	2.8	2.9	2.9	2.9	3.2	3.4	3.5	3.5	3.5
Benchmark	0.6	2.7	2.7	2.7	2.7	2.7	n/a	n/a	n/a	n/a	n/a	n/a
Difference	**0.1**	**0.2**	**0.2**	**0.1**	**0.2**	**0.2**						

Source: SP AusNet

6.6 Corporate Costs

6.6.1 Overview of Historic and Forecast Operating Expenditure

An overview of SP AusNet's historic and forecast corporate costs is provided in Table 6.6.1 and Figure 6.6.2. SP AusNet's current corporate costs have averaged 24 percent above the AER benchmark.

The merger of the SPI PowerNet (transmission) business and the TXU (distribution) business has resulted in a reallocation of costs and focus for which no allowance was made. In particular, the management fees, which were internalised for each specific business, SPI PowerNet and TXU, have now been reallocated across the merged SP AusNet business in line with management effort. It is important to note that these costs are not additional costs to the SP AusNet business as a whole, but just a reallocation of cost. However, given the reallocation of management fees across the whole business, both distribution and transmission, corporate costs for transmission has increased.

The key driver of the expected increase in corporate costs over the period 2008 to 2013 / 14 is the impact of increased labour costs, forecast to grow by 2.83 percent[21] per annum above CPI respectively.

Table 6.6.1: Corporate Opex Costs 2003/04 to 2013/14 (2007/08 $m)

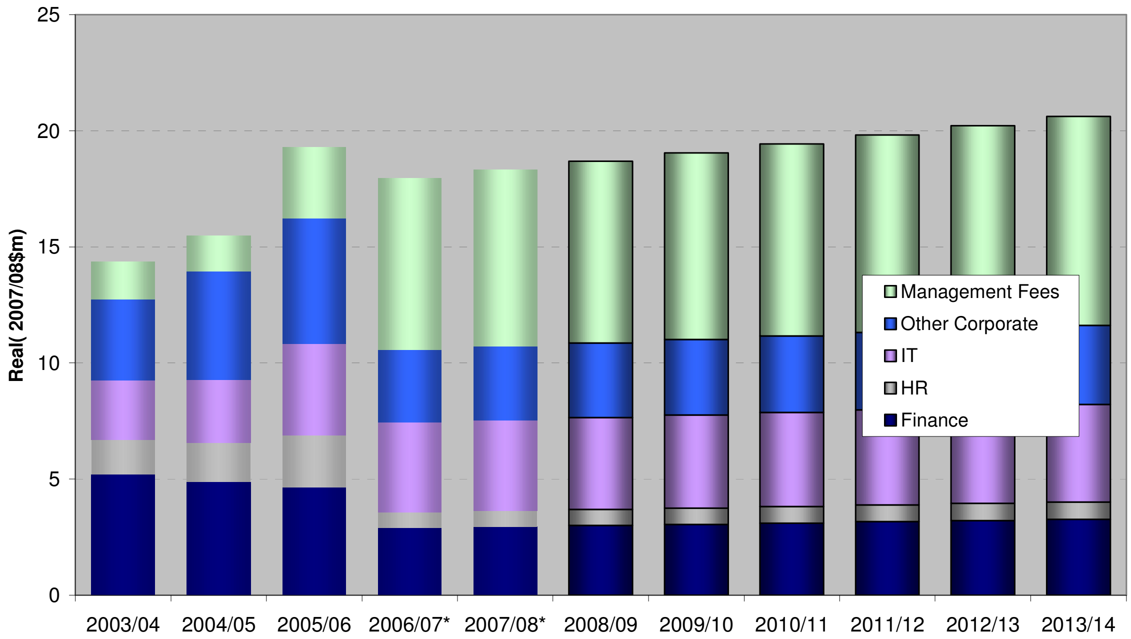
	2002/03	2003/04	2004/05	2005/06	2006/07*	2007/08*	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Finance	2.0	5.2	4.9	4.7	2.9	2.9	3.0	3.1	3.1	3.2	3.2	3.3
HR	0.4	1.5	1.7	2.2	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
IT	0.8	2.6	2.7	3.9	3.9	3.9	4.0	4.0	4.1	4.1	4.1	4.2
Other Corporate	0.9	3.5	4.7	5.4	3.1	3.2	3.2	3.2	3.3	3.3	3.4	3.4
Management fees	0.0	1.6	1.5	3.1	7.4	7.6	7.8	8.0	8.3	8.5	8.7	9.0
Total	**4.1**	**14.4**	**15.5**	**19.3**	**18.0**	**18.3**	**18.7**	**19.0**	**19.4**	**19.8**	**20.2**	**20.6**
Benchmark	3.7	13.7	13.5	13.6	13.8	13.9	n/a	n/a	n/a	n/a	n/a	n/a
Difference	**0.4**	**0.7**	**1.9**	**5.7**	**4.2**	**4.4**						

* Actual to December 2006, forecast to 2013/14

Source: SP AusNet

[21] ibid

Figure 6.6.2: Corporate expenditure 2003/04 to 2013/2014 (average 2007/08 $m)



* Actual to December 2006, forecast to 2013/14

Source: SP AusNet

6.6.2 Explanation of Variations between Historic and Forecast Operating Expenditure

As noted, the merger of the business has resulted in a reallocation of management fees, which was not accounted for in the allowance and has been the key driver for the increase in corporate costs. The current corporate costs have averaged 24 percent above the AER benchmark.

In addition to management fees, Information Technology (IT) costs increased from 2005 / 06 onwards due to the IT separation of the merchant energy business and the establishment of systems for the newly merged business. Further, with the establishment of new systems, training needs for the IT technicians and support engineers have increased in order to ensure they keep abreast of the latest technologies and the hardware they operate on. Although IT costs have increased, the benefits of those new systems have flowed through into the costs of other areas of the business, such as maintenance and assets works, helping maintain lower overall costs.

Human Resources (HR) costs increased in the financial year 2005 / 06, but decreased in the subsequent years, reflecting the increased HR activity associated with the creation of the merged entity. During the current regulatory control period, HR costs averaged 25.9 percent below the AER benchmark.

Despite the upward pressures on operating and maintenance expenditure, SP AusNet will contain expenditure on corporate costs over the 2008 to 2013 / 14 period. Corporate costs are expected to increase on average by 14.94 percent for the next regulatory period.

6.7 Asset Works

6.7.1 Overview of Historic and Forecast Operating Expenditure

An overview of SP AusNet's historic and forecast non-recurrent system costs is provided in Table 6.7.1 and Figure 6.7.2. The asset works expenditure is not recurrent and therefore it is not appropriate to derive forecasts of future requirements from previous expenditure.

The future asset works program is designed to respond to new priorities and problems, which vary from the previous regulatory period. The increasing number and complexity of asset works has resulted in the need to hire technical specialists from time to time to support the core of SP AusNet's engineers and technical staff.

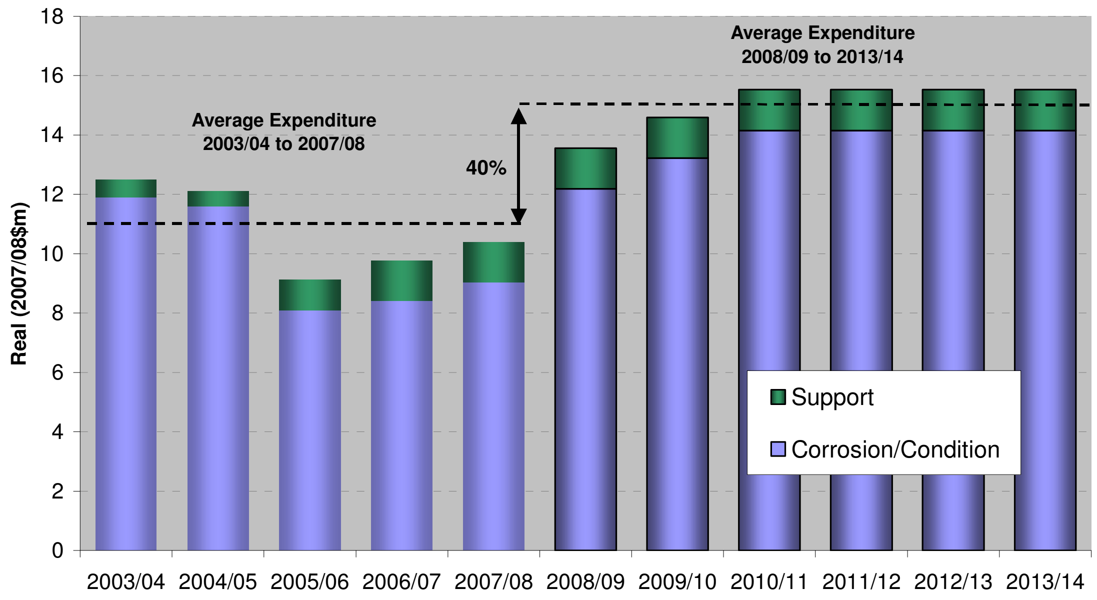
Table 6.7.1: Asset work costs 2003/04 to 2013/14 (2007/08 $m)

	2002/03	2003/04	2004/05	2005/06	2006/07*	2007/08*	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Corrosion/Condition	4.8	11.9	11.6	8.1	8.4	9.0	12.2	13.2	14.1	14.1	14.1	14.1
Support	0.5	0.6	0.5	1.0	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Total	**5.3**	**12.5**	**12.1**	**9.1**	**9.8**	**10.4**	**13.6**	**14.6**	**15.5**	**15.5**	**15.5**	**15.5**
Benchmark	5.4	13.7	13.5	13.6	13.8	13.9	n/a	n/a	n/a	n/a	n/a	n/a
Difference	**-0.1**	**-1.2**	**-1.4**	**-4.5**	**-4.0**	**-3.5**						

* Actual to December 2006, forecast to 2013/14

Source: SP AusNet

Figure 6.7.1 Asset works expenditure 2003/04 to 2013/14 (average 2007/08 $m)



*Actual to December 2006, forecast to 2013/14

Source: SP AusNet

NOTE: NUMBERS IN TABLES MAY NOT ADD TO TOTAL DUE TO ROUNDING.

6.7.2 Explanation of Variations between Historic and Forecast Operating Expenditure

Asset works costs have averaged 18 percent below the AER benchmark during the current regulatory period. This variation reflects the new priorities and problems that have arisen during the current period.

The key drivers for the increase in asset works costs over the forthcoming regulatory control period include the assessed levels of asset failure risk and increased resource requirements for compliance with legislation, rules and regulations. The asset works program addresses health, safety and environmental obligations, which includes asbestos removal and switchyard resurfacing. As noted earlier, the asset works program is non-recurrent and therefore it is not appropriate to base forecasts of future requirements on previous expenditure levels.

The key areas of focus for the asset works program between 2008 / 09 and 2013 / 14 are:

- Repair and prevention of tower corrosion;
- Significant repair or refurbishment projects to mitigate asset failure risk;
- Reduction in OH&S and environmental risk; and
- Condition monitoring.

Examples of projects are discussed in more detail in the following sections.

6.7.3 Tower Corrosion Programs

As the transmission lines reach 50 years of age corrosion problems especially are beginning to become clearly evident. An opex solution to this problem is still a far cheaper option than replacement in this case, as with appropriate maintenance towers can last 70 years or more. The intensive investigative program carried out during the previous regulatory period under the asset works program supports the works outlined below.

Tower Foundation Corrosion	A significant proportion (about 30%) of all SP AusNet's transmission line towers have foundations where the steel is not totally encased in concrete to above ground level and hence have some direct buried steel. Direct buried steel can suffer significant corrosion problems when exposed to aggressive soil or electrolysis effects. The life expectancy of such below-ground steelwork is a function of the performance and extent of the coating system, the aggressiveness of the soil conditions and the presence of stray ground currents. Some early paint-coating systems are at the end of their life and new replacement systems are being implemented. The major concern is loss of galvanising and steel in the below-ground steelwork, which could lead to structural failure. In some cases foundation replacement is required. A recent program of targeted excavation of 23 foundations (within terminal stations) at risk (from acidic soil) resulted in the need for replacement and/or structural repair to four of them, while all such towers suffered some degree of corrosion of buried or ground level steel. Foundations not in need of replacement may need to be protected from further deterioration by the installation of Cathodic Protection (CP) or Impressed Current Cathodic Protection (ICCP) and electrically separated from the station earth grid (as required). Total expenditure of **$4.2 million** is necessary over the next regulatory period.

Tower Ground Level Corrosion	Investigations have indicated the need for ongoing corrosion repairs to ground level steel on a significant number of towers per year. About 30% of SP AusNet's towers have some direct buried steel. A high proportion of fully concreted foundations are also exposed to soil at surface level. Soil build-up or moisture ingress leads to corrosion and metal loss in ground-line steelwork. Treatment often involves structural reinforcement and the application of protective coatings. Total expenditure of **$8.2 million** is necessary over the next regulatory period.
Tower Painting	Towers and rack structures in coastal areas, or near industrial pollution, experience rust of above ground members. This is a continuation of the significant program of painting over the last five years. Total expenditure of **$4.8 million** is necessary over the next regulatory period.
Tower Bolt Replacement	Many towers located in harsh environments suffer rusting of individual nuts and bolts and tower members. This program is required to replace or patch paint badly degraded nuts and bolts to ensure the on-going structural integrity of the tower. Total expenditure of **$0.6 million** is necessary over the next regulatory period.

6.7.4 Major Asset Repair or Refurbishment Programs

These projects cover major repairs or refits that are necessary to ensure equipment continues to perform reliably until the end of its technical life. As these programs do not extend the technical life of the assets, this expenditure cannot be treated as capex. The key programs are outlined below.

Replacement of Tower Steelwork	Replacement of members damaged due to corrosion or impact caused by vehicles or farm machinery. In harsh environments, the corrosion of tower members occurs. This is not a widespread problem, in terms of the numbers of towers, but nevertheless it can incur a significant cost because of the difficulties involved in replacing structural components on loaded towers. Total expenditure of **$1.2 million** is necessary over the next regulatory period.
Replacement of Transmission Line Hardware	This includes replacement of conductors, ground-wire, insulators and termination fittings and line hardware sampling, investigation and repair work. The dampers and spacers for conductors and ground-wires, and suspension and termination assemblies, comprise a variety of forged and cast components in galvanised steel, cast iron and aluminium alloys. These items wear and corrode at connection points and can fatigue due to cyclic loading. Deterioration can sometimes be related to age or type, but is often site specific because of loading or wind conditions. Spacers and dampers, designed to protect conductors and ground-wire, can damage them if attachment clamps become loose. Failure of transmission line hardware can result in a dropped conductor. Total expenditure of **$1.8 million** is necessary over the next regulatory period.

SF_6 Circuit Breaker Refurbishments	Major refurbishment works are required on various SF_6 circuit breakers to improve their reliability. SF_6 CBs have suffered from SF_6 leaks caused by flange corrosion, hardening of seals, interrupter design problems and hydraulic mechanism problems including oil leaks, entrained gas, and trapped metal particle problems. Also, accumulators have suffered nitrogen losses. Corrosion has proven worse than anticipated and SF_6 leaks are the most common cause of SF_6 CB system incidents, followed by hydraulic drive problems. Early SF_6 CBs were purchased with the knowledge that a 'half life' refurbishment would be necessary. This work is essentially a full strip-down with all seals replaced. Total expenditure of **$10.1 million** is necessary over the next regulatory period.
Gas Insulated Switchgear Refurbishment	The number of major failures on the older outdoor GIS has dramatically increased in recent years. For example, at South Morang Terminal Station (SMTS) between 2003 and 2004, there were two major mechanical interrupter failures of circuit breakers and one power flashover of the 500 kV GIS. In addition to major failures, there has been an increase in the number of ongoing defects resulting from SF_6 leaks (caused by corrosion and design problems), hydraulic mechanism leaks and failure of isolators and earth switches to operate correctly. Increased focus on condition monitoring of the 500 kV GIS at SMTS and Sydenham Terminal Station (SYTS), through real-time digital x-ray imaging technology and UHF partial discharge monitoring, has identified further mechanical and electrical defects. Intrusive corrective action was undertaken in 2004 on the serious defects but there still remain defects to be corrected in future refurbishment work. The following major programs need to be continued to ensure the GIS will reach its economic life and to reduce the SF_6 leak rate. The program includes: ▪ silastic injection and corrosion repair of flanges of 500 kV GIS at SMTS; ▪ condition initiated remedial works on the 500 kV GIS at SMTS; ▪ refurbishment of hydraulic mechanisms of the 500 kV GIS circuit breakers at SMTS and SYTS; ▪ regular PD monitoring and investigations of the GIS at SMTS, SYTS, Newport Power Station (NPSD), West Melbourne Terminal Station (WMTS) and Rowville Terminal Station (ROTS); ▪ x-ray and NDT condition inspections of the GIS at SMTS, SMTS, NPSD and WMTS; and ▪ Gas leak repairs on the 220 kV GIS at NPSD. Total expenditure of **$5.2 million** is necessary over the next regulatory period.
Power Cable Repairs	Major repairs are required on the Brunswick Terminal Station – Richmond Terminal Station Line 220 kV Cable as water is entering the cable joints, leading to low sheath insulation resistance. Cable joint entry oil seals are also leaking. The cable has three cable joints in each of 13 joint bays. One joint failed in 2006 causing a major outage. Three joints have been replaced during the current period. It is proposed that six joints are replaced per year over the forthcoming 6-year regulatory period. Total expenditure of **$7.0 million** is necessary over the next regulatory period.

Power and Instrument Transformer Repairs	An allowance is needed for the on line monitoring and off line testing of transformers. The allowance would include the costs of urgent replacement of failed units and replacement of On Load Tap Changer (OLTC) components. Regular dissolved gas analysis of oil samples from oil filled transformers is a primary tool for condition assessment. This analysis provides a reasonable assessment of insulation condition and permits the planned removal of units that have deteriorated beyond acceptable limits. Monitoring has shown that the degradation rate can be slow in many cases but also accelerate as the unit approaches failure. The requirement to replace OLTC components is the result of manufacturers advice following a problem identified with an SP AusNet transformer. Total expenditure of **$2.3 million** is forecast over the next regulatory period.

6.7.5 Occupational Health & Safety Risk and Environmental Risk

As noted in section 6.3.2 the asset works program has focused on ensuring compliance with our legislative obligations.

Asbestos Removal	An audit of all terminal stations, field depots, and communications sites was carried out in 2004 and an asbestos register established. From this an asbestos management strategy has been developed to test for and remove asbestos containing material including building cladding, tiles, secondary insulation panels and switchboards. This program has been integrated with the refurbishment program where applicable. Total expenditure of **$2.7 million** is necessary over the next regulatory period.
Switchyard Resurfacing	The switchyard surface material forms an integral part of the design of the earth grid, which protects personnel from electrocution at a terminal station. Surface stability is also important for pedestrian, vehicle and mobile plant traffic, allowing safe access for work on the electrical assets. A number of surfaces have deteriorated or have inappropriate switchyard surface material and need renewing. Total expenditure of **$2.5 million** is necessary over the next regulatory period.
Lead contamination	Three towers over the Yarra River on the Fishermen's Bend Terminal Station (FBTS) to West Melbourne Terminal Station (WMTS) 220 kV Lines (next to the Bolte Bridge) were painted red and white with lead based paint over 30 years ago, to aid aircraft navigation. Work to remove the lead based paint, and repair any damage to the galvanising underneath, will be completed during the current period. However, recent soil samples have revealed an elevated level of lead in the surrounding soil in the proximity of waterways, including the Yarra River. SP AusNet will complete remediation of the surrounding soil during the forthcoming period. Total expenditure will be **$0.5 million** in 2008 / 09.

Transformer Leaks Repairs and Oil Treatment	This includes major oil leak repairs and replacement/reclamation of aged and contaminated oil. Oil leaks from transformer tanks, coolers, pipe work, valves and other fittings is one of the most widespread problems with oil-filled power transformers. Apart from the environmental problem caused by oil leaking from a transformer, oil on the tank surface increases the risk of a fire. The oxidation or degradation of oil with time, particularly with free-breathing oil preservation systems, produces compounds which accelerate the ageing process of solid insulation, particularly at elevated temperatures. With increased utilisation and operation at higher loads, it is likely that in future it will be necessary to carry out replacement or treatment of the oil on more 'free-breathing' transformers. Consideration also needs to be given to the replacement of insulating oil containing non-scheduled poly chlorinated biphenyls (PCBs) prior to planned work involving processing of the oil. Total expenditure of **$4.3 million** is necessary over the next regulatory period.

6.7.6 Condition Monitoring

SP AusNet is embarking on a major program to develop a knowledge-based asset management system that utilises both on-line and off-line condition monitoring data. This expenditure is required to investigate, adopt and implement new condition monitoring technologies.

Total expenditure of **$1.0 million** is necessary over the next regulatory period.

6.8 Other costs

6.8.1 Self-insured Risks and Deductibles

There are a number of risks borne by SP AusNet in the conduct of its regulated business which are not compensated through WACC or otherwise, and which cannot be insured cost-effectively. The business bears and manage these risks, and must therefore be compensated for them.

SP AusNet engaged SAHA Consulting to update and reassess the risks outlined in the Trowbridge Consulting *Valuation of Non-insured Risks* report that formed the basis of the self-insurance allowance in the 2002 Decision. SP AusNet will be providing the SAHA report to the AER on a confidential basis.

In addition to these costs, SAHA Consulting has also assessed the expected value of deductibles over the upcoming regulatory period. The current Revenue Cap Decision allows deductibles paid as a result of an insurance event to be claimed via a pass-through mechanism rather than the expected annual cost incurred to be included as an opex allowance. However, deductibles are no longer pass-through events due to the new materiality threshold for pass-through events established in the new National Electricity Rules.

The expected annual cost of deductibles has also been included in the opex forecasts. The self-insured and deductible costs are shown in Table 6.8.1.

Table 6.8.1 Non-insured risks (2007/08 $m)

	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Non insured risks	2.54	2.54	2.54	2.54	2.54	2.54

Source: SP AusNet

NOTE: NUMBERS IN TABLES MAY NOT ADD TO TOTAL DUE TO ROUNDING.

6.8.2 Equity Raising Costs

The ACCC recognised that some entities have to incur costs when raising equity[22]:

> "These include payments for services such as financial structuring, marketing, preparing and distributing information, and undertaking presentations to prospective investors and underwriting".

On the basis of the reasoning set out in its NSW and ACT transmission revenue cap decision for 2004/05-2008/09, the ACCC included an allowance for equity raising costs in its 2002 *Decision on Victorian Transmission Network Revenue Caps 2003 - 2008*. The ACCC considered that an average of recent equity raising costs of 0.215 percent per annum for Australian infrastructure equity issues, amortised in perpetuity, was an appropriate Australian benchmark for the purpose of its decision.

For this revenue proposal, equity raising costs have been calculated as 0.215 percent of the benchmark equity share (40 percent) of the opening RAB value for each year of the proposed regulatory period. This continues the precedent established in the regulator's previous Decision.

The equity raising costs are shown in Table 6.8.2.

Table 6.8.2 Equity Raising Costs (2007/08 $m)

	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Equity raising costs	1.9	1.9	2.0	2.0	2.0	2.0

Source: SP AusNet

6.8.3 Debt Raising Costs

Transactions costs incurred raising debt to fund the provision of regulated electricity transmission services are a necessary and legitimate expense for which the distribution business should be compensated. These costs are incurred on an ongoing basis as businesses continually roll over their stock of debt. Provision of an allowance for these expenses in the cost of debt is firmly established in regulatory decision-making.

Debt raising costs were approved in the 2002 ACCC *Decision on Victorian Transmission Network Revenue Caps 2003 - 2008*. Equity raising costs were included as a cash flow in the regulated opex, whereas debt-raising costs were allowed as an additional margin in the debt component of the WACC calculation. More recent regulatory decisions have included both as cash flows in the opex; therefore, SP AusNet has followed this convention.

Debt raising costs have been calculated as 0.125 percent of the benchmark debt share (60 percent) of the opening RAB value for each year of the proposed regulatory period. This aligns with the latest precedent set in the 2005 *ESC Victorian Electricity Distribution Price Review Final Decision* and the emerging 'regulatory norm' illustrated in Table 6.8.3.

[22] The NSW and ACT Transmission Network Revenue Caps – TransGrid 2004/05-2008/09: Draft Decision, page 83

Table 6.8.3 Electricity distribution regulatory precedent

Regulator	Date	Decision status	Network type	Debt transaction costs
ICRC	March 2004	Final decision	Electricity distribution	12.5bps
IPART	June 2004	Final decision	Electricity distribution	12.5bps
ESCOSA	April 2005	Final decision	Electricity distribution	12.5bps
QCA	April 2005	Final decision	Electricity distribution	12.5bps
ESC	October 2005	Final decision	Electricity distribution	12.5bps

The AER currently relies on an Allen Consulting Group Report prepared for the ACCC in 2004[23]. This recommends an allowance of 8 basis points be used for debt raising costs – excluding an allowance for the dealer swap margin of 5 basis points.

More recently however, Allen Consulting Group has recommended that an allowance of 12.5 basis points be provided for the debt raising costs of the Queensland gas distribution businesses[24].

> ACG also recommends that an allowance of 12.5 basis points be provided for debt raising costs. The cost of raising debt is a necessary cost of providing the regulated services, and hence appropriately included in the revenue caps for the regulated entities. We note that 12.5 basis points exceeds the amount suggested by ACG in a recent detailed study. The difference, however, is marginal and an allowance of 12.5 basis points provides for regulatory consistency and errs on the side of conservatism.

Furthermore, SP AusNet believes that excluding the allowance for the dealer swap margin is not consistent with the ACCC Final Decision on GasNet *Access Arrangements for the Principal Transmission System* or the associated Appeal Decision of the Australian Competition Tribunal, which included this margin.

The debt raising costs are shown in Table 6.8.4.

Table 6.8.4 Debt Raising Costs (2007/08 $m)

	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Debt raising costs	1.7	1.7	1.7	1.7	1.7	1.8

Source: SP AusNet

6.9 Easement Land Tax

In 2004, the Victorian Government extended land tax to electricity transmission easements owned by electricity transmission companies in Victoria. The new tax arrangement was designed to counter a shortfall in Government revenue as a result of the Government's abolition of the Smelter Reduction Amount levy.

This very significant new impost was not provided for in the current regulated revenue cap, therefore, SP AusNet applies annually for a pass-through of the financial effect associated with this new tax under its current Pass Through Rules described in Section 5.7.5 of the 2002 *ACCC Decision on Victorian Transmission Network Revenue Caps 2003 - 2008*.

23 Allen Consulting Group, Debt and Equity Raising Transaction Costs, Final Report, December 2004.
24 Op. Cit., Allen Consulting Group, Memorandum on Cost of Debt Margin, July 2005 page 38.

This tax now needs to be included in opex forecasts used in the calculation of the revenue cap for the forthcoming regulatory control period. The value of the land tax is directly related to the value of the land underlying the easements, and as such, the land tax is expected to increase at the same rate as the underlying land value. Therefore, the forecast assumes that the tax increases at the same rate as the average annual increase in Melbourne house prices over the last 20 years (*ABS Publication 6416.0 House Prices Indexes: Eight Capital Cities*). This forecast is shown in Table 6.9.1.

Over the period, any positive or negative variation between the actual tax paid and the forecast approved by the AER will be recovered/reimbursed via the pass-through mechanism outlined in Clause 6A.7.3 of the NER. Therefore, notwithstanding the assumption described above, SP AusNet will only recover the actual tax paid over the period.

Table 6.9.1 Easement Land Tax (2007/08 $m)

	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Easement Land Tax	81.6	84.8	88.2	91.8	95.4	99.2

Source: SP AusNet

6.10 Summary

SP AusNet continues to deliver an efficient opex program as illustrated by the company's performance in the current regulatory period. As noted in section 3.6, opex benchmarking analyses demonstrate that SP AusNet's operational efficiency places it at the forefront of the transmission sector in Australia. This provides confidence to stakeholders that the proposed opex in the forthcoming regulatory period is efficient and consistent with delivering appropriate compliance and service outcomes. The present shortage of skilled labour and the resource and construction boom will continue to place upward pressures on the costs of efficiently procuring and deploying operating and maintenance resources.

Despite these pressures, SP AusNet plans to deliver an efficient overall opex program in the forthcoming regulatory period at a total cost that represents a modest increase on the actual opex incurred in the current period.

Table 6.10.1 Total Opex Costs (2007/08 $m)

	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Controllable opex costs	69.4	71.9	74.1	75.4	76.6	77.8
Easement Land Tax	81.6	84.8	88.2	91.8	95.4	99.2
Rebates	6.6	6.6	6.6	6.6	6.6	6.6
Debt Raising Cost	1.7	1.7	1.7	1.7	1.7	1.8
Equity Raising Cost	1.9	1.9	2.0	2.0	2.0	2.0
Total Opex costs	**161.2**	**166.9**	**172.7**	**177.5**	**182.4**	**187.5**

Source: SP AusNet

7 Regulatory Asset Base

7.1 Introduction

In accordance with the National Electricity Rules (NER) and guidance from the Australian Energy Regulator (AER), SP AusNet has constructed an opening regulatory asset base for the purposes of calculating the return on capital and depreciation elements of the revenue cap from 2008 onwards.

The opening 1 January 2003 Regulatory Asset Base (RAB) was established as required by the NER and rolled forward by adjusting for capital expenditure, depreciation, retirements and inflation over the period to 1 April 2008. In addition, previously excluded assets relating to non-contestable services, that will become revenue capped from the start of the new regulatory period, are included in the RAB from 1 April 2008, which results from the specific regulatory arrangements that exist in Victoria[25]. Finally, an adjustment to the 1 April 2008 RAB is made to satisfy the AER's new regulatory accounting methodology, published in the Explanatory Statement accompanying the AER's post tax revenue model (PTRM), requiring capital expenditure to be recognised on an as-incurred basis rather than as commissioned.

A high level summary of how the RAB was constructed is set out in the following sections, together with relevant background information, as follows:

- Section 7.2 describes the establishment of an opening RAB as at 1 January 2003;
- Section 7.3 outlines the rolling forward of the asset base to 1 April 2008 using Depreciation from the 2003 Decision (adjusted for actual inflation) and actual capex and inflation up until 2005/06 and forecasts of capex and inflation for 2006 / 07 and 2007 / 08;
- Section 7.4 provides information on the rolling in of assets related to non-contestable excluded services;
- Section 7.5 provides information on the rolling-in of work in progress in accordance with the change to the AER's preferred regulatory accounting methodology;
- Section 7.6 concludes the chapter by providing a summary of the derivation of the RAB value as at 1 April 2008;

7.2 Establishing the Opening Regulatory Asset Base as at 2003

Under the new National Electricity Rules promulgated on 16 November 2006, each Transmission Network Service Provider (TNSP) has a Regulated Asset Base (RAB) established on a certain specified date. Clause 6A.6.1 of Chapter 6 and Clause S6A.2.1 of Schedule 6A.2 establishes SP AusNet's opening RAB as at 1 January 2003 as $1,835.60 million, adjusted for any difference between the estimated and actual capital expenditure for the previous regulatory control period. SP AusNet has adjusted this value for the difference between estimated and actual capital expenditure for the nine months of 2002 / 03, before the start of the current regulatory period (1 April 2002 to 31 December 2002).

SP AusNet has not adjusted these numbers further to remove the benefit associated with this difference, given its understanding of the AER agreed approach. The AER has stated that it will not claw back any benefit from a capex underspend for the period 2002 / 03 to 2007 / 08,

[25] These arrangements are described in detail in Section 2.3.

subject to outcomes of a prudency review of that capex. This agreement reached with the AER is protected under Clause 11.6.9 of the NER.

In accordance with these provisions, SP AusNet's adjusted opening RAB as at 1 January 2003 was $1,788.3 million.

7.3 Roll Forward of 2003 Regulatory Asset Base

Under the new National Electricity Rules, Clause 6A.6.1 of Chapter 6 and Schedule 6A.2 establishes the methodology to be used for the roll forward of the RAB.

Under Clause 11.6.9 of the NER, this approach can be modified having regard to the existing revenue determination and other arrangements agreed with the AER. The agreed roll-forward approach for the current regulatory control period adjusts for outturn inflation, actual capital expenditure and disposals and inflation adjusted depreciation allowed for in the 2002 Decision.

7.3.1 Depreciation

To roll forward from the 2003 RAB, SP AusNet has used economic depreciation as determined in the ACCC 2002 Final Decision adjusted for actual inflation (forecast for 2006 / 07 and 2007 / 08). Economic Depreciation is calculated by determining the nominal depreciation, and offsetting the CPI indexation for each asset class. The calculation of economic depreciation is shown in Table 7.3.1.

Table 7.3.1 Economic Depreciation 1 Jan 2003 to 1 April 2008 (Nominal $m)

Year	2003^	2003/04	2004/05	2005/06	2006/07*	2007/08*
Depreciation	18.2	77.4	81.8	86.6	92.3	97.6
Indexation	-23.7	-36.8	-44.6	-57.4	-58.6	-52.0
Economic Depreciation	**-5.4**	**40.6**	**37.2**	**29.3**	**33.7**	**45.6**

^ Stub period from 1 January to 31 March 2003

* Forecasts

Source: SP AusNet Roll-forward Model

7.3.2 Capital Expenditure

To roll forward from the 2003 regulated asset base, SP AusNet has used actual asset additions (net of disposals) for the period 2003 to 2005 / 06 and forecasts of capex (net of disposals) for 2006 / 07 and 2007 / 08. A comparison of the 2002 Decision allowances and actual capex is shown in Table 7.3.2.

Table 7.3.2: Net Capital Expenditure 1 Jan 2003 to 1 April 2008 (Nominal $m)

Year	2002/03	2003^	2003/04	2004/05	2005/06	2006/07*	2007/08*
Actual Capex	38.2	30.4	52.4	71.2	102.1	108.9	116.3
Actual Disposals	-2.5	-2.5	-1.0	-2.2	-1.6	-0.8	-0.8
Actual Net Capex	**35.6**	**27.9**	**51.4**	**69.0**	**100.5**	**108.1**	**115.6**

^ Stub period from 1 January to 31 March 2003

* Forecasts

Source: SP AusNet Roll-forward Model

7.4 Roll-in of Non-contestable Prescribed Services

In its 2002 Revenue Cap Application, SP AusNet (then SPI PowerNet) outlined its proposal for treatment of assets associated with providing non-contestable services, that are initially outside the revenue cap (under the Victorian Regulatory Arrangements) for the new regulatory period commencing on 1 April 2008. This treatment is identical to that used in the previous 2002 ACCC Final Decision for excluded service assets completed during the 1997 to 2002 regulatory period. The description of the treatment is reproduced below:

> "…Where a service is non-contestable, having regard to the NEC definition, SPI PowerNet and its customer will write this into the Network Agreement or Connection Agreement.
>
> Contestable services provided by SPI PowerNet shall not form part of the revenue-capped services, at any time.
>
> For the duration of the prevailing (2003 to 2007/08) regulatory period, non-contestable services shall be the subject of a supplemental Network or Connection Agreement. The derivation of charges for the service shall be on the basis of:
>
> - the building block revenue model as described in this Application;
> - operating and maintenance charges based on incremental cost;
> - efficient establishment cost for the new services (as agreed in the Network or connection agreement); and
> - the Vanilla WACC applied using the parameters as proposed in this application but with updated variables.
>
> Charges for the 2008/09 to 2012/13 regulatory period in respect of non-contestable augmentations undertaken over the 2003 to 2007/08 period shall be determined via allocation of the next revenue cap in accordance with the charging allocation principles of the NEC. That is, the associated assets will be included in the RAB from 1 April 2008 and the costs of service provision will be captured within the overall revenue cap. "[26]

This roll-in of assets is protected for SP AusNet under Clause 11.6.21 of the NER. Therefore, SP AusNet has rolled-in assets associated with the provision of non-contestable services that were commissioned since the cut off date for the previous review.

The major additions will be the non-contestable network and connection works such as interface and connection works at the Cranbourne Terminal Station and non-contestable work on the Snowy Interconnector Upgrade. A full list of projects is provided in Appendix D.

The value of those assets SP AusNet is rolling into the RAB on 1 April 2008 is $118.0 million (nominal)[27].

7.5 Roll-in of Work in Progress

The AER's new regulatory accounting methodology published in Explanatory Statement accompanying the AER's post-tax revenue model (PTRM) requires capital expenditure for future regulatory periods be recognised on an as-incurred basis rather than as commissioned.

[26] SPI PowerNet 2002 Application

[27] Includes projects completed and in service by31 December 2006. SP AusNet may update the project list for more recent projects in a supplementary submission at the time of the Draft Decision.

Under this methodology the TNSP receives a return on its work in progress (WIP) as an alternative to capitalising interest during construction. In effect, this draws forward cash flows.

Therefore, SP AusNet is required to capitalise WIP (including regulatory finance during construction (FDC) incurred to date) as at 1 April 2008 and provide its capex forecasts on an as-incurred basis exclusive of regulatory FDC.

The value of WIP to be capitalised into the RAB is $23.2 million.

7.6 Summary

The written-down value of the rolled forward RAB as at 1 April 2008 is $2,222.9 million. The roll-forward is summarised in Table 7.6.1.

Table 7.6.1 Asset Base Roll-Forward from 1 Jan 2003 to 1 April 2008 (Nominal $m)

Year	2003^	2003/04	2004/05	2005/06	2006/07*	2007/08*
Opening Asset Base	1788.3	1823.4	1834.2	1866.1	1937.3	2011.7
Indexation	23.7	36.8	44.6	57.4	58.6	52.0
New Assets (Capex)	29.7	51.4	69.0	100.5	108.1	115.6
Depreciation	-18.2	-77.4	-81.8	-86.6	-92.3	-97.6
Closing Asset Base	1823.4	1834.2	1866.1	1937.3	2011.7	2081.7
Excluded Assets						118.0
Work in progress						23.2
Opening RAB 1 April 2008						**2222.9**

^ Stub period from 1 January to 31 March 2003.

Source: SP AusNet

A breakdown by asset category is provided in Table 7.6.2

Table 7.6.2: Regulatory Asset Base on 1 April 2008 (Nominal $m)

Asset Class	Value 1 April 2008
System Assets	
Secondary	194.4
Switchgear	363.6
Transformers	162.0
Reactive	92.4
Lines	1022.6
Establishment	87.7
Communications	27.7
Non System Assets	
Inventory	7.2
IT	39.0
Vehicles	2.5
Other business support	8.3
Premises	10.3
Land	96.3
Easements	108.8
Regulatory Asset Base	**2,222.9**

Source: SP AusNet Roll-forward Model

8 Depreciation

8.1 Introduction

Under Clause 6A.6.3 of the NER, depreciation schedules must use a profile that reflects the nature of the category of assets over the economic life of that category of assets.

SP AusNet has depreciated each asset category in the Regulated Asset Base (RAB) on a straight-line basis over the economic life proposed. As per Clause 6A.6.3, SP AusNet has followed standard practice by assigning a regulatory life to assets that equate to their expected economic or technical life. In general, the regulatory, economic and technical lives of an asset coincide.

The asset life used in each asset category represents the weighted average of all the assets in that category. It should be recognised that within an asset category, individual assets may have an expected life that can be substantially different to this average. For example, circuit breakers have an average expected life of 45 years; however, 66 kV equipment can be expected to last between 50-55 years, while 500 kV circuit breakers, under considerably more electrical stress, may only last 35-40 years.

SP AusNet generally has assigned technical lives for its assets that are longer than those applied by the other Transmission Network Service Providers (TNSPs) in Australia.

8.2 Depreciation Changes

SP AusNet has varied the regulatory lives from the previous regulatory control period to better reflect the true economic life of the asset categories in two instances.

Firstly, it is appropriate to lower the life of the secondary asset base from 25 years to 15 years for both the existing asset base and new assets. This is driven by:

- the substantial replacement of analogue secondary equipment;
- the shorter life of "off the shelf" digital equipment; and
- the SCADA systems and RTU in the secondary asset base having a technical life closer to 10 years.

This life aligns with the standard life used for secondary assets by other TNSPs.

Secondly, SP AusNet is also aligning its regulatory and statutory lives for IT and business support costs in the future.

Standard lives for the various asset classes for the future regulatory control period are shown in Table 8.2.1.

Table 8.2.1: Standard Lives for Assets

Asset Class	Standard Life
System Assets	
Secondary	15
Switchgear	45
Transformers	45
Reactive	40
Lines	60
Establishment	45
Communications	15
Non System Assets	
Inventory	Not depreciated
IT	5
Vehicles	3
Buildings	10
Other business support	10
Land	Not depreciated
Easements	Not depreciated

Source: SP AusNet

Depreciation from 1 April 2008 to 31 March 2014 is shown in Table 8.2.2.

Table 8.2.2: Depreciation 2008/09 to 2013/14 (Nominal $m)

	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Depreciation	110.8	121.0	130.2	139.1	147.2	144.4
Indexation	-67.2	-70.2	-73.2	-76.2	-79.2	-82.1
Economic Depreciation	**43.6**	**50.9**	**57.0**	**62.9**	**68.0**	**62.2**

Source: SP AusNet, AER PTRM

9 Capital Financing and Taxation

9.1 Introduction

The importance of the rate of return for a capital-intensive business with long-lived assets underscores the need for a conservative approach where there is uncertainty surrounding the estimation of the rate of return. Without the capacity to earn a market return on funds invested in the business, a regulated entity will struggle to attract sufficient capital to invest in, operate and maintain its network. In the longer term, consumers' interests are protected by ensuring adequacy and consistency in the rate of return available to investors in Australian energy infrastructure.

SP AusNet notes that there is a substantial body of regulatory precedent in relation to the rate of return applied to Australian infrastructure assets. Importantly, this has been reflected in the methodology and parameters for this review, which are now fixed in Chapter 6 of the National Electricity Rules (NER).

Therefore, SP AusNet has used the specific values above for the purposes of its revenue proposal. Nonetheless, to finalise the WACC calculation a number of further variables must be estimated. Against this background, the remainder of this Chapter is structured as follows:

- Section 9.2 sets out details of SP AusNet's estimate of the Weighted Average Cost of Capital (WACC), which is made in accordance with the provisions of clause 6A.6.2 of the NER. This WACC is used to determine the return on capital component of the revenue proposal.
- Section 9.3 provides details of the net tax allowance calculated for inclusion in the revenue proposal. SP AusNet's calculations are consistent with the WACC methodology and parameter values specified in clause 6A.6.2 and the requirements of the AER's post-tax revenue model (PTRM).

9.2 An Estimate of the Vanilla Weighted Average Cost of Capital

For the purpose of setting a revenue cap for SP AusNet's prescribed services, a Vanilla WACC needs to be estimated that represents an efficient benchmark for a transmission company in the same operating and regulatory context providing only the prescribed services on a stand-alone basis. As noted above, clause 6A.6.2 sets out that the post-tax nominal vanilla Weighted Average Cost of Capital (WACC) is to be estimated in accordance with the following formula:

$$WACC = k_E \frac{E}{V} + k_D \frac{D}{V}$$

where:

- k_E is the nominal return on equity; (determined using the Capital Asset Pricing Model) and is calculated as:

  $r_f + \beta_e \times MRP$

  where:

  r_f is the nominal risk free rate for the regulatory control period;

  β_e is the equity beta; and

  MRP is the market risk premium;

- k_D is the nominal return on debt and is calculated as:

  $r_f + DRP$

  where:

  DRP is the debt risk premium for the regulatory control period.

- $\frac{E}{V}$ is the equity share in total value (equal to 1 - $\frac{D}{V}$);
- $\frac{D}{V}$ is the debt share in total value.

Clause 6A.6.2 also 'locks in' the following parameter values:

- benchmark gearing ($\frac{D}{V}$) is set at 60 percent;
- the market risk premium (MRP) is 6 percent;
- the equity beta (β_e) is 1.0; and
- the benchmark credit rating used to estimate the debt risk premium is BBB+.

The establishment of the above parameter values in the NER therefore requires SP AusNet to estimate the following remaining WACC parameters:

- the nominal risk free rate;
- forecast inflation; and
- the debt margin.
- Each of these parameters is addressed in turn.

9.2.1 Risk Free Rate

The risk free rate represents the rate of return on an asset with zero default risk. In estimating the WACC, it is a component of both the cost of equity and cost of debt.

In accordance with clause 6A.6.2 (c) of the NER, the annualised yield on the 10-year government bond is used as the appropriate proxy for the risk free rate. The proxy for a real risk free rate will be an interpolation of inflation-indexed government bond rates.

For the purposes of this revenue proposal these rates are set at their values estimated before lodging the proposal. These values are subject to change – depending on capital market conditions - in the period between now and the time at which the AER makes its Final Decision on the revenue cap. For the purpose of determining the risk free rate to apply in the Final Decision, SP AusNet nominates a 10-day averaging period, between dates to be agreed with the AER in accordance with provisions set out in clause 6A.6.2(c)(2)(i).

The values used in this revenue proposal are 5.70 percent for nominal risk free rate and 2.60 percent for the real risk free rate.

9.2.2 Forecast Inflation

For the Final AER Decision, the inflation rate will be derived from the difference between nominal and indexed bond yields over the period corresponding to the revenue control period. Consistent with this approach, SP AusNet has derived an inflation rate forecast of 3.02 percent for the period 2008 / 09 to 2013 / 14. This inflation assumption has been used throughout the proposal.

9.2.3 Debt Margin

In determining the WACC for a regulated entity, the cost of debt is estimated by adding a debt margin to the risk free rate. Clause 6A.6.2 (e) of the NER defines the debt margin as the margin between the 10-year Commonwealth annualised bond rate and the observed annualised Australian benchmark corporate bond rate for corporate bonds which have a BBB+ credit rating from Standard and Poors and a maturity of 10 years.

The debt margin observed represents the credit risk only and does not compensate the business for costs related to debt raising activities. These other costs are addressed as part of the opex proposal outlined in Chapter 6.

The AER's standard practice for estimating the debt margin has been to use observations sourced from the CBASpectrum database. As has been well documented in previous regulatory decisions, a report produced by NERA indicates that the credit spread data provided by CBASpectrum is understated by approximately 25.6 basis points for long dated bonds.

The AER responded to the concerns expressed in previous regulatory decisions in its Directlink Final Decision in 2006 by using data sourced from Bloomberg as an alternative.

Therefore, SP AusNet has used 125 basis points as the debt margin in its proposal, being the observed average over the twenty trading days between 30 October 2006 and 24 November 2006 of:

- the adjusted yield for a 10 year BBB+ bond of 136 basis points (sourced from CBASpectrum data adjusted for the downward bias by 25.6 basis points); and
- the yield for 10 year BBB bond of 115 basis points (sourced from Bloomberg)

9.2.4 Summary

SP AusNet has calculated a post tax nominal vanilla WACC of 8.85 percent in accordance with the requirements of the NER and AER guidelines.

The key parameters and variables underlying the cost of capital calculation are summarised in Table 9.2.1.

Table 9.2.1 Proposed WACC parameters and variables

Parameter/Variable/Outcome	Proposed value
Parameters	
Gearing (D/V)	60%
Market risk premium	6.00%
Equity beta	1
Credit rating	BBB+
Gamma	0.5
Variables	
Risk free rate – nominal 10 year government bond	5.70%
Real risk free rate – indexed 10 year government bond	2.60%
Debt margin	125 bp
Outcomes	
Expected inflation[1]	3.02%
Nominal cost of debt	7.06%
Post-tax nominal cost equity	11.70%
Vanilla WACC (as at time of lodgement)	**8.85%**

^ Calculated via the Fisher Equation from the risk free rate and the real risk free rate.
Source: SP AusNet

9.3 Net Tax Allowance

As part of the post-tax nominal approach, a separate (cash flow) allowance has to be made in the revenue cap for corporate income tax, net of the value ascribed to dividend imputation credits. Clause 6A.64 of the NER sets out the methodology for calculating the allowance for corporate income tax in accordance with the following formula:

$$ETC_t = (ETI_t \times r_t)(1 - \Upsilon)$$

where:

- ETI_t is an estimate of the taxable income for that regulatory year that would be earned by a benchmark efficient entity as a result of the provision of prescribed transmission services if such an entity, rather than the Transmission Network Service Provider, operated the business of the Transmission Network Service Provider, such estimate being determined in accordance with the post-tax revenue model;
- r_t is the expected statutory income tax rate for that regulatory year as determined by the AER; and
- Υ is the assumed utilisation of imputation credits, which is deemed to be 0.5.

SP AusNet has rolled forward its benchmark tax depreciation position established in the 2002 ACCC Final Decision in relation to assets providing prescribed services as required under the AER post-tax revenue model. Since this date the Australian Tax Office has changed the standard tax lives for various asset classes used to establish depreciation for tax purposes. Therefore, for assets rolling into the tax base from the start of the new regulatory period tax lives have been set equal to tax life specified by the Australian Tax Office for the category of assets.

Based on current forecasts of bond rates and inflation, SP AusNet's proposed net tax allowance for the regulatory period is as set out in Table 9.3.1. This will need to be updated by the AER prior to the Final Decision.

Table 9.3.1 Proposed net tax allowance, 2008/09 to 2013/14 (nominal $m)

	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Income Tax Payable	27.3	28.8	30.0	30.8	31.7	29.8
Imputation Credit	-13.7	-14.4	-15.0	-15.4	-15.9	-14.9
Tax allowance	**13.7**	**14.4**	**15.0**	**15.4**	**15.9**	**14.9**

Source: SP AusNet PTRM

10 Operating Expenditure Efficiency Mechanisms

10.1 Introduction

SP AusNet operates its electricity transmission business so as to seek out and achieve cost-efficiencies while:

- ensuring that all standards and compliance obligations are met; and
- continuing to deliver a standard of service and network reliability that meets or exceeds customers' expectations.

A key driver of SP AusNet's performance has been the understanding that the revenue capping arrangements would provide for an explicit incentive payment in relation to the efficiency gains made over the period 2003 to 2007 / 08.

10.2 Operating Expenditure Efficiency Savings

SP AusNet expects opex efficiencies achieved during the current regulatory control period to be subject to a glide-path over the next regulatory period as outlined in the 1999 Draft Statement of Regulatory Principles (DRP). Statement S7.2 on page 97 of the DRP states:

> "Benefits will be glide pathed for a five year period commencing at the start of each regulatory review.
>
> The Commission will make the following adjustments at the end of each regulatory period, to apply in the next regulatory period:
>
> … • Operations and maintenance expenditure – straight line glide path over the next regulatory period; …"

A more detailed description of the mechanism is provided in background discussions on pages 90-91 of the DRP (1999), which states:

> "This form of glide path allows for the gradual sharing of the benefits of efficiency gains between users and the TNSP in the form of lower prices. Further, for reasons of simplicity the glide path will be a simple straight-line phase out of efficiency gains. That is, for a regulatory period of five years, efficiency gains beyond the X factor would reduce at a rate of 20 percent per year. Thus, the TNSP will keep 100 percent of excess efficiency gains for the first year of the next regulatory period, 80 percent of the excess efficiency gains for the second year, and so on, until all of the excess efficiency gains are phased out by the end of the regulatory period."

For the purpose of determining the efficiency gains made by SP AusNet over the current regulatory period, a comparison between the opex benchmark contained in the ACCC's 2002 decision which excludes;

- easement land tax;
- self-insurance;
- rebates;
- equity and debt raising costs; and
- the glide path of efficiency gains from opex and capex from the previous regulatory period;

With the company's actual expenditure, which has excluded the same items, is shown in Table 10.2.1. This ensures that the glide path has been determined from a like-by-like comparison.

Table 10.2.1: Opex comparison (Real 2007/08 $m)

Year	2003^	2003/04	2004/05	2005/06	2006/07*	2007/08*
Decision (CPI adjusted)	20.6	69.3	70.3	69.7	70.3	71.2
Actual	17.8	61.8	62.1	63.7	60.2	61.7
Difference	**2.8**	**7.5**	**8.3**	**6.0**	**10.0**	**9.4**

^ Stub period from 1 January to 31 March 2003

** Forecast.*

Source: SP AusNet

Therefore, SP AusNet seeks a glide path on the generated NPV, which amounts to $22.20 million over the period. This is calculated in Table 10.2.2.

Table 10.2.2: Glidepath of opex efficiencies (Real 2007/08 $m)

	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Glide Path	8.4	6.7	5.0	3.4	1.7	0.0

Source: SP AusNet

SP AusNet has proven from its performance that it will respond to incentive payments and seek cost-efficiencies while also ensuring its obligations are met and continuing to deliver a standard of service that meets or exceeds customers' expectations.

11 Total Revenue and Average Price Path

11.1 Introduction

SP AusNet's final revenue proposal is based on the post tax building block approach outlined in Chapter 6 of the NER and the AER Guidelines and post tax revenue model. The components of the building block have been described in the preceding chapters.

The building block formula to be applied in each year of the revenue control period is:

MAR = return on capital + return of capital + Opex + Tax

= (WACC x RAB) + D + Opex + Tax

where:

MAR = Maximum allowable revenue

WACC = post tax nominal weighted average cost of capital

RAB = Regulatory Asset Base

D = economic depreciation (nominal depreciation – indexation of the RAB)

Opex = operating and maintenance expenditure + efficiency glidepath payments

Tax = regulated business income tax allowance

This revenue is then smoothed with an X factor that meets the requirements of Clause 6A.6.8 of the NER. A brief summary of the building blocks, the raw revenue and smoothed revenue is outlined in this chapter.

11.2 Asset Base Roll Forward to 2013 / 14

The movements in the RAB over the 2008 / 09 to 2012 / 13 regulatory period are set out in Table 11.2.1. These incorporate the capital expenditure plan from Chapter 5 and the expected depreciation over the period from Chapter 8.

Table 11.2.1: Asset Base Roll-Forward from 1 April 2008 to 31 March 2014 (Nominal $m)

Period starting	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Opening Asset Base	2222.9	2322.8	2423.3	2522.6	2621.4	2718.7
New Assets (Capex)	143.5	151.4	156.2	161.7	165.3	199.4
Indexation	67.2	70.2	73.2	76.2	79.2	82.1
Depreciation	-110.8	-121.0	-130.2	-139.1	-147.2	-144.4
Closing Asset Base	2322.8	2423.3	2522.6	2621.4	2718.7	2855.9
RAB for return purposes	**2222.9**	**2322.8**	**2423.3**	**2522.6**	**2621.4**	**2718.7**

Source: SP AusNet PTRM

11.3 Return on Capital

The WACC calculation is detailed in Chapter 9 of this proposal. The return on capital has been calculated by applying the post tax nominal vanilla WACC to the opening regulatory asset base consistent with the AER post tax revenue model. This calculation is shown in Table 11.3.1.

Table 11.3.1: Return on Capital from 1 April 2008 to 31 March 2014 (Nominal $m)

	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
RAB for return purposes	2,222.9	2,322.8	2,423.3	2,522.6	2,621.4	2,718.7
WACC	8.85%					
Return on Capital	**196.7**	**205.6**	**214.5**	**223.3**	**232.0**	**240.6**

Source: SP AusNet PTRM

11.4 Depreciation

The calculation of depreciation is detailed in Chapter 8 of this proposal. The AER post tax revenue model calculates economic depreciation by subtracting the indexation of the opening asset base from the depreciation for each regulatory year. A summary of this calculation is shown in Table 11.4.1.

Table 11.4.1: Depreciation from 1 April 2008 to 31 March 2014 (Nominal $m)

	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Depreciation	110.8	121.0	130.2	139.1	147.2	144.4
Indexation	-67.2	-70.2	-73.2	-76.2	-79.2	-82.1
Economic Depreciation	**43.6**	**50.9**	**57.0**	**62.9**	**68.0**	**62.2**

Source: SP AusNet PTRM

11.5 Operating and Maintenance Expenditure

The calculation of operating and maintenance costs is detailed in Chapter 6 of this proposal. The total opex including debt and equity raising costs, rebates, easement tax and other allowances are shown in Table 11.5.1.

Table 11.5.1 Operating expenditure from 1 April 2008 to 31 March 2014 (Nominal $m)

	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Opex Costs	71.5	76.3	81.0	85.0	88.9	93.0
Easements Land Tax	84.0	90.0	96.5	103.4	110.7	118.6
Rebates	6.8	7.0	7.2	7.5	7.7	7.9
Equity Raising costs	2.0	2.1	2.1	2.2	2.3	2.4
Debt Raising costs	1.7	1.8	1.9	1.9	2.0	2.1
Glidepath	8.6	7.1	5.5	3.8	1.9	0.0
Total	**174.7**	**184.3**	**194.3**	**203.7**	**213.6**	**224.1**

Source: SP AusNet PTRM

11.6 Income Tax Payable

The income tax payable calculation is detailed in Chapter 9 of this proposal. The estimated tax allowance is shown in Table 11.6.

Table 11.6 Tax allowance from 1 April 2008 to 31 March 2014 (Nominal $m)

	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Income Tax Payable	27.3	28.8	30.0	30.8	31.7	29.8
Imputation Credit	-13.7	-14.4	-15.0	-15.4	-15.9	-14.9
Tax allowance	**13.7**	**14.4**	**15.0**	**15.4**	**15.9**	**14.9**

Source: SP AusNet PTRM

11.7 Raw Revenue Requirement

The raw revenue requirement for each year of the period is calculated as the sum of return on capital, regulatory depreciation, operating and maintenance expenditure, efficiency carry-over and net tax allowance. The outcomes are presented in Table 11.7.1.

Table 11.7.1: Raw revenue requirement, 2008/09 to 2013/14 (Nominal $m)

	Financial years ending 31 March					
	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Return on Capital	196.7	205.6	214.5	223.3	232.0	240.6
Economic Depreciation	43.6	50.9	57.0	62.9	68.0	62.2
Operating and Maintenance	82.0	87.2	92.3	96.6	101.0	105.5
Easement Land Tax	84.0	90.0	96.5	103.4	110.7	118.6
Glidepath	8.6	7.1	5.5	3.8	1.9	0.0
Net Tax Allowance	13.7	14.4	15.0	15.4	15.9	14.9
Raw revenue requirement	**428.7**	**455.1**	**480.7**	**505.3**	**529.5**	**541.9**

Source: SP AusNet PTRM

11.8 Smoothed Revenue Requirement

While the raw revenue requirement is already comparatively smooth, it still needs to be converted to a CPI - X format in order for the revenue cap to be implemented. The revenue cap proposed is:

- for the financial year ending 31 March 2009, $419.5 million (nominal); and
- for the financial years ending 31 March 2010 to 2014, escalating according to a constant X factor of - 3.22 percent.

The smoothing approach chosen smooths the revenue with the previous period for both SP AusNet and customers and satisfies the requirements of the National Electricity Rules in that it meets the following criteria:

- the revenue in the last year (2013 / 14) is within 7 percent of the Building Block Revenue (in 2013 / 14, as per NER clause 6A.6.8);
- the P_0 and X-factors are constant in each year; and
- the total building block revenue and the total smoothed revenue for the regulatory control period must be equal in NPV terms.

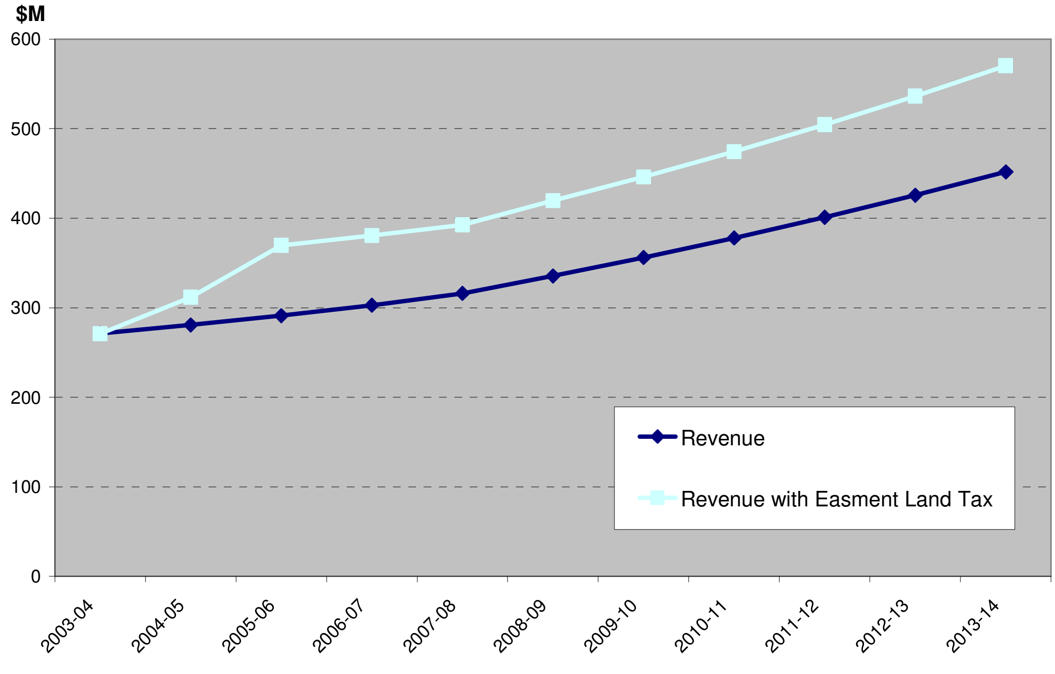
As would be expected, the smoothed revenue requirement is not significantly different from the raw revenue requirement (refer Table 11.8.1).

Table 11.8 Smoothed revenue requirement, 2003 to 2007/08 (Nominal $m)

	Financial years ending 31 March					
	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Raw revenue requirement	428.7	455.1	480.7	505.3	529.5	541.9
Smoothed revenue requirement	419.5	446.1	474.4	504.4	536.4	570.4
Difference	**9.2**	**9.0**	**6.4**	**0.9**	**-6.9**	**-28.5**

Source: SP AusNet PTRM

Figure 11.8 Smoothed revenue (nominal $m)



Source: SP AusNet

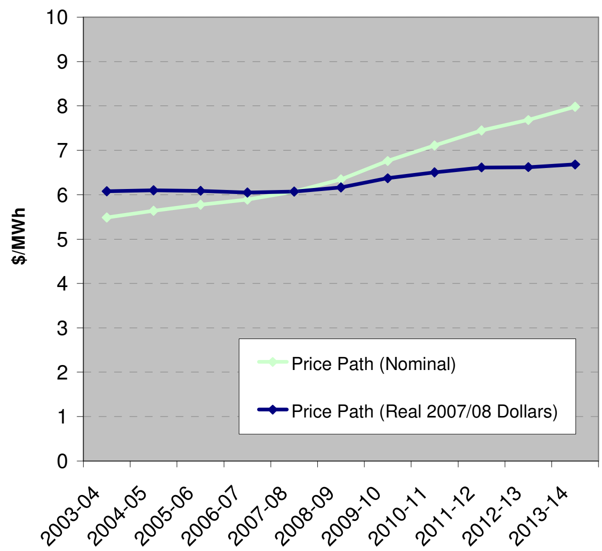
NOTE: NUMBERS IN TABLES MAY NOT ADD TO TOTAL DUE TO ROUNDING.

11.9 Average Price Path under the Proposed Revenue Cap

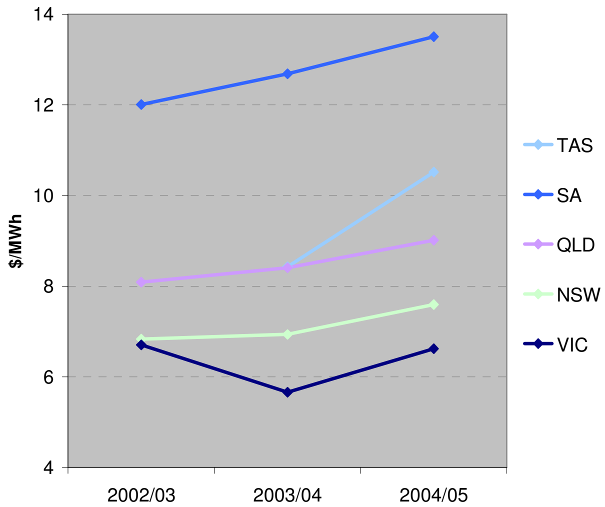
SP AusNet's unit charge for providing transmission services is currently the lowest in Australia. The revenue path proposed by SP AusNet will continue to deliver low transmission prices for Victoria and ensure that prices remain competitive with or lower than the transmission prices across the National Electricity Market (NEM).

Figure 11.9: Future Real Price Path

Forecast Transmission Price Path*



Transmission Charge 2002/03 to 2005/06



* Effects of the Victorian easement land tax and the roll-in of previously unregulated assets are excluded to allow a like-for-like comparison over time.

Source: SP AusNet, AER TNSP Comparison Reports.

12 Appendices

Appendix A – Jervis Consulting Report

A report on the Asset Risk Management Survey conducted for SP AusNet in July/August 2006 by Jervis Consulting.

Appendix B - VENCorp Availability Incentive Scheme

A more detailed explanation of the VENCorp Availability Incentive Scheme.

Appendix C – SKM Report

A report compiled by consulting engineers Sinclair Knight Merz on *Escalation Factors Affecting Capital Expenditure Forecasts* dated 21 February 2007.

Appendix D – Major Project List

A full list of projects incorporating the major additions to the non-contestable network and connection works such as interface and connection works at the Cranbourne Terminal Station and non-contestable work on the Snowy Interconnector Upgrade.

Appendix E – Asset Management Strategy

A report outlining the strategy for the management of the Victorian Electricity Transmission Network assets by SP AusNet.

Appendix F – BIS Schrapnel Report

A study on real increases in labour and materials costs by BIS Schrapnel, Business Research and Forecasting Consultants.

Electricity Transmission Regulatory Reset

2008/09 – 2013/14

Appendix A

Jervis Consulting Report

SP AusNet
A member of Singapore Power Group

Report on Asset Risk Management Survey conducted for SP AusNet July/August 2006

Introduction

Asset risk management is an important part of the process of ensuring longer-term network performance. SP AusNet is seeking to promote greater visibility of asset risk management in the transmission segment of its business. The key aims of this initiative is:

- To allow SP AusNet to gain assurance that the quality of approaches being adopted to risk management aspects of the stewardship of its assets is at or moving towards best practice,
- To identify areas where improvement is required and the development of an action plan for moving forward.

In 2002 The Office of Gas and Electricity Markets (Ofgem), the UK Market Regulator conducted an Asset Risk Management Survey of the large electricity and gas network operators. The Survey, developed by an Ofgem consortium was "to explore the medium/long term asset risk management practices".

SP AusNet has taken the decision to use the Ofgem survey instrument to assess its current asset risk management performance and where to target improvement activities.

To achieve the desired outcomes, Jervis Consulting was asked to assist with conducting the Survey (using the Ofgem information provided by SP AusNet), to analyse the results and provide data for the development of an Action Plan.

The intent was to use a consistent approach to that used by Ofgem and to benchmark the SP AusNet results with those companies surveyed by Ofgem.

This report is the completion of the initial review and the success of this first stage is very much dependent on the company's commitment to working through the identified areas of improvements and development and implementation of a focused Action Plan to achieve the move to best practice.

The companies who participated in the Ofgem survey were:

Electricity Distribution

Aquila
LPN and EPN
Scottish and Southern Energy
SEEBAORD Power Networks
Western Power Distributors
East Midlands Electricity
Northern Electricity Distribution Network
SP Distribution plc (including SP Manweb plc)
United Utilities
Yorkshire Electricity Distribution Limited

Electricity Transmission

SP Transmission plc
National Grid
Scottish and Southern Energy

Gas Distribution and Transmission

Transco

Methodology

As mentioned above, the Ofgem Asset Risk Management Survey (provided by SP AusNet) was the instrument used in the review. The Survey uses a simple model (Figure 1 below) that is based on a number of theoretical models.

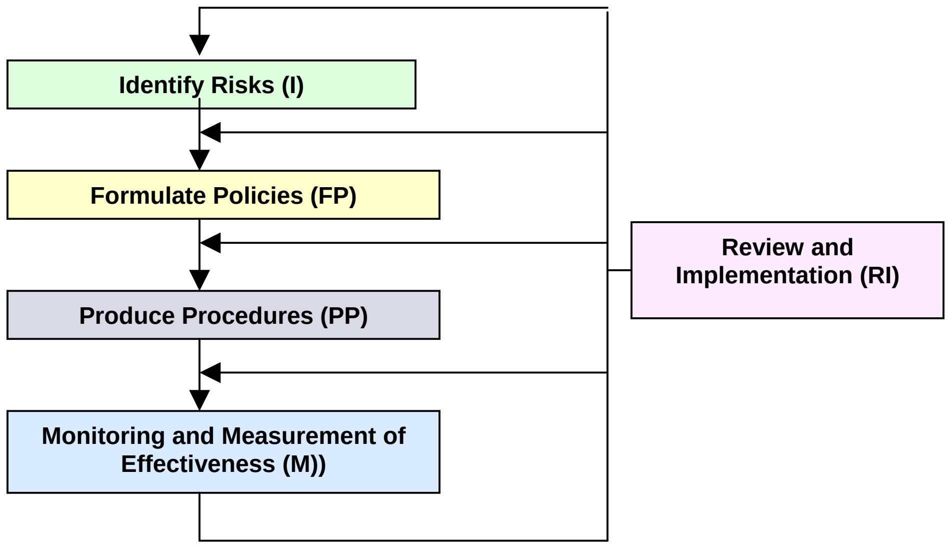


Figure 1: Asset Risk Management Survey Model

This simple high-level model, combined with the content of the questionnaire, is sufficiently robust to allow the exploration of the asset risk management process at the level required for this survey.

The questions in the Survey are structured to investigate the risk management model for the key areas of the company where asset risk activities take place. These are:

- Category A: Business Strategy and Direction
- Category B: Asset and Network Strategy
- Category C: Asset Lifecycle Management

Within each of the categories above, key topic areas were identified and a series of questions are structured to test the integration of information flows between the three categories. They are designed to check how effectively processes are being applied and how the company is monitoring and reviewing its effectiveness in order to continuously improve asset risk management techniques.

A survey questionnaire was prepared using the Ofgem document and a selected number of Network Development Managers (transmission) undertook a workshop to complete the document. Other subject experts were used to verify information provided at the workshop. The responses were then rated against the Asset Risk Management Scoring Matrix, using the evaluation matrix provided in the Ofgem documents. This then allows benchmarking with the UK companies.. The results were then reviewed and an agreed final score for each question determined.

Spider Graphs were then used to compare SP AusNet's performance to the companies in the 2002 Ofgem Report. (See Page 6 of this report)

Scoring

As mentioned previously, SP AusNet's responses to the questionnaire were assessed against the Asset Risk Management Scoring Matrix. The basis of the Scoring Matrix is summarized below:

Level of Process Development	***Guideline for extent of application***	***Points Awarded***
Process fully integrated and effective across the whole company	>90%	5 points
Process mostly in place but not shown to be fully integrated and effective across the company	76%	4 points
Process development complete to moderate extent and/or not applied to notable areas of company asset activities or locations	50%	3 Points
Process under development and/or applied to only some areas of the company asset activities or locations	25%	2 Points
Little or no evidence of process and/or limited application across company asset activities or locations	<10%	1 Point

To score the key topic areas such as Category A, B and C, the quality of the evidence provided in the response to the main question and the sub-questions was assessed. This formed an understanding of the company's asset risk management approach for that key topic areas. The final score awarded depended on both the extent and level of the risk management process and the range of application of the process across the asset types and across the organization.

The questionnaire provides a "snap-shot" of the status of asset risk management at a particular point in time. However it must be recognized that there is no single correct model for asset risk management implementation and that SP AusNet, quite rightly, determines its own priorities for its own business and customers. For example, the planning regime in Victoria provides different scenarios and results to what is expected in the survey.

Survey Results

The radar plot below shows a simple representation of SP AusNet's process position in the 18 segments of the survey. The use of the radar plot presentation allows for the rapid assimilation of multi faceted results. The benefit of using the radar plot is that it allows the reader to quickly ascertain SP AusNet's areas of greater development and the areas where improvement opportunities exist.

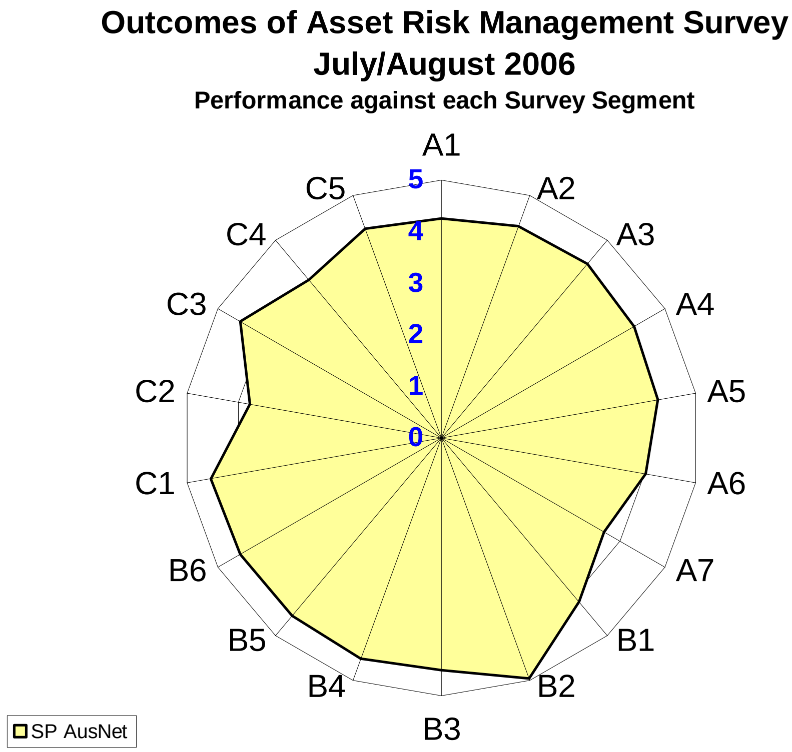


Figure 2: SP AusNet's Performance Radar Plot

The key to the Radar Plots is as follows:

Score	**Classification**
5	Leading
4	Above Intermediate
3	Intermediate
2	Below Intermediate
1	Trailing

	Section B **Asset and Network Strategy**
B1	From Policy to Procurement
B2	Defining Asset Life and Sustainability
B3	Recording Asset Information
B4	Innovation and New Technology
B5	Security of Supply and Asset Utilisation
B6	Compliance with Legislation

	Section A **Business Strategy and Direction**
A1	Aims and Objectives
A2	Identifying Key Issues for Asset Risk Management
A3	Assigning Accountabilities
A4	Structures and Contracts
A5	Operating, Integrating and Interpreting
A6	Risk Assessment and Decision-Making
A7	Review Process

	Section C **Asset Lifecycle Management**
C1	From Procurement to Delivery
C2	Asset Register Contents
C3	Utilisation
C4	Use of Contractors/Suppliers
C5	Inspection and Maintenance Regimes

The general trend of SP AusNet's performance is that its strongest area is Section B, the Asset Network Strategy with the company scoring an average of 4.3. SP AusNet's poorest performance came in Section C Asset Register Contents rated at 3.8 and Risk Assessment and Decision Making at 3.2. The Section A average performance was 3.7.

More specifically SP AusNet's performance against each of the 18 Segments of the survey was as shown below:

	Section A Business Strategy and Direction	Score
A1	Aims and Objectives	4
A2	Identifying Key Issues for Asset Risk Management	4
A3	Assigning Accountabilities	4
A4	Structures and Contracts	4
A5	Operating, Integrating and Interpreting	4
A6	Risk Assessment and Decision-Making	3
A7	Review Process	3

	Section B Asset and Network Strategy	Score
B1	From Policy to Procurement	4
B2	Defining Asset Life and Sustainability	5
B3	Recording Asset Information	4
B4	Innovation and New Technology	4
B5	Security of Supply and Asset Utilisation	5
B6	Compliance with Legislation	4

	Section C Asset Lifecycle Management	Score
C1	From Procurement to Delivery	4
C2	Asset Register Contents	3
C3	Utilisation	4
C4	Use of Contractors/Suppliers	4
C5	Inspection and Maintenance Regimes	4
C6	Risk Assessment and Decision Making	3

It is noted that a number of risk evaluation models and processes were under development at the time of the review but were not considered as they were in the draft stage.

SP AusNet's Strengths

SP AusNet's strengths were shown to be as follows:

- SP AusNet has well-developed processes in the Business Strategy and Planning segment of the Division to identify and assessing the risks for the network in the medium to long term. These are integrated into the Corporate Risk Register.
- Wide experience of Board in infrastructure businesses and involvement with review and comment on Asset Management Strategy, Asset Management Plan and Corporate Risk Plan.
- A strength is the area of assigning accountabilities demonstrated by strong management involvement in the formulating, documenting and devolvement of corporate objectives through the organization to the individual level
- The Asset Management Model, where there is segregation of strategic long-term asset management from the short-term operational delivery provides for reduction in planning and performance conflicts.

- Although network augmentation for security of supply is not a responsibility of SP AusNet, there is a strong in focus on security of supply through monitoring and improvement of asset condition and asset utilisation.
- The use of an annual “workshop approach” and specialist input to the Asset Risk Management process risk identification is sound but outputs need to be formalized.

Improvement Opportunities

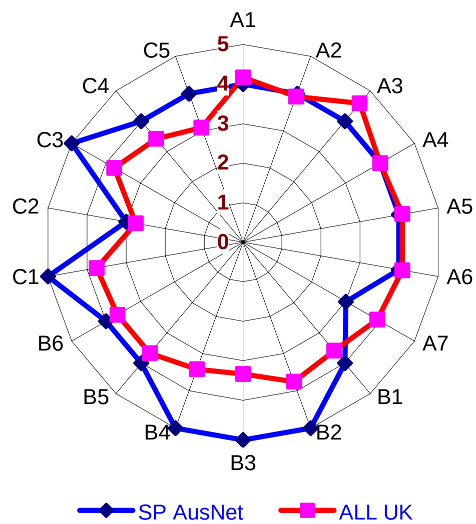
SP AusNet has reasonably developed asset risk management processes. However these are not well documented and generally not supported by Asset Management policies and procedures, except in the maintenance area where detailed documented procedures exist.

- Need to document the transitional plans for non-compliance of technical standards (a NEMMCO requirement)
- The full implementation of the Asset Health Report, the development of which is now nearing completion, will greatly improve critical base information especially with regard to risk performance measurement.
- The implementation of the Corporate Risk Software needs to be completed to improve risk analysis of decisions being made.
- Asset Risk management processes and Asset Models need to “roll out” for all assets to provide consistency of approach to risk assessment and decision-making.
- SP AusNet’s view of the long-term time horizon for setting their asset risk management strategy is generally confined to the next regulatory period and no more than a 10-year period. A longer-term view would seem to more appropriate.
- SP AusNet uses a reasonably defined and effective documented approach to risk management, including some modeling. Since the review was completed in August improvement activities have been ongoing. However more improvement will be achieved by introducing a rigorous, integrated and systematic approach to identifying, assessing and recording risk.
- The better collection and strong and utilization of the asset lifecycle information should be a primary focus for SP AusNet. Currently some valuable information is collected.
- Improve quality control process that monitors the compliance and workmanship of both internal and external contractors.
- Although the deployment of corporately set objects is sound some more well-defined performance objectives (e.g. asset performance, monitoring, and risk identifying and recording), set and monitored at Divisional and the individual levels would be a benefit.
- Monitoring of performance against the medium and longer-term objectives needs improvement. Currently some monitoring of contractor output is conducted but very little for internal resources.
- More detailed review of resourcing needs and the inclusion of a resourcing section in the Asset Management Strategy.
- The involvement in more meaningful asset management benchmarking, particularly outside the electricity industry would more than likely, lead to improved practices.

Comparison to Ofgem Survey Results

The Spider Graphs below compare SP AusNet's performance with two outcomes of the 2002 Ofgem Study. Graph one compares SP AusNet's performance against the combined performance of all Ofgem participating companies. Graph two compares SP AusNet's outcomes against the top 4 Ofgem Study performers.

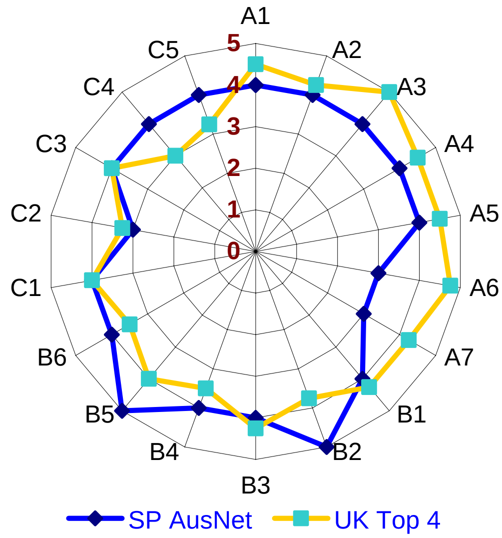
Graph One SP AusNet compared with Average of UK Study



The graph shows that SP AusNet performs well against the average of the 12 companies in the Ofgem study. In Section A, Business Strategy and Direction, SP AusNet's performance is generally equal to the average with lower than average performance in Assigning Accountabilities (A3) and Reviewing Process (A7). In Section B, Asset and Network Strategy, SP AusNet outpoints the average in all categories. In Section C, Asset Life Cycle Management, SP AusNet again shows superior performance in all segments.

Graph Two

SP AusNet Performance Compared to Average of Top 4 UK Performers



When comparing SP AusNet's performance to the average of the best 4 performers in the Ofgem Study the chart shows areas where SP AusNet will benefit from establishing relationships with these best performers. In Section A, Business Strategy and Direction, SP AusNet's performance is equal to or below the average in all 7 categories. The poorest performing segments are A6, Risk Assessment and Decision Making and A7 Review Process.

In Section B, Asset and Network Strategy, SP AusNet is equal to or better than the UK top 4 company average in all categories. It is superior in performance in Segments B2 Defining Asset Life and Sustainability, B4 Innovation and New Technology, B5 Security of Supply and Asset Utilisation and B6 Compliance with Legislation.

In Section C, Asset Life Cycle Management, SP AusNet again shows a performance equal to or superior in all segments except number 2, Asset Register Contents. SP AusNet scored a 4 on segment C4 Use of Contractors and Suppliers and a 4 on Segment C5 Inspection and Maintenance Regimes, which was, better than the UK Top 4 company average.

Summary

SP AusNet's overall Survey result is good with strong performances in most Sections. The results indicate that SP AusNet's is undertaking its Asset Risk Management activities in a structured and sound manner and is at or better than most best practices identified in the UK Ofgem study.

In several areas SP AusNet is performing exceptionally well while in other segments clear improvement opportunities have been identified. Addressing these improvement opportunities will lift the overall performance even more.

It is suggested that the review exercise be completed again in 18 months time to ascertain how SP AusNet has addressed the improvement actions identified.

Attachments:

Attachment 1	Asset Risk Management Scored Questionnaire
Attachment 2	Asset Risk Management Survey Scoring Matrix
Attachment 3	List of Participants in the Survey
Attachment 4	Ofgem Report

Attachment 1

Asset Risk Management Survey
Scoring Matrix

Score	Process	Evidence	Integration	Deployment	Review	Scoring Guideline
5	Comprehensive documented process for the effective operation of the risk management process step under consideration. The company would be able to demonstrate a well thought out, fully developed and well documented process	There is strong evidence that the process is carried out in an integrated way with the other steps of the process and information flows into and out of the step under consideration	There is clear evidence that inputs to and outputs from the individual risk management process are connected and integrated to the overall organizational risk management process	The process is deployed across all asset types and across the regional and organizational structure	There is evidence of regular reviews that demonstrate the effectiveness of the process in benefiting asset stewardship, evidence and refinement of the overall process as a result of the review process	As a guideline, a company that achieves less that 90% of the scope of the question will achieve a 5 point score
4	The particular step of the risk management process under consideration is mostly documented, in place and fairly well developed for the company actively under assessment and shown to be working effectively in that area	There is evidence that the process is carried out in an integrated way with the other steps in the process and information flows from each step into other steps	The company is unable to demonstrate that the process is fully and effectively integrated into the overall organizational risk management process, although there may be evidence that this is happening in many areas	The process is deployed across most asset types and regional areas but there is insufficient evidence to confirm that outputs from the risk management process applied to the individual asset types are integrated into the overall organization of the risk management process	There is evidence of regular reviews of the effectiveness of the process and evidence of refinement to the overall process as a result of the review process	As a guideline, a company that achieves less that 75% of the scope of the question will achieve a 4 point score
3	The particular step of the risk management process under consideration is moderately well defined and documented but there are a few areas where some improvements could be made or completed	Information into and out of the step of the risk management process under consideration is not fully effective but there is some evidence that it is taking place	The company is unable to demonstrate that the process is fully and effectively integrated into the overall organization risk management process although there may be some evidence that this is happening in some areas	The process is deployment across half of asset types or regional areas but not all	There is evidence of reviews or refinement to the process as a result of the review process but not on a regular basis or in a structured way	As a guideline, a company that achieves less that 50% of the scope of the question will achieve a 3 point score
2	The particular step of the risk management process is loosely defined and documented but with several areas either lacking the definition or specification. A number of areas of the process would require improvements	Limited evidence of information flow into and out of the step of the risk management process under consideration	Limited evidence of the risk management process being integrated into the organizational risk management approach	Deployment across about less than half of asset types/ activities and/or regional areas	Limited evidence of a review process for assessing the effectiveness of the process or refining it	As a guideline, a company that achieves less that 25% of the scope of the question will achieve a 2 point score
1	The particular step of the risk management process under consideration is poorly defined and documented with many areas either not covered or in need of improvement. Some areas may be carried out on an informal basis but this is not fully documented	Little evidence of information flow into and out of the step of the risk management process under consideration	Little evidence of the risk management risk management process being integrated into the organizational risk management approach	Deployment across few if any asset types/activities and/or regional areas	Limited or no evidence of a review process for assessing the effectiveness of the process or refining it	As a guideline, a company that achieves less that 10% of the scope of the question will achieve a 1 point score

Ofgem document reference: 30/02

Asset Risk Management Survey

Survey Guide

(including Survey Questionnaire)

A report for Ofgem by:

British Power International

ERA Technology

Mott MacDonald

List of Contents

Tables

Figures

Glossary

ARM	Asset Risk Management
IIP	Information and Incentives Project
Long term	a period in excess of five years ahead
Medium term	a period of time up to five years ahead
RM	risk management

Summary

Ofgem is seeking to promote greater visibility of asset risk management in the transmission and distribution of electricity and gas. The key aims of this initiative are to allow Ofgem to gain reassurance of the quality of the approaches being adopted by the network companies to the risk management aspects of their stewardship of the asset base, and the identification and encouragement of best practice in the area of asset risk management.

To fulfil the aims of this initiative Ofgem has initiated an Asset Risk Management Survey. The survey has been prepared on behalf of Ofgem by British Power International, ERA Technology and Mott MacDonald. They have been retained by Ofgem to assist in the first year of the survey's development and implementation.

This document details the work done thus far in the production of a survey guide and questionnaire designed to enable Ofgem to gather information on attitudes and approaches to asset risk management from the licensed gas and electricity transmission and distribution businesses throughout England, Scotland and Wales.

To explore the management of asset risks a simplified model of the typical risk management process has been adopted as the basis of the survey questionnaire and scoring methodology. A series of questions covering the main categories first proposed in Ofgem's first consultation document in November 2001 have been formulated. Each main category is split into a number of key topics against which a main question and a basket of sub-questions is asked. The responses from the companies across the whole questionnaire will be assessed against the risk management model and will explore the level of development, extent of deployment and level of integration of risk management processes across the range of asset management activities. As part of the questionnaire within one of the categories questions have been targeted to probe selected operational areas to assess the application of the risk management process and explore its effectiveness across certain aspects of the asset base and network.

The company responses to the questionnaire will initially be assessed based on a scoring methodology. Following this initial scoring each company will be subject to an audit visit to seek evidence to confirm the responses provided in the questionnaire. Upon completion of this process a final score can be awarded for each key topic area. The scores will then be used to provide a classification from 'leading' to 'trailing' for that area of the questionnaire, thus enabling the identification of asset risk management performance within the industry.

The results of the survey will be published in the form of a commentary and a series of 'radar plots' which will show relative company performances in each of the key topic areas.

Full company results will be confidential to Ofgem and the company, with an industry summary produced for public reporting. In the first year, the participating companies will be named in the published report, but their individual scores or commentaries will not be identifiable.

This is the first year of the survey and Ofgem acknowledges that there will be refinements made for future survey years.

1 Introduction

Ofgem's primary obligation is to protect the interests of both existing and future consumers of electricity and gas. The responsible stewardship of long-life network assets by companies is a key factor that impacts on the interests of existing and future consumers and as a consequence it is an area in which Ofgem takes an interest. Asset risk management is an important part of the process of ensuring longer term network performance, therefore Ofgem is seeking to promote greater visibility of asset risk management in order to encourage best practice and to gain reassurance of the management of network infrastructure.

Ofgem first proposed the concept of an annual Asset Risk Management (ARM) Survey in a consultation document published in November 2001[1]. Comments on the proposal were invited from the electricity and gas transmission and distribution companies (network companies) and other interested parties.

The Regulator has appointed a consortium of consultants to assist in the preparation of the survey. The consortium is made up of British Power International, ERA Technology and Mott MacDonald, who are also currently working with Ofgem on the Information and Incentives Project (IIP). The companies have brought together people who have industry-based technical expertise, a strong audit background and the analytical skills needed to help deliver the requirements of this survey.

This paper presents the survey that has been designed to explore the asset risk management approaches of the electricity and gas network companies taking into account all stakeholder requirements. It will enable Ofgem to highlight risk management approaches that are considered to be 'best practice' within the context of risk management of network assets. This work will complement, but be separate from, other initiatives such as Ofgem's IIP work.

The proposed survey document is set out in this paper in the following manner:

- Section 2 describes the structure of the questionnaire. This section includes the key areas of analysis and the asset risk management model adopted as the basis of the survey. In addition this section includes the general and detailed structure of the questions explaining how the current questionnaire has evolved from the initial proposals of the first consultation document, how the format of the questionnaire will be set out and provides a guide to the different level of questioning of the survey

- Section 3 gives a detailed explanation of the proposed scoring methodology developed to score the companies' responses to the questionnaire

- Section 4 sets out the proposed survey process including the distribution of the questionnaire, the audit visits and the production of company reports

- Appendix A contains the proposed survey questionnaire

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[1] Asset Risk Management in electricity and gas networks – A proposed survey and its interaction with Information and Incentives Project, First consultation document. November 2001

2 Structure of the Proposed Survey

2.1 Introduction

This section covers how the proposed survey has been developed and formulated.

2.2 Key Areas of Analysis

Due to the high level of the survey and the acknowledgement that there is significant commonality between the management of asset risk within both the gas and electricity network companies the proposed survey is designed to be generic and applicable across all sectors within the industry.

Asset management is a term that has been widely used in recent years and has developed many different meanings, ranging from purely financial management through to the very narrow definition of routine asset maintenance. This survey will review the approach to the management of risk to the whole life management of the infrastructure assets, both for delivering longer-term performance to required standards and for ongoing infrastructure development for future users.

To understand the main issues that concern asset risk management a review of the policies, strategies and systems in place to manage the network and its assets is necessary. Additionally, information exchange throughout the organisation is an important part of the process.

The following categories first proposed in Ofgem's consultation document of November 2001 have been viewed as broadly reflecting the key areas within a company where risk asset management activities take place and so provide a useful framework for developing this generic survey:

Category A Business Strategy and Direction

Category B Asset and Network Strategy

Category C Asset Life Cycle Management

These categories are employed to classify a set of general questions (see Appendix A) that will be presented to the companies to explore their asset risk management strategies. Within Category C, selected topics have been included to probe specific operational areas. The selected topics will be reviewed in future survey years.

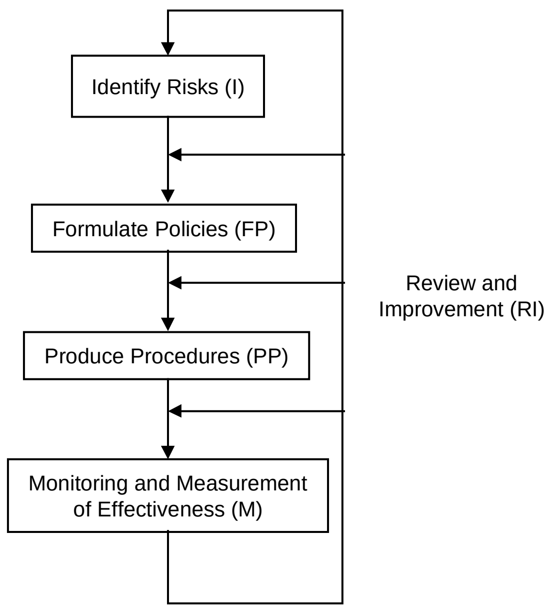
2.3 Asset Risk Management Model

A simplified risk management model has been developed (see Figure 1) based on a number of theoretical models, which shows the high-level steps in a typical risk management process.

It is appreciated that other models exist, such as those contained in HSE guidelines and various quality management processes such as ISO 9000 and ISO 14000. It is however considered that the simple high-level model in Figure 1 embodies the theories underlying these other models and, combined with the content of the proposed questionnaire, is sufficiently robust to allow the exploration of the asset risk management process at the level required for this survey. The proposed model splits the process into the following critical elements:

1. Identify Risks (I)
2. Formulate Policies (FP)
3. Produce Procedures (PP)
4. Monitor and Measure Effectiveness (M)
5. Review and Improvement (RI)

Figure 1: Risk Management Model

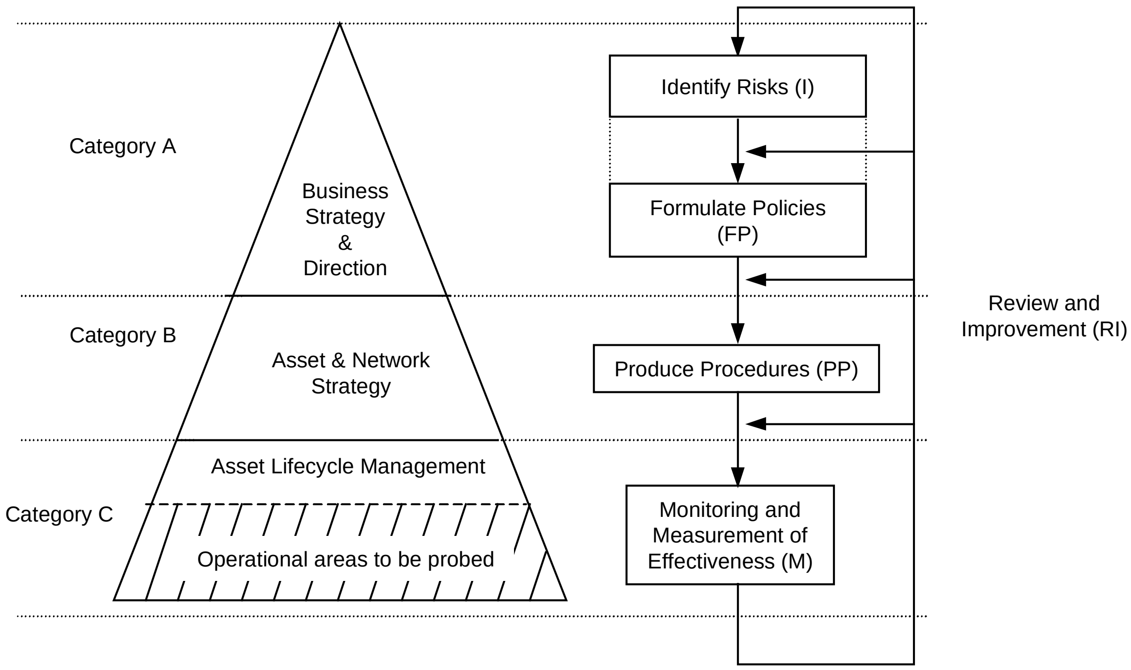


The importance of review and improvement within the risk management process is reflected in the fact that this activity feeds into the process at each step.

The questions in the survey have been structured to investigate this risk management model for the key areas of analysis identified in Section 2.2. For the reasons outlined above it is considered that the area of Review and Improvement will be included in the question sections for each of the other process steps. As an integral part of each step the questions have been structured to include the assessment of how information is fed into the step and how it flows out of the step.

Figure 2 shows how the risk management model maps to the key activity categories identified by Ofgem in their November consultation document.

Figure 2: Mapping of Risk Management model to Asset Risk Management Activity Categories



The figure above shows how we consider that the risk management model could be applied across the different activity categories within the surveyed companies. This is designed to account for the application of risk management as an integral part of a top-down management process.

The proposed questionnaire will assess the asset risk management process across all the three main categories, in each case targeting the questions to explore the principal steps in the typical risk management model carried out at that level as shown in Figure 2.

As well as the general questions for Categories A, B and C, which investigate the risk management model steps, it is also proposed that more specific questions will be included to assess the application and effectiveness of the asset risk management process. This section of the questionnaire is expected to change on an annual basis to explore the effectiveness of the process in different areas.

For the 2002 survey the areas selected will be:

(a) asset registers;

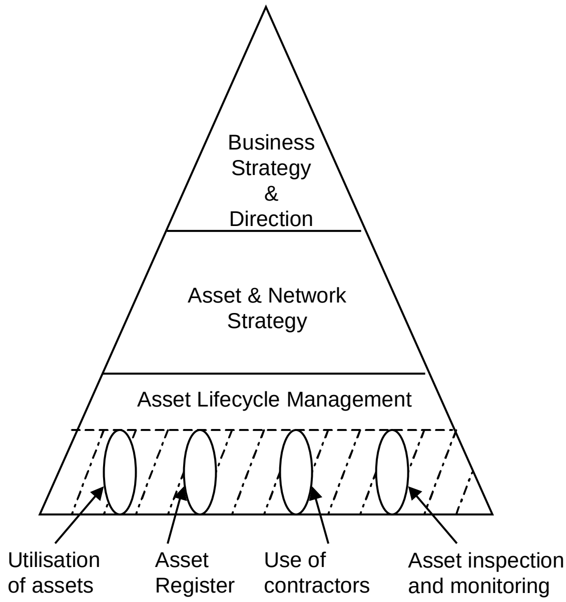
(b) utilisation of assets;

(c) use of contractors/suppliers;

(d) asset inspection and monitoring regimes.

and as illustrated in Figure 3 below.

Figure 3 : Operational Areas to be Investigated



The areas selected for the detailed section of the survey are likely to develop or change in future years. The gathering of performance evidence in these selected areas will also enable base-lining of performance that can be reviewed as an on-going measure of the effectiveness of the asset risk management process.

This approach will allow the assessment of how the risk management process feeds through from the corporate level, through the asset strategy level to effective 'on-the-ground' application of the risk management process. By carrying out this type of probing questioning we will test the effectiveness of this process.

2.4 Questions

2.4.1 General Structure

The proposed structure of the survey questionnaire reflects the basic model (Figure 1) of how asset risk management may fit into the companies' structure and activities. Whilst this model is not expected to exactly reflect individual organisational structures, it does help to define the key topic areas that the survey will address.

Questions have been formulated to fit within the three main categories identified in section 2.2. Beneath these main categories a series of sub-category question areas has been developed to reflect the areas to be investigated during the proposed questionnaire process. These sub-categories have been titled key topic areas. Shown below are the key topic areas to be covered:

(I) Business Strategy and Direction

- Aims and objectives
- Identifying key issues for Asset Risk Management

- Assigning accountabilities
- Structure and contracts
- Operating, integrating and interpreting
- Risk assessment and decision making
- Audit and accreditation

(II) Asset and Network Strategy

- From policy to procedure
- Recording asset information
- Defining asset life and serviceability
- Innovation and new technologies
- Security of supply and asset utilisation
- Compliance with legislation

(III) Asset Lifecycle Management

- From procedure to delivery
- Asset register contents
- Utilisation
- Use of contractors and suppliers
- Inspection and maintenance regimes

Although questions are structured into these three categories, the survey recognises that the most effective overall approach to asset risk management is to take an integrated and balanced view of the issues, from corporate strategy through to network strategy and life cycle asset management.

The proposed survey questions have been structured to test for integration of information flows between the three categories. It will also check how effectively processes are being applied and how companies are monitoring and reviewing their effectiveness in order to continuously improve asset risk management techniques. As review and improvement is implicit at each stage of the risk management process, included at each step are questions that will probe this aspect.

2.4.2 Format of the Questions

(i) Introduction

This section explains the structure of the proposed questionnaire and shows how the structure has been designed to explore the relevant areas. The full questionnaire is shown in Appendix A.

Respondents should familiarise themselves with all the questions before starting to answer them. It is suggested that a thorough reading of the whole questionnaire will assist respondents in understanding what information is being sought and where best to include the relevant information and evidence.

Companies should ensure that statements of performance can be backed up with evidence if requested at the survey visit.

Table 1 shows an example question from the questionnaire to illustrate the format.

(ii) Categories

The questionnaire is divided into three sections. These correspond to the categories established in the model of asset risk management activities in Ofgem's first consultation document in November 2001.

- Business Strategy & Direction (Category A)
- Asset & Network Strategy (Category B)
- Asset Lifecycle Management (Category C)

Within each of the three main categories key topic areas have been identified and a series of questions both high level and more detailed have been asked.

(iii) Topic Area Main Narrative Question

The main numbered questions, which head the beginning of each sub-category, (shown in bold print), and marked as ***Topic Area – narrative question*** act as key topic areas. A key topic heading is also shown. At this level of the questionnaire a company should 'set the scene' for the topic area, providing a brief narrative that describes its general process and approach to that topic. It is also an opportunity for the company to include information which may not be specifically asked in the more detailed sub-questions but is felt to be of importance in demonstrating the company's approach in that area. The response to each of these questions should be restricted to no more than 250 words.

(iv) Sub-Question

In the second column of the questionnaire, and associated with each main question, is a basket of ***Sub-questions*** (a, b, c etc.) and these should each be answered briefly and factually. If the respondent considers that it is imperative for the assessment of the question that further information is provided the responses to the sub-question may be up to 200 words but no longer. These questions are the main route by which the survey seeks to obtain evidence for the general risk management approach and identify the level of information needed to establish best practice, and that asset stewardship is being adequately carried out. The individual sub-questions themselves will not be scored, but will be used to obtain more specific evidence in support of the narrative response to the main question.

(v) Areas for Consideration

Supporting the sub-questions is a series of bullet points. They provide a guideline of areas that the companies are encouraged to cover in their answers to the sub-questions. The points are indicative and by no means exhaustive and should be considered in this light.

(vi) Scoring Areas

A risk management step identifier (Scoring Area) is assigned to each of the ***sub-questions*** as shown in the third column of the example question shown in Table 1. These identifiers correspond to the steps of the risk management model shown in Figure 1. Figure 2 illustrated how the risk management model mapped on to the key activity categories. This showed that for category A, questions would either be classified as ‘identify risks’ or ‘formulate policies’, while for categories B and C the questions would explore ‘produce procedures’ and ‘monitoring and measurement of effectiveness’ respectively. This allows the assessment of a company’s performance for each of the steps (the scoring is explained in detail in Section 3).

(vii) Summary

It is important that sub-questions are considered carefully and a clear and full response provided taking into account the areas of consideration guidelines shown against each sub-question or group of sub-questions. Respondents should review the scoring definitions in Section 3, which outline how the response is assessed and scored in order to understand what level of evidence is required to achieve each score.

Evidence should be available to support all statements and claims made in the responses.

The way the questions are structured is demonstrated in the following example.

Table 1: Example Question

<table>
<tr><td colspan="3">Category:</td><td>Business Strategy and Direction</td></tr>
<tr><td colspan="3">Topic Area:</td><td>Risk assessment and decision making</td></tr>
<tr><td colspan="4">Topic Area – Narrative Question.

Risk Assessment and Decision Making

What is the process for making Asset Risk Management decisions?</td></tr>
<tr><td>Ref.</td><td>Sub-Question</td><td>Scoring Area</td><td>Areas of Consideration</td></tr>
<tr><td>a)</td><td>Does the company carry out risk analysis studies of the decisions made?</td><td>I</td><td>• Scope, depth and comprehensiveness of risk analysis studies
• Risks identified
• Acceptable levels of risk
• Integrated approach to risk, or separate
• Breadth of application, e.g. assets, skills and resources, logistics.</td></tr>
<tr><td>b)</td><td>What specific policies has the company formulated to manage the risks identified?</td><td>FP</td><td>• Mitigation of the effects of risks that have been identified as unacceptably high
• Monitoring the effect of risk mitigation actions.</td></tr>
</table>

Ref.	Sub-Question	Scoring Area	Areas of Consideration
c)	Does the company use a formalised methodology for decision support?	FP	• Methodology • Quantified risk information used in action planning • Consistency of approach • Communication to decision makers • Review of methodology • Effectiveness.
d)	Has an overall Risk Analysis been carried out for the performance of the network?	I	• Company wide network performance Risk Analysis study • Performance as seen by customers (e.g. reliability, availability, quality) • Approval/review by senior management • Future changes • On-going/repeatable • List other risk assessment areas that have been considered.

3 Scoring

3.1 Introduction

Ofgem considers that in order to interpret the responses to the survey effectively, it is necessary to develop a methodology for scoring the company responses to the questionnaire.

This section therefore introduces the scoring methodology developed to score the responses to the survey questionnaire. A discussion of the options considered, the way in which the scoring will be applied and what constitutes each score level are included.

The scoring methodology proposed in the first consultation document has been modified and expanded to utilise the risk management process model adopted (Figure 1) as the basis for this survey.

The methodology has also been developed to accommodate some of the concerns raised by the network companies in responses to the first consultation document.

3.2 Options for Scoring Methodology

The scoring methodology and questionnaire are intrinsically linked. They therefore have to be developed concurrently and take each element into account.

3.2.1 Option 1

Option 1 would be to devise a questionnaire that relies on closed questions to which mainly "yes" or "no" answers would be required. The response could then be marked against a pre-determined answer, resulting in a percentage of "correct" answers, which could then be ranked/graded against a defined percentage score. There would be a need to weight the scores to get an overall grade. During the audit visits the auditor would collect data/evidence against a pre-determined checklist.

Advantages

- Simple and transparent method of conducting the survey
- Ensures absolute consistency across the surveyed companies

Disadvantages

- Does not take account of different and equally valid approaches that may be carried out in different companies
- Does not allow the survey to explore the details of the asset risk management approach without resulting in very large volumes of questions
- Does not allow companies to provide details of innovative and different approaches that may not have been considered by the originators of the survey
- Weighting the scores across such a wide range of questions would be complex.
- Risk of Ofgem appearing to prescribe a specific approach, rather than using it as a tool to identify best practices.

3.2.2 Option 2

Option 2 would be to structure the questionnaire around the categories initially proposed in Ofgem's first consultation document, but using a tiered approach of more open questions to explore the asset risk management approach in more detail. The scoring would be structured on the basis of the provision of evidence to demonstrate that the company had an effective and thorough approach to risk management throughout the company structure. The range of possible scores to be awarded would depend upon the degree to which the levels of performance are to be sub-divided. The scores could then be aggregated if required to give a score for a particular area or an individual aspect of the risk management process.

Advantages

- Allows the survey to be sufficiently generic to cover different asset risk management approaches across different companies
- The survey can probe below the superficial responses to seek evidence to support company statements
- In scoring the survey, account can be taken of a number of important areas necessary for the successful operation of the process within one score

Disadvantages

- The questionnaire responses and audit visits will need to cover significant amounts of information
- There will be a degree of subjectivity in determining how well the questionnaire responses satisfy the requirements for a particular score

3.2.3 Conclusion

Having considered the options above and possible variations within these options, it was considered that Option 2 represented the most appropriate survey structure and scoring approach in order to achieve the aims set out for the survey. The success of this option will be assessed following completion of the first survey to establish where refinements may be required.

3.3 Application of Scoring

To score the survey questionnaire it is proposed to use the risk management process model shown in Figure 1 will be used as the basis.

As described in Section 2.4.2 the question areas are broken down into key topic area main questions, sub-questions with areas for consideration guidelines. The questions have been designed to explore the particular step of the risk management process model carried out at the company level targeted by that set of questions.

Each main question has a number of sub-questions associated with it. For each sub-question a scoring identifier/risk management process step has been attributed. A score between 1 and 5 will be awarded to the main question based on the narrative response to that question and the responses to the sub-questions. For the main questions in categories B and C all sub-questions will be to explore the same principal step with the review and improvement step included in all main questions, while in category

A two steps of the risk management model as well as the review and improvement step will be covered.

Category A (Business Strategy and Direction)	- Identify risks
	- Formulate policies
Category B (Asset and Network Strategy)	- Produce procedures
Category C (Asset Lifecycle Management)	- Monitoring and measurement of effectiveness

The scores will be awarded based on how the responses demonstrate that the process step under question is being carried out and provides evidence that could be compared against the scoring definitions shown in Section 3.5.

An initial score for the main question will be awarded based on the responses to the questionnaire. In areas where the response is insufficient this score will then be confirmed by seeking further information during the auditor's visit.

For Category C, in addition to the responses to the questions being awarded a numerical score, the questions also request certain key metrics as verification of performance.

3.4 Scoring Criteria

To score the key topic areas for Categories A, B and C, the quality of evidence provided in the response to the main question and the sub-questions will be assessed. The scope of the response is expected to cover the following points,

- The degree of development of the risk management process step and its application across company activities/assets.
- The extent of information flow into and out of the risk management process step
- The extent of integration and effectiveness of the process within the overall organisational asset risk management approach
- The extent of application of the process across all asset types and regional areas
- The review of the step and its use in refinement and improvement of the process
- The extent to which asset stewardship is benefiting in practice

These points form the framework for the scoring definitions shown below in section 3.5.

From the response to the main question and sub-questions, the auditor will form an understanding of the company's asset risk management approach for that key topic area. During the audit visit the auditor will verify the extent of, or absence of, the evidence available to support the responses, particularly where responses to the questionnaire were considered insufficient.

The respondents should familiarise themselves with the scoring definitions and criteria for scoring in section 3.5 in order to understand how the evidence presented in the responses will tie in with the scoring process.

The scoring methodology is intended to take account of the variability in the extent and robustness of the evidence available. Therefore, the auditor will be able to grade the response and evidence over a range of scores.

3.5 Scoring Definition

The main questions will be awarded a score from 1 to 5.

The score will depend upon the response to the main question and sub-questions, although the individual sub-questions will not be scored separately. The scores will be based on the extent of the risk management process step for the company activity under assessment, the flow of information into and out of each process step, the degree to which the process is dynamic with review and improvement an integral part, and the evidence of a positive benefit for asset stewardship

3.5.1 Criteria for award of 5 points

- Comprehensively documented process for the effective operation of the risk management process step under consideration. The company would be able to demonstrate a well thought out, fully developed and well documented process
- There is strong evidence that the process is carried out in an integrated way with the other steps of the process and information flows into and out of the step under review
- There is clear evidence that inputs to and outputs from the individual risk management processes are connected and integrated to the overall organisational risk management process
- The process is deployed across all asset types and across the regional and organisational structure
- There is evidence of regular reviews that demonstrate the effectiveness of the process in benefiting asset stewardship, and evidence of refinement of the overall process as a result of the review process
- As a guideline, the company will need to achieve greater than 90% of the scope of the question to achieve a 5-point score.

3.5.2 Criteria for award of 4 points

- The particular step of the risk management process under consideration is mostly documented, in place and fairly well developed for the company activity under assessment and shown to be working effectively in that area
- There is evidence that the process is carried out in an integrated way with the other steps of the process and information flows from each step into the other steps
- The company is unable to demonstrate that the process is fully and effectively integrated into the overall organisational risk management process, although there may be evidence that this is happening in many areas

- The process is deployed across most asset types and regional areas but there is insufficient evidence to confirm that outputs from the risk management processes applied to the individual asset types are integrated into the overall organisational risk management process
- There is evidence of regular reviews of the effectiveness of the process and evidence of refinement to the overall process as a result of the review process
- As a guideline, the company will need to achieve about 75% of the scope of the question to achieve a 4-point score.

3.5.3 Criteria for award of 3 points

- The particular step of the risk management process under consideration is moderately well defined and documented but there are a few areas of the process where some improvements could be made or completed
- Information flow into and out of the step of the risk management process under consideration is not fully effective but there is some evidence it is taking place
- The company is unable to demonstrate that the process is fully and effectively integrated into the overall organisational risk management process although there may be some evidence that this is happening in some areas
- The process is deployed across around half of asset types or regional areas but not all
- There is evidence of reviews or refinement to the process as a result of the review process but not on a regular basis or in a structured way
- As a guideline, the company will need to achieve about 50% of the scope of the question to achieve a 3-point score.

3.5.4 Criteria for award of 2 points

- The particular step of the risk management process under consideration is loosely defined and documented but with several areas either lacking in definition or specification. A number of areas of the process would require improvements
- Limited evidence of information flow into and out of the step of the risk management process under consideration
- Limited evidence of the risk management process being integrated into the organisational risk management approach
- Deployed across about less than half of asset types/activities and/or regional areas
- Limited evidence of a review process for assessing the effectiveness of the process or refining it
- As a guideline, the company will need to achieve about 25% of the scope of the question to achieve a 2-point score.

3.5.5 Criteria for award of 1 point

- The particular step of the risk management process under consideration is poorly defined and documented with many areas either not covered or in need of improvement. Some areas may be carried out on an informal basis but this is not fully documented.

- Little evidence of information flow into and out of the step of the risk management process under consideration
- Little evidence of the risk management process being integrated into the organisational risk management approach
- Deployed across a few if any asset types/activities and/or regional areas
- Limited or no evidence of a review process for assessing the effectiveness of the process or refining it
- As a guideline, a company that achieves less than 10% of the scope of the question will achieve a 1-point score.

3.5.6 Summary

The final score awarded will depend on both the extent and level of development of the risk management process and the range of application of the process across the asset types and across the organisation. For example, a company may have a well-developed policy in an aspect of risk management, but which is effectively applied to only about half of its network assets. Therefore, although the process has been well developed, it can not be demonstrated that it is integrated across the company. Under these circumstances a company would score 3 points.

The scoring can be summarised as follows;

Table 2: Scoring Summary

Process Development	***Guideline for extent of application***	***Points Awarded***
Process fully integrated and effective across the whole company, bringing clear benefits for asset stewardship	>90%	5 points
Process mostly in place but not shown to be integrated and effective across the whole company	75%	4 points
Process development complete to moderate extent and/or not applied to notable areas of company asset activities or regions	50%	3 points
Process under development and/or applied to only some areas of company asset activities or regions	25%	2 points
Little or no evidence of process and/or limited application across company asset activities or regions	<10%	1 point

3.6 Key Topic Area Scores

The score awarded to the main question as described above will give a numerical value between 1 and 5 to demonstrate how well the step of the risk management process for which that question was devised is carried out.

This will result in, for example, seven scores for the main questions asked for category A, covering identification of risks and formulation of policies (and review and improvement). These scores can either be presented on a radar plot as discussed in Section 4 to show the overall company approach to these areas of asset risk management and a commentary made to identify areas of best practice, even where these may not be fully integrated enough to achieve the 5-point rating.

The scoring methodology has been intentionally designed to avoid the need for weighting of scores and the potential this would allow for the aggregation of scores/classifications for the different risk management steps into an overall score for the company.

3.7 Key Topic Area Classification

To illustrate the level of development and practice of the asset risk management steps across the company activities, we propose to "grade" the approach in the areas assessed.

Table 3: Classification Scores

Classification	Points
Leading	5
Above Intermediate	4
Intermediate	3
Below Intermediate	2
Trailing	1

A Company with a leading classification for certain steps of its asset risk management process could be identified as one with elements of best practice. This issue is discussed further in section 3.9.

The scoring system proposed is an 'absolute' score, though this will be moderated by the fact that the survey is being carried out across a number of companies and sectors.

Individual company results will be confidential between the relevant company and Ofgem. There will be an opportunity for each company to discuss its results with Ofgem in order to make best use of the results of the survey.

3.8 Validation of Scoring

3.8.1 Introduction

An issue of concern raised by various companies in their response to the first consultation document concerned the consistency of a scoring methodology and classification across all the surveyed companies given that the survey assessment and audit visits are expected to be carried out a number audit team. This issue will be addressed in a number of ways:

- Independent audit teams containing an appropriate mix of sector knowledge and audit competency
- Moderation of scores
- Single person review of all audit reports to check for consistency of approach and question the assumptions and statements made by the audit team.

3.8.2 Audit Teams

The teams that carry out the audit will contain an appropriate mix of sector knowledge and audit competency. In addition, the auditors will have a parallel survey manual that gives them an objective means by which to seek evidence and assess performance. To avoid the potential for 'reverse-engineering' of results, this more detailed information will not be presented to the companies in the questionnaire.

3.8.3 Moderation of Scores

To ensure that each survey team is adopting a consistent application of the scoring methodology one survey questionnaire will be scored by all teams as an example. The scores generated by each team will be reviewed to check for consistency. Where differences between teams are highlighted guidelines to the relevant audit teams will be issued to ensure that questionnaire assessments will be carried out consistently.

3.8.4 Review of Audit Reports

As a final review a senior person from the audit teams will carry out an overall review of the final audit reports to check the consistency of approach across the survey and question the assumptions and statements made by the audit team.

3.8.5 Conclusion

The detailed format of the validation process is to be finalised prior to carrying out the survey. It should be noted that Ofgem will undertake a formal review with the survey consultant consortium to provide assurance of the consistency of application of scoring and audit.

3.9 Identification of Best Practice

One of the objectives of the survey is to identify companies who have adopted an approach to risk management that would be considered to be a "leading" example in the particular area assessed. This is not intended to represent an endorsement of a particular asset management strategy or risk management strategy, as it is acknowledged that under different circumstances, alternative strategies may be equally appropriate.

We consider that a leading company would be seen as one that fulfilled all elements of the process of risk management and with its risk management process fully effective and integrated within the overall organisational risk management process.

4 Presentation of Results

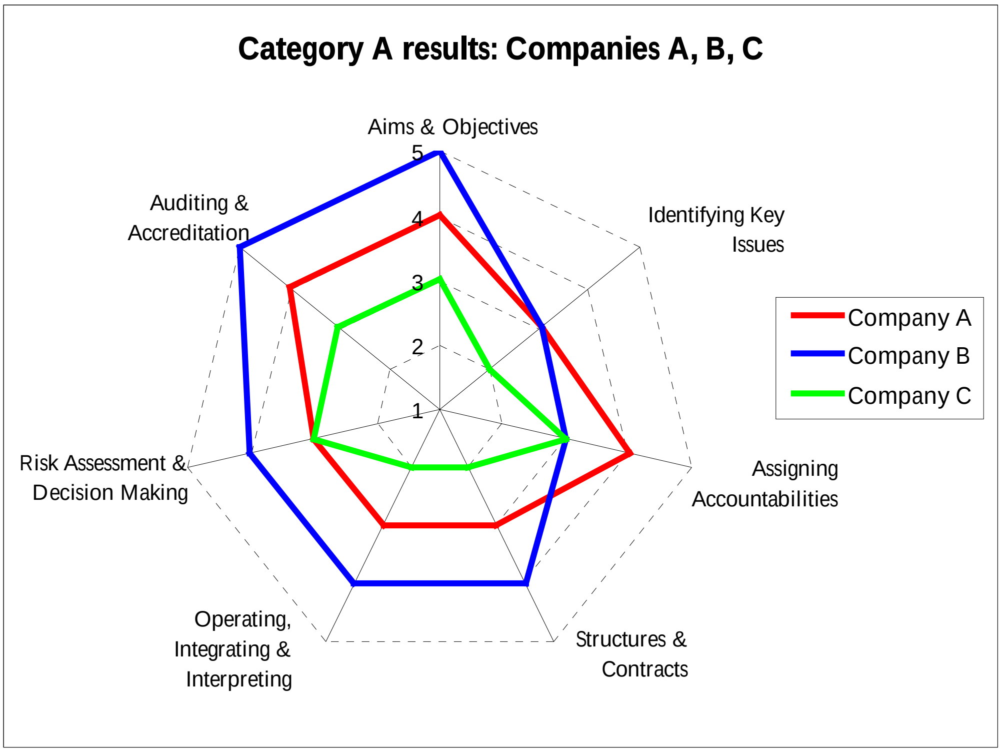
In the first year, results will be made publicly available without identifying the performance of individual companies. The report will identify which companies have participated in the survey, but will not give further company specific information. The detailed results for a particular company will only be available to Ofgem and that company.

The public reporting of results will be in the format of an overview commentary of the companies' surveyed and particular issues of note. This report will also include a series of diagrams to show the high-level performance ratings of companies (without naming them).

Diagrams provide a simple representation of overall performance in a particular area of the survey. The most appropriate format for expressing this information is in the form of a series of 'radar plots', an example of which is shown below.

It is recognised that simple radar plots may not adequately represent all areas of company performance in the survey. For example, a medium ranking score in a particular category may be due to particularly good asset risk management policy or process being in place only for a limited range of the assets. We would still wish to recognise the value of the particular policy or process, and encourage its extension, such that a higher-ranking performance might be achieved in the future. Providing a commentary on examples such as this will be an important supplement to the diagrammatic reporting.

Figure 4 : Example radar plot reporting of results – Survey Category A



A series of these radar plots, each expected to show three or four companies, would cover all the companies surveyed, and to cover each category of the survey.

5 Survey Process Issues

5.1 Introduction

This section provides a guide to how the proposed survey would be conducted. It deals with the distribution of the questionnaire and survey guide; the audit visits to the companies after initial analysis of the responses to the questionnaire and briefly describes the report on the survey results.

5.2 Questionnaires

Each company will receive a copy of the survey guide and questionnaire for completion and return. It is intended that this documentation will be provided in electronic format for ease of use. The aim of the written response questionnaire is to capture in the most concise but effective way, the nature of asset risk management processes in each of the three separate categories. Responses to the questions should be clear and concise, containing all relevant information. The return of responses should be by electronic submission.

The questionnaire will be scored using the scoring methodology developed and an initial score awarded.

The first year of the survey is, in part, a pilot exercise. This will enable the companies to test the format of the written responses against the information and evidence required to assess them.

5.3 Audit visits

The response to the questionnaire is the first stage of the survey process. To ensure that the assessment of the companies' written responses is as rigorous as possible, follow-up visits will be needed to further probe some issues where insufficient or inconsistent information was provided at the questionnaire response stage and to confirm the information provided for the detailed questions in Category C that look in more detail at the effective application of selected asset risk management activities.

To allow companies adequate time to prepare for the audit and to make best use of the limited audit time available, companies will be notified of the areas to be covered during the audit visit and the principal documentation required for review. Some flexibility will be required, however, to recognise that particular questions may arise during the course of the visit.

Where appropriate, the information gathered during these visits will be used to modify the initial assessments/scores, resulting in a final assessment for each company across the range of areas explored.

5.4 Report

Once the visits have been undertaken, the scores revised where necessary, and a review process carried out, a final report with company specific appendices will be prepared for Ofgem. Brief, confidential company-specific appendices, summarising the performance of each company, will accompany a more general overview report to be presented to Ofgem. The appendices will be treated as strictly confidential and will only be discussed between Ofgem and the respective company. A summary overview of the surveyed companies will also be prepared for publication. In this summary companies participating in the survey will be named but there will be no attribution of scores or individual comments to identified companies.

5.5 Conclusion

It is expected that the first year of this survey will provide valuable information in understanding how the companies carry out the process of asset risk management. It is also likely to highlight areas of the survey where further development will enhance the value of the survey for future years.

As a consequence, in the light of the experience gained during this pilot stage, the opportunity will be taken to carry out any necessary modifications to the format of the questionnaire and scoring methodology in order that this survey will be provide maximum benefit for Ofgem and the network companies in subsequent years.

Appendix A Survey Questionnaire

Appendix A of the Survey Guide
(Ofgem document reference 30/02)

Ofgem Asset Risk Management Survey Questionnaire

Consultation Version

BPI BRITISH POWER INTERNATIONAL

ERA TECHNOLOGY

Mott MacDonald

1 Introduction to Questionnaire

In order to facilitate ease of company responses, this Appendix has been designed to be a stand-alone questionnaire within the body of the complete Survey Manual. Thus this introductory section repeats Section 2.4.2 of the Survey Guide. The structure of the questionnaire is explained and the different question tiers used to explore the relevant areas are shown.

Respondents should familiarise themselves with all the questions before starting to answer them. It is suggested that a thorough reading of the whole questionnaire will assist respondents to understand what information is being sought and where best to include relevant information and evidence as compared against the scoring definitions.

Companies should ensure that statements of performance can be backed up with evidence if requested at the survey visit.

2 Categories

The questionnaire is divided into three sections. These correspond to the categories established in the model of asset risk management activities in Ofgem's first consultation document in November 2001.

- Business Strategy & Direction (Category A)
- Asset & Network Strategy (Category B)
- Asset Lifecycle Management (Category C)

Within each of the three main categories key topic areas have been identified and a series of questions both high level and more detailed have been asked.

3 Topic Area Main Narrative Question

The main numbered questions, which head the beginning of each sub-category, (shown in bold print), and marked as ***Topic Area – narrative question*** act as key topic areas. A key topic heading is also shown. At this level of the questionnaire a company should 'set the scene' for the topic area, providing a brief narrative that describes its general process and approach to that topic. It is also an opportunity for the company to include information which may not be specifically asked in the more detailed sub-questions but is felt to be of importance in demonstrating the company's approach in that area. The response to each of these questions should be restricted to no more than 250 words.

4 Sub-Question

In the second column of the questionnaire, and associated with each main question, is a basket of ***Sub-questions*** (a, b, c etc.) and these should each be answered briefly and factually. If the respondent considers that it is imperative for the assessment of the question that further information is provided the responses to the sub-question may be up to 200 words but no longer. These questions are the main route by which the survey seeks to obtain evidence for the general risk management approach and identify the level of information needed to establish best practice, and that asset stewardship is being adequately carried out. The individual sub-questions themselves will not be scored, but will be used to obtain more specific evidence in support of the narrative response to the main question.

5 Areas for Consideration

Supporting the sub-questions are a series of bullet points. They provide a guideline of areas that the companies are encouraged to cover in the answers to the sub-questions. The points are indicative and by no means exhaustive and should be considered in this light.

6 Scoring Areas

A risk management step identifier (Scoring Area) is assigned to each of the ***sub-questions*** as shown in the third column of the questionnaire. These identifiers correspond to the steps of the risk management model shown in Figure 1 of the Survey Guide, Section 2.3. This allows the assessment of a company's performance for each of the steps (the scoring is explained in detail in Section 3 of the Survey Guide).

7 Index

At the beginning of the questionnaire an index provides a guide to the main questions of each category. This index can be used as a method of navigating through the questionnaire.

8 Summary

It is important that sub-questions are considered carefully and a clear and full response provided taking into account the areas for consideration guidelines shown against each sub-question or group of sub-questions. Respondents should review the scoring definitions in Section 4 of the Survey Guide, which outline how the response is assessed and scored. Evidence should be available to support all statements and claims made in the responses.

Index of Questions

Section A Business Strategy & Direction

Q1	*Topic Area –- Narrative Question* **Aims and Objectives** **How does your company's aims and objectives influence the management of assets?**		
Ref.	**Topic Area Sub-Questions**	**Scoring Area**	**Areas of Consideration**
a)	How are medium/long term network performance issues represented and considered at corporate level?	I	• Performance targets set for the company • Written company objectives • Individual(s) performance targets at each level of management. • Medium/long term network performance targets • Regular items on agendas/ regular meetings
b)	How are variances between progress and targets addressed at this level, and conflicts with other business drivers addressed?	I & RI	• Evidence that medium/long term performance targets have been set • If conflicting, how are short-term pressures relieved e.g. - New connections requirements versus ongoing maintenance/inspection programme • Variances in actual and target performance identified and addressed • Objectives reconciled with other company drivers .

Scoring Area Codes:-
I = Identification of Risk
FP = Formulate Policies
PP = Produce Procedures
M = Monitoring and Measurement of Effectiveness
RI = Review and Improvement

Ref.	Topic Area Sub-Questions	Scoring Area	Areas of Consideration
c)	What is the extent of Board level experience in relevant asset management areas?	I	• Input to and influence on corporate strategy • Responsibility for medium/long term network performance • First hand experience (in addition to the responsible line manager) • Is this held by executive or non-executive members? • How are asset strategies and proposals tested, challenged and verified?

Q2	*Topic Area –- Narrative Question* **Identifying Key Issues for Asset Risk Management** **Describe the key strategic elements that are critical to setting your overall Asset Risk Management strategy, and how these have been identified.**		
Ref.	**Topic Area Sub-Questions**	**Scoring Area**	**Areas of Consideration**
a)	List the key elements contained within the company's Asset Risk Management strategy with brief bulleted descriptions of their interaction with other policies and strategies.	I	• Key Performance Indicators • Frequency of reporting • Communication to relevant staff • Feedback on action and performance indicators • Inspection & maintenance policy • Resources – people & equipment • Suppliers • Spares capability • Customer focus • Security of supply including capacity • Budget constraints
b)	Is there a structured approach to risk identification for assets?	I & RI	• A risk register • Periodic review of risks • Integrated with wider risk register (as in Turnbull recommendations)

Ref.	Topic Area Sub-Questions	Scoring Area	Areas of Consideration
c)	When considering corporate strategy for overall staff levels how is this reconciled with the requirements of asset risk management and other network activities (e.g. new connections)?	I	• People plan • Reconciliation with planned activity • Age profiles and future shortfalls. • Retention and new recruitment
d)	What is done to ensure that the identified network equipment resource will be available when required?	FP	• Asset Management plan • Types and number of equipment required • Supplier requirements • Risks caused by equipment shortage • Review/modify future resource plans.

Q3	*Topic Area –- Narrative Question.* **Assigning Accountabilities** **Explain how the company assigns corporate and individual accountabilities for the medium/long term performance of the network and its assets.**		
Ref.	**Topic Area Sub-Questions**	**Scoring Area**	**Areas of Consideration**

a)	Are accountabilities/responsibilities identified and formally agreed with individuals?	I	• The reporting/accountability process for asset issues is integrated within the wider management performance system at all levels
			
			• Supporting medium/long term network performance objectives
			
			    • Targets for individuals at and below the highest level of management through…
			
			    • Individual medium/long term network performance objectives
			
			    • Periodic progress reviews and resolution of problems with progress
			
			    • Incentivisation for individuals and/or teams

Q4	*Topic Area –- Narrative Question* **Structures and Contracts** **How has the company identified that its current organisational structure is the correct one, in terms of good Asset Risk Management planning and risk mitigation, throughout the company?**		
Ref.	**Topic Area Sub-Questions**	**Scoring Area**	**Areas of Consideration**
a)	What do you regard as the key factors of the organisational structure for delivering medium/long term asset performance objectives?	I	If the management of the network is contracted to a separate external or internal service provider then: • Where are the following accountabilities – and what is the rationale? - Ownership - Business strategy & direction - Asset & network strategy - Asset lifecycle management - Asset lifecycle work delivery
b)	What arrangements are in place for the ownership and management of the assets? Is it all in-house or are some aspects out-sourced?	FP	
c)	How are internal and external contractual arrangements managed and reviewed to ensure medium term network performance objectives are met?	FP & RI	• Medium/long term objectives expressed in contractual requirements • Delivery of objectives within a short term or terminable contract • Review of contractual arrangements • Monitoring of actual progress against objectives

Scoring Area Codes:-
I = Identification of Risk
FP = Formulate Policies
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<table>
<tr><td>Q5</td><td colspan="3">Topic Area –- Narrative Question

Operating, Integrating and Interpreting

How is information used to provide assurance of medium /long term network performance?</td></tr>
<tr><th>Ref.</th><th>Topic Area Sub-Questions</th><th>Scoring Area</th><th>Areas of Consideration</th></tr>
<tr><td>a)</td><td>What are the key processes for information to inform the policies?
How are they implemented?</td><td>I</td><td rowspan="3">The company has undertaken a study to understand the link(s) between the condition and performance for all assets.
Link between asset condition and asset/network performance
Link incorporated into the asset register and the asset management decision process
Validation of performance, e.g. the reliability of the asset</td></tr>
<tr><td>b)</td><td>What are the key factors in defining which asset conditions are critical to medium/long term performance of the network?</td><td>FP</td></tr>
<tr><td>c)</td><td>What other interactions on the asset life, condition or performance are assessed in determining the policies?</td><td>I</td></tr>
</table>

Q6	*Topic Area –- Narrative Question* **Risk Assessment and Decision-Making** **What is the process for making Asset Risk Management decisions?**

Ref.	Topic Area Sub-Questions	Scoring Area	Areas of Consideration
a)	Does the company carry out risk analysis studies of the decisions made?	I	• Scope, depth and comprehensiveness of risk analysis studies • Risks identified • Acceptable levels of risk • Integrated approach to risk, or separate • Breadth of application, e.g. assets, skills and resources, logistics
b)	What specific policies has the company formulated to manage the risks identified?	FP	• Mitigation of the effects of risks that have been identified as unacceptably high. • Monitoring the effect of risk mitigation actions.

Scoring Area Codes:-
I = Identification of Risk
FP = Formulate Policies
PP = Produce Procedures
M = Monitoring and Measurement of Effectiveness
RI = Review and Improvement

Ref.	Topic Area Sub-Questions	Scoring Area	Areas of Consideration
c)	Does the company use a formalised methodology for decision support?	FP	• Methodology • Quantified risk information used in action planning • Consistency of approach • Communication to decision makers • Review of methodology • Effectiveness.
d)	Has an overall Risk Analysis been carried out for the performance of the network?	I	• Company wide network performance Risk Analysis study • Performance as seen by customers (e.g. reliability, availability, quality) • Approval/review by senior management • Future changes • On-going/repeatable • List other risk assessment areas that have been considered.

Q7	*Topic Area –- Narrative Question* **Audit and Accreditation** **Describe the corporate review process for the Asset Risk Management Strategy, including how it is audited and accredited.**		
Ref.	**Topic Area Sub-Questions**	**Scoring Area**	**Areas of Consideration**
a)	How are policies and policy changes managed and applied across the company?	FP	• Policy change communication and training staff of new policy/procedures • Audit to verify compliance with stated policy • Shortfalls in compliance • How revisions are made and what drives the changes
b)	To what extent has accreditation to national/international standards been achieved across key processes?	FP	• Company policy towards process certification • Standard for key Asset Management processes • Asset Management process audits
c)	In terms of medium/long term network performance, does the company learn from industry best practice from other relevant organisations?	RI	• Benchmarking • Other companies

Section B Asset & Network Strategy

Q1	*Topic Area –- Narrative Question* **From Policy to Procedure** **How are Asset Management policies, set at Corporate level, translated into working procedures?**		
Ref.	**Topic Area Sub-Questions**	**Scoring Area**	**Areas of Consideration**
a)	Does the company document Asset Management procedures and do these get communicated to the correct staff?	PP	• Communication to the appropriate staff and on-going accessibility by staff. • Associated training plan • Monitoring the quality of the work carried out under the new procedure.
b)	How frequently are the procedures reviewed?	PP	• Procedure review • Verification and comparison of performance levels • Achievement of expected performance levels • Actions to address any differences • Review of procedures on a regular basis
c)	How does the company ensure effective implementation of a policy change within the procedures?	RI	
d)	Does the company verify the level of performance achieved by the change against expectation?	RI	

Scoring Area Codes:-
I = Identification of Risk
FP = Formulate Policies
PP = Produce Procedures
M = Monitoring and Measurement of Effectiveness
RI = Review and Improvement

Q2	*Topic Area –- Narrative Question* **Recording Asset Information** **How does the company ensure that the relevant asset information is recorded and available to feed corporate decisions/policies?**		
Ref.	**Topic Area Sub-Questions**	**Scoring Area**	**Areas of Consideration**
a)	Is there a register on which assets are recorded? Does this include their condition/performance/serviceability? How often is it updated?	PP	• Identification of asset register requirements needed for effective asset risk management • Specifications allow for future scope & development of the system and network itself • Management process identified and documented • Resources identified to ensure effective use • User interface – single interface/register, or multiple interfaces/registers.
b)	Has the company identified and documented the content and user requirements of its asset register to ensure effective Asset Risk Management?	PP	

Q3	*Topic Area –- Narrative Question* **Defining Asset Life and Serviceability** **How is asset life and serviceability defined and how is it reviewed?**

Ref.	Topic Area Sub-Questions	Scoring Area	Areas of Consideration
a)	How does the company ensure that the previously defined critical asset conditions, that are also important to asset life and serviceability, are translated into a suitable procurement specification?	PP	• Asset performance. • Key attributes including network activities performed on asset • Procedure for specification to supplier • Procurement specification format, contains requirements information that can be traced back to asset performance objectives, with the facility for update and improvement • Supplier's understanding of purpose and expectations of the asset

Ref.	Topic Area Sub-Questions	Scoring Area	Areas of Consideration
b)	What procedures does the company have to monitor and record the condition of an asset and link this to its performance?	PP	• Capture of information • Condition indicators • Asset register link • Links between the reported condition and asset serviceability • Condition information used to make decisions on asset life and serviceability • Asset/network-modelling techniques & the use of actual recorded information to assist asset life and serviceability studies
c)	What process is in place to compare and review actual asset condition with the expected condition?	PP & RI	• Inaccessible assets (for example buried pipes and cables) • Capture of asset information during planned work i.e. other than inspections take place • Development of policy for future assessments of condition and serviceability
d)	How is this comparison used in further asset planning?	PP & RI	

Scoring Area Codes:-
I = Identification of Risk
FP = Formulate Policies
PP = Produce Procedures
M = Monitoring and Measurement of Effectiveness
RI = Review and Improvement

Q4	*Topic Area - Narrative Question* **Innovation and New Technology** **How does the company manage innovation and introduction of new technology that could impact on long-term network performance?**		
Ref.	**Topic Area Sub-Questions**	**Scoring Area**	**Areas of Consideration**
a)	Does the company have a procedure to address the procurement of new assets/technology and if so, what risk analysis is done prior to the adoption of new technology?	PP	• Strategy for the introduction of new assets/technology • Linked to the expected benefits. • Identification and quantification of risks from the new technology • Level of acceptability
b)	Are control measures put in place to manage the identified risks and is the procedure for this documented?	PP	• Review the effectiveness of control measures • Installation, operation, maintenance and de-commissioning of new assets. • Staff training and equipment

Ref.	Topic Area Sub-Questions	Scoring Area	Areas of Consideration
c)	How are medium term network performance objectives used to drive the search for new assets/technology?	PP	• Nominated responsible person or team • Identification of opportunities with key asset/network decision-makers. • External links to ensure that new technologies, practices and experiences are learnt from other parts of the industry, manufacturers and R&D providers
d)	How does the company keep abreast of new technology or innovation in assets and Asset Management techniques?	PP	
e)	What is the process for approving the use of new technology or innovation in assets or asset management techniques?	PP	
f)	How does the company track the performance of new technology or practices against expectation?	PP	• Operational performance requirements detailed in asset specifications • Assurance of the manufacturing quality of suppliers • Policy on field trials/tests • Variations between expectation and actual performance • Influence on future asset acquisition processes.

Q5	*Topic Area –- Narrative Question* **Security of Supply and Asset Utilisation** **Security of Supply is a key element of good Asset Management. How does the company take account of Security of Supply in an Asset Management policy?**

Ref.	Topic Area Sub-Questions	Scoring Area	Areas of Consideration
a)	What is the approach used to identify risks to security of supply?	PP	• Methodology to identify and quantify the risks and assumptions associated with supply security, both within and beyond established security standards • Are exceptional events included? • Plan for mitigating the risks and/or recovering from events • Sensitivity analysis on risks and assumptions. • Identification of high risk/high sensitivity regions or groups of customers • Emergency plans to manage exceptional security of supply events .
b)	On what frequency does the company review the risks to security of supply?	RI	

Ref.	Topic Area Sub-Questions	Scoring Area	Areas of Consideration
c)	What procedure is used by the company to forecast the capacity requirements for the network for the medium/long term?	PP	• Methodology for forecasting future capacity requirements • Factors taken into account when forecasting future capacity requirements of the network • Effectiveness of forecasting reviewed on a regular basis • Capacity shortfalls – assets at or beyond nominal capacity • Structured use of short term ratings of assets

Scoring Area Codes:-
I = Identification of Risk
FP = Formulate Policies
PP = Produce Procedures
M = Monitoring and Measurement of Effectiveness
RI = Review and Improvement

Q6	*Topic Area –- Narrative Question* **Compliance with Legislation** **How does the company ensure that compliance with legislation, regulations and standards is achieved and how is it integrated with the asset risk management decision processes?**		
Ref.	**Topic Area Sub-Questions**	**Scoring Area**	**Areas of Consideration**
a)	Does the company have a structured process to keep standards and other requirements under review for changes outside the company?	PP	• Responsibilities for monitoring the requirements of new legislation, regulations and other external standards • Procedure for the assessment of implications for future Asset Management Strategy • Identification of associated risks, quantification and the route to modification of asset management plans • Compliance and how compliance is assessed
b)	Does the company carry out an impact analysis to assess how the changes will impact on current Asset Management Strategy?	PP	
c)	How are changes in legislation, regulations and standards applied throughout the company?	PP	
d)	How does the company assess that compliance has been achieved?	RI	

Section C Asset Life Cycle Management

Q1	*Topic Area –- Narrative Question* **From Procedure to Delivery** **How are the Asset Management procedures delivered? How are the elements of Asset Life Cycle managed?**		
Ref.	**Topic Area Sub-Questions**	**Scoring Area**	**Areas of Consideration**
a)	How does the company ensure that agreed Asset Management procedures and practices are actually implemented, day to day?	M	• Compliance with procedures
b)	How is the effectiveness of these procedures and practices measured, and over what time-scales?	M	• Key attributes defined • Comparative data • Measurement of improvement • Time scales defined

Ref.	Topic Area Sub-Questions	Scoring Area	Areas of Consideration
c)	What measured outputs are recorded and how are these used to compare with, review and adjust procedures and practices?	M	• List outputs measured • Method of recording • Comparison • Review • Adjustment procedure
d)	How does the company learn from incidents and near misses?	RI	• Reviewed for lessons learned • Structured approach to review • Action points derived • Tracked to completion

Q2	*Topic Area -– Narrative Question* **Asset Register Contents** **How is asset information recorded and updated?**		
Ref.	**Topic Area Sub-Questions**	**Scoring Area**	**Areas of Consideration**
a)	How does the company ensure that changes in asset populations are recorded on the asset register e.g. from commissioned and decommissioned items, and over what time-scales? How are errors in the register identified and addressed?	M	• Asset types • Sufficient linkages existing between multiple registers • Asset information logged • Network activities that will affect asset performance • Asset condition and performance • Deterioration • New and removed assets • Linkage between asset register and geographical information systems (e.g. mapping for locations/fault monitoring from customer calls) • Feedback from the field

Ref.	Topic Area Sub-Questions	Scoring Area	Areas of Consideration
b)	What checks are carried out to ensure that locally or remotely captured asset condition information is accurately recorded on the asset register? What is the current level of accuracy?	M	• Management process • Audits • Resource and appropriate skills • Information for network modelling. • Condition, condition trend and performance • Asset management decisions
c)	How is performance measured, in respect to the accuracy and timeliness of updating asset information onto the register? What is the current level of compliance, in quantified terms?	M	
d)	How does the company monitor whether condition information recorded on the asset register actually initiated the appropriate actions e.g. repair/maintenance/capital investment? What is the current percentage of situations where this has occurred? How is the effectiveness of this measured? Can you provide numerical analysis?	M	

Q3	*Topic Area — Narrative Question* **Utilisation** **How is the utilisation of assets assessed?**		
Ref.	**Topic Area Sub-Questions**	**Scoring Area**	**Areas of Consideration**
a)	How does the company monitor actual demand on the assets/network, at which parts of the network and how frequently?	M	• Capacity monitoring – appropriate performance indicators • Review and comparison of data • The differences between actual and targeted levels of demand and capacity are used to re-design the network
b)	How is actual demand compared to asset/network capacity and how are anticipated shortfalls against nominal capacity addressed? Over the next business plan period, how many identified shortfalls are there for which there are no approved solutions?	M	
c)	How are actually recorded demands compared with previous assumptions and models? What current levels of accuracy has modelling achieved?	M	

Q4	*Topic Area — Narrative Question* **Use of Contractors/Suppliers** **How do you manage the use of contractors/suppliers and their effectiveness on Asset Risk Management?**		
Ref.	**Topic Area Sub-Questions**	**Scoring Area**	**Areas of Consideration**
a)	What indicators are used to monitor the overall performance of network/asset service providers, internal and external? How are the performance indicators measured? What is the current quantified level of performance?	M	• Performance Indicators for asset management • Measured contractor performance on asset management • Addressing shortfalls in performance • Checking quality of workmanship
b)	Have there been formal joint reviews of contractor performance?	RI	
c)	How has the performance shortfalls of contractors been addressed by the company? Have actions been agreed or taken to address these? What levels of performance improvement have been achieved from these?	M & RI	
d)	How does the company continually assess the quality of contractors' work? Are quality levels quantified and recorded – if so what are the current levels?	RI	

Q5	*Topic Area -– Narrative Question* **Inspection & maintenance regimes** **How is the inspection and maintenance regime derived, and how is its effectiveness monitored?**		
Ref.	**Topic Area Sub-Questions**	**Scoring Area**	**Areas of Consideration**
a)	How does the company measure compliance against its policy for Inspection and Maintenance intervals (either time or condition based)? What is the current, quantified level of compliance?	M	• Procedure for the delivery of the inspection and maintenance policy • Completion of work at the stated intervals (time or condition) • Records are kept of work carried out on routine inspection and maintenance • Record includes details of condition found • Form of information captured (e.g. on paper or on a hand-held computer so that it can be uploaded directly into the company's database) • Delay period for recording these details • Company range of access to information
b)	What is the current level of historic backlogs, and how are these being addressed?	M	
c)	How does the company ensure that details of work carried out and conditions recorded are properly recorded and effectively communicated to the asset register?	M	

<table>
<tr><th>Ref.</th><th>Topic Area Sub-Questions</th><th>Scoring Area</th><th>Areas of Consideration</th></tr>
<tr><td>d)</td><td>How is the quality of Inspection and Maintenance work assessed? Is there a schedule of quality checks in place? What is the level of achievement against quality check schedules?</td><td>M
& RI</td><td rowspan="2">• The company ensures that inspection and maintenance staff remain trained and competent to carry out the work
• Supervision and monitoring of the work, Quality Assurance of this.
• Schedule of refresher training in inspection and maintenance skills
• Staff are equipped to perform the work
• Systematic process
• Regular review
• Trends identified and tracked</td></tr>
<tr><td>e)</td><td>Do you review and modify inspection and maintenance regimes in the light of operational, safety and environmental incidents?</td><td>M
& RI</td></tr>
</table>

Asset Risk Management Survey

Composite Industry Report

December 2002

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1 Introduction

Asset risk management is an important part of the process of ensuring longer-term network performance. Ofgem is seeking to promote greater visibility of asset risk management in the transmission and distribution of electricity and gas. The key aims of this initiative are as follows:

- To allow Ofgem to gain reassurance of the quality of the approaches being adopted by the network companies to the risk management aspects of their stewardship of the asset base
- The identification and encouragement of good practice in the area of asset risk management

To fulfil the aims of this initiative Ofgem has initiated an Asset Risk Management Survey. The survey has been prepared on behalf of Ofgem by British Power International, ERA Technology and Mott MacDonald. They have been retained by Ofgem to assist in the first year of the survey's development and implementation.

The 2002 survey was designed to explore the asset risk management approaches of the electricity and gas network companies and it is the first stage of an evolving process. It has provided valuable information in understanding how the companies carry out the process of asset risk management and it has highlighted areas of the survey where further development will enhance it for future years. The limitations placed on the survey by being a first year and the fact that it is part of a learning process, indicate that the 2002 results should be the interpreted as useful indications of the extent of development and application of asset risk management in the companies studied rather than definitive findings. This is one of the reasons why full company results are confidential to Ofgem and each company, with this consolidated industry summary provided for public reporting. The participating companies are named in Section 2 of this report but their individual results, although reported here are not attributable. This form of anonymous reporting is consistent with international benchmarking practices.

The success of this first stage was very much dependent on the companies' voluntary participation in the survey. All companies embraced the concept and their help in this regard is gratefully acknowledged.

This paper presents the results of the 2002 survey and the findings are set out in this paper in the following manner:

- Section 2 describes the methodology adopted in the design, delivery and analysis of the survey. This section includes a brief discussion of the contents of the survey, the scoring methodology employed and a description of the process undertaken to deliver the survey. It also comments on the limitations of the survey and the lessons learnt.

- Section 3 presents the results. These are summarised using radar plots and also by discussing general trends that have been observed through analysing company specific data. It also provides an illustrative example of leading practice and a summary of the areas where companies are strong and where they may need some improvement.

- Section 4 sets out the way forward with lessons for the future and topics for further discussion.

- The appendices contain the radar plots, which represents the assessed scores for all companies; these are not attributed to individual companies.

2 Methodology

Section 2 describes the methodology adopted in the design, delivery and analysis of the survey. This section includes a brief discussion of the contents of the survey, the scoring methodology employed and a description of the process undertaken to deliver the survey. It also comments on the limitations of the survey and the lessons learnt.

2.1 Introduction

The approach followed by the Consortium has three main elements:

- Design of the survey
- Delivery of questionnaires and audit visits
- Analysis of the results.

A brief summary of each element is given in the following sections. (For full details refer to the Consortium's Report *Asset Management Survey, A Survey Guide*, submitted to Ofgem in July 2002).[1]

This section also comments on the limitations of the approach taken and the lessons learnt in the delivery of the survey.

2.2 Survey content

This section covers how the survey was developed and formulated.

The survey was designed to be generic and applicable across all sectors within the industry. Accordingly, the same survey was employed to explore asset risk management in the following energy network companies:

- Electricity distribution:
  - Aquila
  - East Midlands Electricity
  - LPN and EPN
  - Northern Electric Distribution Limited
  - Scottish and Southern Energy
  - SP Distribution plc (including SP Manweb plc)
  - SEEBOARD Power Networks
  - United Utilities
  - Western Power Distribution
  - Yorkshire Electric Distribution Limited

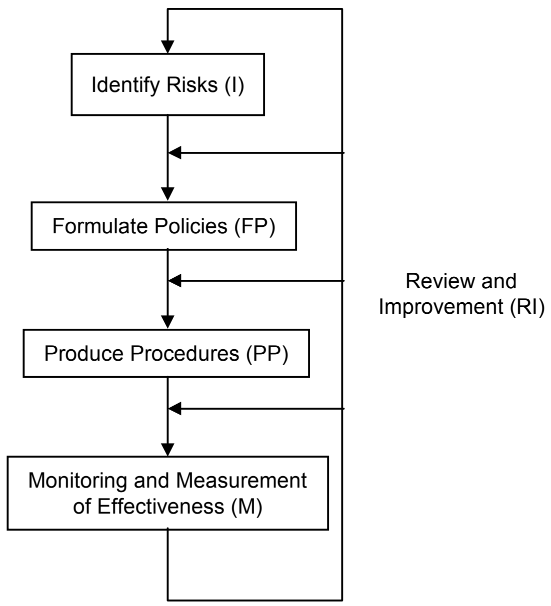
[1] http://www.ofgem.gov.uk/newprojects/assetrisk_pubs.htm.

- Electricity transmission
  - SP Transmission plc
  - Scottish and Southern Energy
  - National Grid
- Gas distribution and transmission:
  - Transco

Note - There are only 12 sets of results (radar plots), as some companies with both distribution and transmission assets or two distribution licence areas, adopt basically similar asset management approaches to both sets of assets. They are therefore each represented by one plot. This also serves to protect anonymity.

The survey employs a simplified model of a generalised risk management process and has been based on a number of theoretical models. (See Figure 1) Other models exist, such as those contained in HSE guidelines and quality management standards such as ISO 9000 and ISO 14000. It is considered that the simple high-level model in Figure 1 embodies the theories underlying these other models and, combined with the content of the proposed questionnaire, is sufficiently robust to allow the exploration of the asset risk management process at the level required for this survey.

Figure 1: Risk Management Model



The questions in the survey were structured to investigate this risk management model for the categories as proposed in Ofgem's consultation document of November 2001. These broadly reflect the key areas within a company where asset risk management activities take place. These are:

- Category A: Business Strategy and Direction
- Category B: Asset and Network Strategy
- Category C: Asset Life Cycle Management

In the 2002 survey questions were included under Category C to explore the following areas in more detail, and to provide quantified assessments of the companies' performance in those areas:

- Asset registers
- Utilisation of assets
- Use of contractors/suppliers
- Asset inspection and monitoring regimes

These selected topics were included to probe specific operational areas. It is envisaged that this section of the questionnaire will change on an annual basis to explore the effectiveness of the process in different areas.

The questionnaire was designed to assess the asset risk management process across all the three main categories, allowing the assessment of how the risk management process feeds through from the corporate level, through the asset strategy level to effective 'on-the-ground' application of the risk management process.

2.3 Delivery of the Survey

The survey was delivered as a two-part process.

- Questionnaires were sent to companies for completion and return
- Audit visits were undertaken to probe and clarify the companies' questionnaire responses

2.3.1 Questionnaires

A questionnaire was formulated to elicit information from each company on their approach to asset risk management. The questionnaire was divided into three sections to correspond to the categories identified in section 2.2. Within each of the three main categories key topic areas were identified and a series of questions at both high and more detailed level were asked. The survey questions were structured to test for integration of information flows between the three categories. They were also designed to check how effectively processes are being applied and how companies are monitoring and reviewing their effectiveness in order to continuously improve asset risk management techniques.

Companies were encouraged to submit focused responses by limiting the number of words provided in their replies and by allowing them to cross-reference their responses to other questions. The limitation of words was also important to ensure consistency and fairness when assessing responses.

2.3.2 Audit visits

The response to the questionnaire was the first stage of the survey process. To ensure that the assessment of the companies' written responses was as rigorous as possible, follow-up visits were carried out. These probed issues further where it was considered that insufficient or inconsistent information may have been provided at the questionnaire response stage and to confirm the information provided for some questions. To allow companies adequate time to prepare for the audit the areas that were to be covered during the audit visit were notified to them in advance.

The audit visits were limited to one day per company and the audit teams contained a mix of industry experience and knowledge, as well as audit competency. The auditors had a common survey manual that provided them with an objective means by which to seek evidence and assess performance. To avoid the potential for 'reverse-engineering' of results, this auditor's manual was not available to the companies.

2.4 Analysis

The company responses to the questionnaire were initially assessed based on a scoring methodology. This is summarised in Table 1.

Table 1: Scoring Summary

Level of Process Development	*Guideline for extent of application*	*Points Awarded*
Process fully integrated and effective across the whole company	>90%	5 points
Process mostly in place but not shown to be integrated and effective across the whole company	75%	4 points
Process development complete to moderate extent and/or not applied to notable areas of company asset activities or regions	50%	3 points
Process under development and/or applied to only some areas of company asset activities or regions	25%	2 points
Little or no evidence of process and/or limited application across company asset activities or regions	<10%	1 point

Note: Maximum points may not necessarily equate to best practice – please see comments in section 2.5.3.

To score the key topic areas for Categories A, B and C, the quality of evidence provided in the response to the main question and the sub-questions was assessed. From the response to the main question and sub-questions, the auditors formed an understanding of the company's asset risk management approach for that key topic area. During the audit visit, auditors verified the extent of, or absence of, the evidence available to support the responses, particularly where responses to the questionnaire were considered insufficient.

The final score awarded depended on both the extent and level of development of the risk management process and the range of application of the process across the asset types and across the organisation.

To ensure that all survey teams applied the scoring methodology consistently, guidance was provided and also the scores generated by each team were reviewed and the assumptions and statements made by the audit team were questioned.

2.5 Characteristics of the Survey

2.5.1 Scope and timing

The survey was designed to cover a wide range of themes within a limited timescale and with the audit visits being limited to one day per company. These factors together limited the in-depth understanding that could be obtained, but this was to some extent offset by the open format of the survey questionnaire completed by the companies. The exercise proved useful in providing information, which was otherwise not available, on how asset risk management is carried out within the network companies. It revealed an understanding of the range of different approaches used by the companies, as well as areas of good practice that could possibly be shared within the industry. This will enlighten the structuring of future surveys and it will direct further in-depth analysis in the future. It is important to realise that the survey was based on a snapshot of the companies' approach to asset risk management at the time of the survey. Although individual company reports have acknowledged, where appropriate, those areas currently under development by the companies, assessed scores reflect the degree of development found at the time of the survey.

2.5.2 Questionnaire/audit Process

As already mentioned, the companies' written responses were word limited. Some companies were able to work within this constraint more effectively than others. The impact of this restriction was limited by the two-tier questionnaire/audit process used for the delivery of the survey. This proved to be useful because it allowed the companies and the auditors to target their efforts and to correct false impressions. For example, in some cases, companies' asset risk management capabilities were overstated in their written response and found weaker during the audit process. In other instances, the auditors found that companies had undersold their capabilities in their written responses and were able to gain a more complete view during the visits.

2.5.3 Effort versus Return

One important issue that has been raised by some companies is whether sufficient regard has been paid to the question of effort versus return, with respect to the degree of development of their asset risk management approaches. Higher scores indicate those companies that have developed a greater depth of implementation to their asset risk management approaches. In contrast, some companies judge that the benefits to asset risk management of this degree of implementation do not give them sufficient benefit to warrant the effort required. A good example of this is the definition, collection and recording of asset condition information; some companies routinely collect and act on condition information that has been defined from a risk analysis exercise, and this has been assessed by them as an effective approach. Other companies consider that the effort involved in doing this is insufficiently rewarded by benefits to long term stewardship and have consciously not adopted such an approach.

The issue of how to recognise the effectiveness of the chosen degree of development, whilst at the same time acknowledging the highly developed approaches adopted by some companies, will benefit from wider debate, and will help to inform the approach adopted for future surveys.

Fundamentally, whilst a greater "extent of development" may permit more effective management of asset risks, such extra development comes at a cost and therefore future surveys could usefully place additional focus on whether such development provides value for money to the customer.

Ofgem has consistently stated its view that there is no single correct model for asset risk management implementation and that each company will, quite rightly, determine the priorities for its own business and its customers. The benchmarking information revealed by the survey will no doubt, help inform companies decisions in this regard.

3 Survey Findings

3.1 Radar Plots

3.1.1 Approach

Diagrams have been chosen to provide a simple representation of overall process development in the many areas encompassed by the survey. The most appropriate format for expressing this information is in the form of a series of 'radar plots', an example of which is shown in Figure 2 below. These allow rapid assimilation of multi-faceted results.

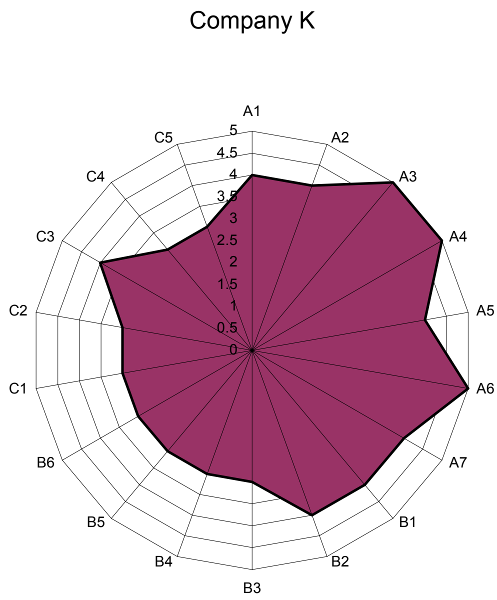
The radar plots indicate individual companies' assessed scores for each of the main questions, across all three categories of the survey. In this way the degree of process development, can be easily identified, and related to the relevant category and its question area.

It is important to recognise that it is inappropriate to summate a company's individual scores into a single total, and to use this figure to compare with the total scores relating to other companies. Such comparison would not provide an accurate or useful ranking of overall inter-company performance. The reason for this is two-fold: firstly each question carries unequal weighting in terms of its contribution to the overall approach and, secondly, company effectiveness depends on interactions between individual question areas. The value of the radar plot to each company is to indicate their own areas of greater or lesser development, to compare these to those of other companies, and to help them to make decisions on how the development of their asset risk management process might progress.

For Ofgem, the radar plots indicate the upper and lower bounds of activity and provide a first assessment of assurance that network companies are addressing this range of key topic areas.

The radar plots are a snapshot and may not adequately represent all areas of company performance in the survey. For example, a medium ranking score in a particular category may be the result of particularly good asset risk management policy or process being in place only for a limited range of the assets. It is important that the value of the particular policy or process is recognised, and consideration given to its extension by the companies, where warranted in the future.

Figure 2: Example radar plot reporting of results



3.1.2 Company Results

The radar plot results for each company, which for this survey are not attributable to the companies, are shown in Appendix A. The appendix also contains a key to aid understanding of the radar plot axes.

3.2 General Trends

On average, and in general for each company, performance was strongest in Category A and lessened progressively through categories B and, more markedly, C. The strongest performing area related to *Assigning Accountabilities*, with companies scoring an average of 4.6. The least developed areas related to *Asset Register Contents* and *Inspection and Maintenance Regimes* with companies scoring averages of 2.8 and 3.1 respectively.

In general, companies demonstrated stronger levels of development in *identifying risk*, *setting strategy* and *assigning accountabilities* than in the delivery of the day-to-day procedures that had been developed to deliver them. As indicated above, a key area of limited development was the management processes for ensuring that defined asset conditions were collected, stored and acted upon to agreed standards of timeliness and content accuracy.

Overall performance in the areas of *security of supply and asset utilisation* scored 3.7, with a notably higher degree of development in place for the upstream networks e.g. the higher voltages of the electricity companies' systems. There was evidence that some companies are beginning to further develop their approach for the downstream networks, but there remains at present a marked difference in the extent of study and assessment between the two parts of the systems.

3.2.1 Key Themes for Further Consideration

Analysis of the survey findings has allowed for some key themes to be identified for further consideration. These are as follows:

- The time horizon that frames the approach to asset risk management
- The extent to which the company has identified the risks to medium/long term asset management, and how these risks are managed within policy, procedure and practice.
- How information relating to network assets is defined, captured and used to ensure effective asset management.

(i) Time Horizon

Companies adopted a range of different time horizons when setting their asset risk management strategies. Some companies had a long-term vision for the performance requirements of their networks, and had set themselves indicative network performance objectives a long way into the future, in some cases for up to 20 years. A suite of relevant key performance indicators usually supported these objectives. Whilst such companies understood the influence on these objectives of external drivers, including the outcomes of regulatory reviews, the existence of a long time horizon was seen to set the foundations for a more robust approach to asset risk management, and to enable the development of strategies and indicative work programmes to deliver the objectives. The companies considered as having the most developed approach tended to establish strategies and planning processes that were flexible enough to factor in changing requirements, thus ensuring a responsive process.

Some companies had a very limited time horizon, in some cases restricted to the current regulatory price review period, and they had adopted this approach due to the uncertainties of the outcome of the next regulatory review. In general this did not allow for a robust approach to medium/long term asset management, and policies and procedures set by such companies tended to contribute to long-term asset health intuitively at best, rather than in a demonstrably well-thought out and holistic manner.

The time horizon for resource planning, both for people and equipment, is generally short term, even for those companies with long-term horizons and objectives. Where indicative work programmes have been identified for many years ahead, in general this information has not been used to plan for the resources that will be required to deliver them. Very little is done throughout the industry to identify and tackle future risks and requirements of resourcing.

(ii) Identifying and Managing Risks

The majority of companies have developed good processes to identify and assess the risks to medium/long term network performance and, in some cases, have quantified those risks in terms of their probability and impact on network performance. Some companies have documented these risks into a well-managed Risk Register, which is integrated with their corporate register and thus allows for an integrated and balanced suite of mitigation approaches.

The strongest-performing companies in this area demonstrated clearly defined and systematic approaches to risk management and decision-making, including the use of a wide range of modelling tools. One company had developed a number of its own analysis tools, including a network performance analyser and an asset condition analyser. The combined use of these tools is actively used to develop optimum network strategies for some asset types, from risks identified in its risk identification process.

Some companies have a less developed approach to the identification and management of risks. In a few cases there has not been a comprehensive and documented risk identification exercise, although in most of these cases such an approach is now being established for the future. For these companies, the current approach is somewhat piecemeal and ad-hoc, and although decisions appear to contribute to asset and network health from the perspective of good engineering practice, the approach does not provide for the selection of optimum risk mitigation strategies.

In a few cases companies have performed robust risk identification analyses, and documented the results well, but have not followed this through by addressing unacceptable risks with identifiable procedures and work programmes. For these companies it is considered that their overall asset management approach would benefit from a review of the completed risk analysis and the introduction of a more systematic approach to rank and address the identified risks.

(iii) Defining, Capturing and Using Asset Information

One of the key themes of the survey was to assess how companies defined the asset related information that should be collected throughout the asset lifecycle, how effectively such information is collected and stored and how the information is used to inform decisions relating to medium/long term asset management.

Companies assessed as leading in this area demonstrated clear linkages between the analytical risk identification studies they had carried out, their inspection policies, the specification and management of asset registers and the use made of asset information by decision makers.

Key to this process was found to be company understanding of the links between asset condition and long term network performance. Some companies have carried out comprehensive studies to identify asset and network risks and have defined the asset conditions which impact network performance, in some cases quantifying these in terms of probability and impact. Some companies have used these defined conditions to derive their inspection and maintenance (I and M) policy, and routinely collect the asset condition information within their I and M programmes. The most developed companies have established asset register systems that are clearly specified to support their I and M policies.

Some companies have taken a conscious decision to limit the extent of condition information captured, and have adopted a policy of "reporting by exception", having defined acceptable limits from their risk identification studies. In some cases the exceptional limits are acted on but left unrecorded on the asset register. There is a significant variation between companies in the effectiveness of data capture management. The strongest performers in this area have specified and documented their asset register systems to clearly support their asset management strategy and procedures, with defined resource levels to ensure timely and accurate data entry. They have specified appropriate data capture technologies, and the use of mandatory fields to ensure that defined conditions are always entered. Strong players in this area are also developing inherent condition trending techniques, in order to improve the effectiveness of the use of captured asset data.

Lesser performers in this area tend to have numerous legacy asset register systems with a limited degree of functionality and interaction between them and which do not reflect and support changes that have been made to asset management procedures.

In general and for most companies, there are good, inherent controls to ensure that work recorded onto hand held data capture devices is well managed in terms of the timeliness and content of its recording into the asset register. There are far less effective controls in respect of information captured in paper format and this is an area of general weakness throughout the companies assessed.

Procedures to ensure that changes to the asset base are captured e.g. on commissioning and decommissioning of assets, are generally robust for above ground upstream plant, with control room and asset register driven controls often found to be in place. Procedures with respect to buried assets and downstream plant are far less robust.

In general, the data definition and capture process is better developed for above ground assets, particularly for single site plant e.g. at electrical substations, for which most companies have benefited from joint industry initiatives to define relevant asset conditions. The process with respect to overhead power lines is less well-developed, although some companies have improved in this area over the last 2-3 years; nevertheless the definition, capture and use of condition information relating to overhead lines generally lags that relating to single site plant. In the case of overhead lines, the approach is generally to capture historic circuit performance, rather than asset condition, and to analyse this information in order to inform decision-making. This is an area that would warrant further consideration and would benefit from the sharing of best practice for predicting and assessing the risk of line failure.

The approach to the management of underground power cables differs significantly to the approach to other power assets. Most companies do not have a pro-active approach to the management of their solid dielectric cables (although most do have a more pro-active approach to the management of pressurised, monitored cables). At best, with some exceptions, historic fault performance analysis is used to inform decision-making. Most companies don't have confidence in the technical effectiveness or cost benefit argument of condition monitoring techniques for underground cables, and have not adopted this technology to any significant degree; one exception to this is the work presently underway within one company to develop some of these technologies. Most companies do not take the opportunity to assess and record cable condition when it is fortuitously exposed; there is one exception to this, with one company now doing so as part of its documented procedure. Few companies have a systematic approach to cable failure analysis, and so lose the opportunity to understand failure modes and trends for the future. In general (with very minor exceptions) the approach to the management of solid underground cables is not systematic or proactive.

3.2.2 Areas of Good Practice

During the survey examples of good practice were identified that could be used as a model for other parts of the industry. In line with the companies' wishes for confidentiality, examples of these are reproduced without reference to the company involved.

(i) Category A: Business Strategy and Direction

- A well-defined methodology used to score and rank identified risks within the risk register, and to identify investment prioritisation.

- Letter of Compliance used to ensure that individual engineers' areas of responsibility comply with company policies and procedures, in conjunction with a performance management framework.

- The development of asset condition and network condition analyser models and the use of these to inform asset management decision-making.

- The use of a Risks and Issues Management database, which assigns individual ownership, monitors and tracks progress and manages outstanding mitigation actions.

(ii) Category B: Asset and Network Strategy

- A pro-active approach to collect and record condition information relating to buried assets, where practicable.

- A strong approach to the introduction of new technology; R and D strategy is documented, clearly driven by performance and business objectives and implementation managed by a steering group structure.

- Establishment of a central records update facility to manage all aspects of asset data collection and recording.

(iii) Category C: Asset Life Cycle Management

- A strong quality control process used to monitor the compliance and workmanship of external contractors, including the use of a strong independent audit framework.

- The comprehensive network utilisation assessments undertaken to ensure compatibility with future load requirements.

- Policy rules for asset management are directly translated into practice through the asset data management system, which allows policy changes to be rapidly and comprehensively applied to all relevant activities. The functionality of system also facilitates the handling of immediate issues, such as operational restrictions.

4 The Way Forward

4.1 Lessons Learnt

Since this was the first survey of its kind undertaken by Ofgem, it was anticipated that lessons would be learnt about its process and content and that these would be used to inform and shape the approach used for future surveys. The key lessons learnt were as follows:

- Although the survey was structured to assess integration of approach across the three categories, nevertheless there was some unnecessary repetition across some questions, which in some cases served to confuse the company as to the response required.
- Elements of some questions were judged, during the audit, to be less relevant to medium/long term asset risk management than others. Although the relative importance of these has been reflected in the assessed scores, some of these could be dropped from future surveys.
- The principle of a small and constant audit assessment team proved successful in ensuring that companies were assessed consistently and fairly.
- Some companies appeared to put less effort into their written response than they did the on-site audit, despite the fact that some question areas were assessed solely on the company's written response. The scope of the on-site audit may have been over-estimated by some companies.
- The time and resources available to the survey audit team were necessarily limited, allowing only a high level assessment, which was highly dependant on the quality of the companies' written response and the evidence they presented at audit.
- The schedule of audits entailed some back-to-back visits, which did not allow sufficient time to fully reflect on the evidence seen.

4.2 Next Steps

Consideration of the results and the process to obtain them, is now required, recognising that Ofgem seeks (a) assurance of good asset stewardship, testing this in the widest possible context, and (b) to promote good practice across the regulated electricity and gas network companies, where each company has responsibility to develop and implement strategies according to its own risk assessments and priorities.

In order to discuss the results of this year's survey, both in terms of the radar plots and areas of good practice, an Industry Seminar is planned for respondees in January 2003. This will also consider the lessons learnt regarding the practicalities of the survey process and will highlight any topics for attention. Options for future surveys will be explored.

This will also be discussed with the Electricity Association, who represent many of the companies involved in this years survey.

To foster wider awareness of the survey and its findings an Open Seminar is also being planned. This will be arranged in conjunction with a relevant Learned Society, such as the Institute of Asset Management. This will permit discussion of the extent of asset risk management in Ofgem's regulated network companies compared to other regulated businesses and/or asset intensive sectors. As there are currently plans to formulate a general 'standard' for asset management, it will also share understanding of the practicalities of measuring asset risk management performance across the broad range of areas included within the scope of this years Ofgem survey.

4.3 Suggested Issues for the Industry Seminar

(a) Process Review	lessons from development of the survey questionnaire and its implementation, from the audit visits, and from the follow-up processes, and from the results presentation
(b) Best Practices	with the agreement of the companies concerned, a sharing of their experiences with particular reference to the "effort versus return" justification
(c) Topics for Attention	to consider any common views on asset risk management matters that warrant further attention and how they might be progressed for mutual benefit.
(d) Way forward	a pooling of ideas for developing the Asset Risk Management Survey, including timing and format and topics for particular attention. Ofgem would wish to see a sufficiently robust process developed to enable company names to be attributed. Clarity is likely to be required on the prospective uses of any measures generated and how they might relate to other Ofgem programmes e.g. Price Reviews, IIP etc.

4.4 Wider Audience

An Open Seminar would provide an opportunity to

(a) communicate the findings of the survey and experience with the methodology to a wider audience of asset risk management practitioners and other interested parties

(b) present this in the context of views and experiences from sectors other than the electricity and gas networks, so that development of future surveys might be better informed

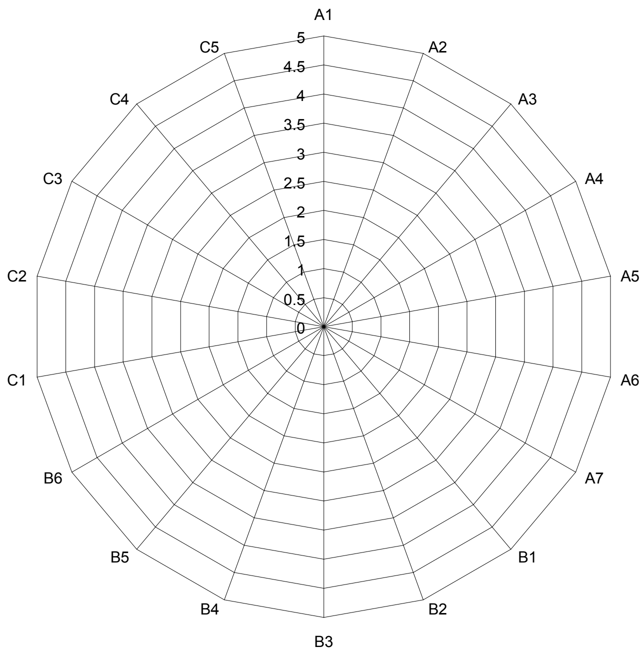
5 Radar Plots

KEY TO RADAR PLOTS

	Section C Asset Life Cycle Management
C1	From Procedure to Delivery
C2	Asset Register Contents
C3	Utilisation
C4	Use of Contractors/Suppliers
C5	Inspection & maintenance regimes

	Section A Business Strategy & Direction
A1	Aims and Objectives
A2	Identifying Key Issues for Asset Risk Management
A3	Assigning Accountabilities
A4	Structures and Contracts
A5	Operating, Integrating and Interpreting
A6	Risk Assessment and Decision-Making
A7	Review Process

Radar Plot for Company Audited

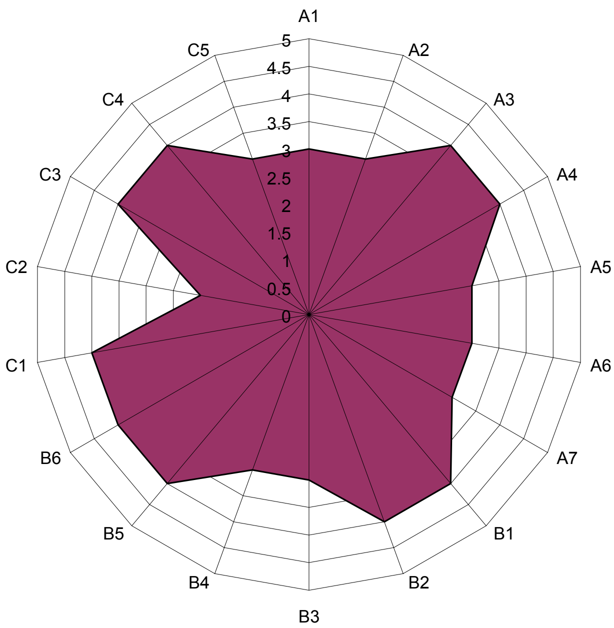


Score	Classification
5	Leading
4	Above Intermediate
3	Intermediate
2	Below Intermediate
1	Trailing

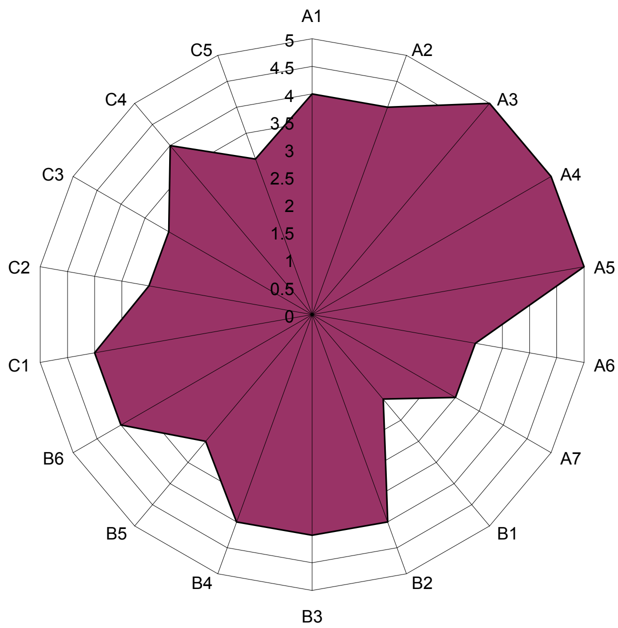
	Section B Asset & Network Strategy
B1	From Policy to Procedure
B2	Defining Asset Life and Serviceability
B3	Recording Asset Information
B4	Innovation & New Technology
B5	Security of Supply and Asset Utilisation
B6	Compliance with Legislation

Radar Plots for Companies A to D

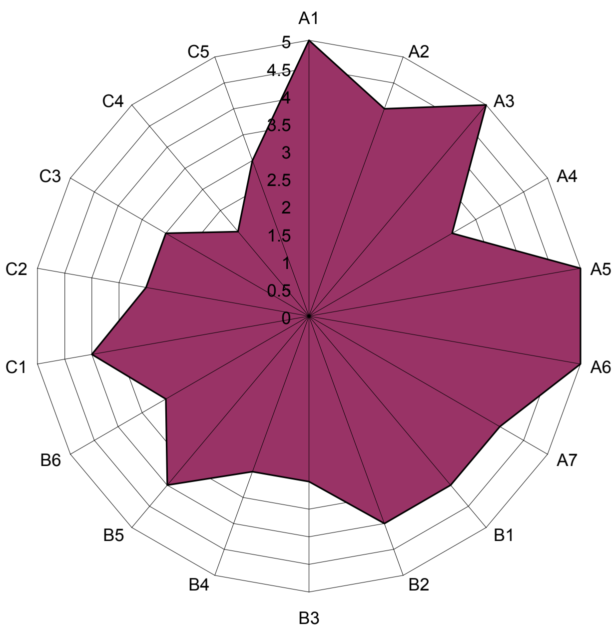
Company A



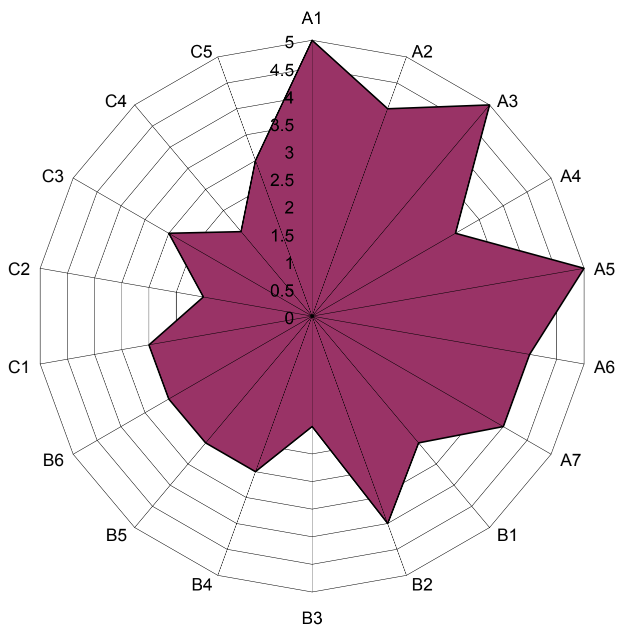
Company B



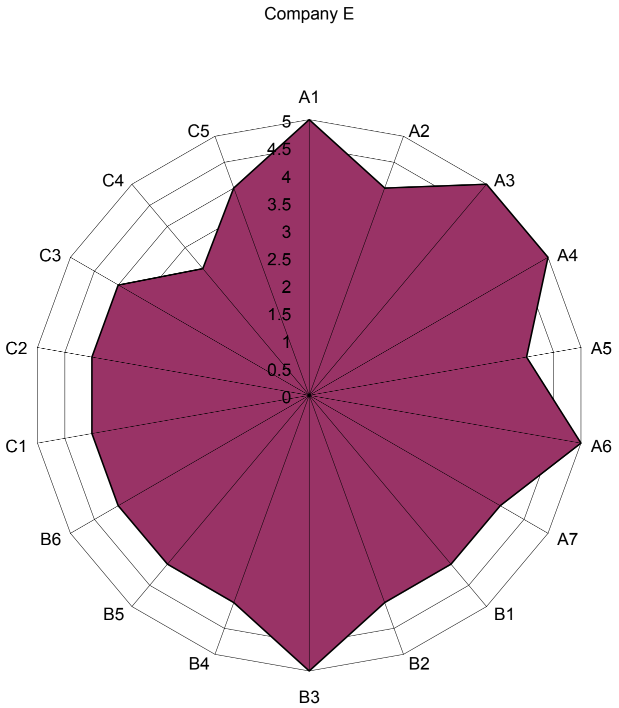
Company C

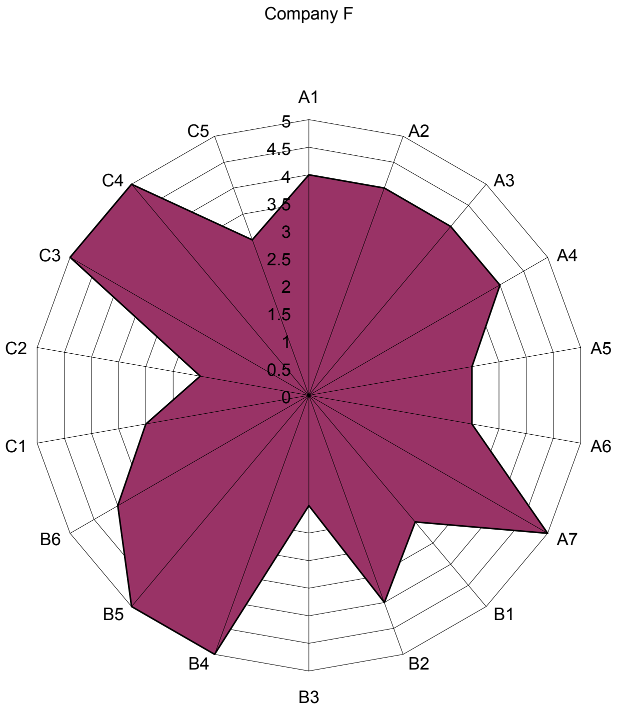


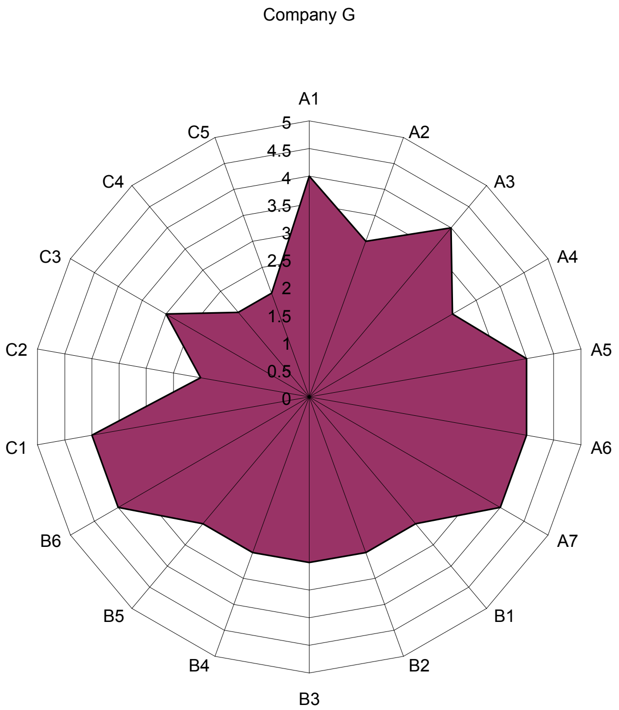
Company D

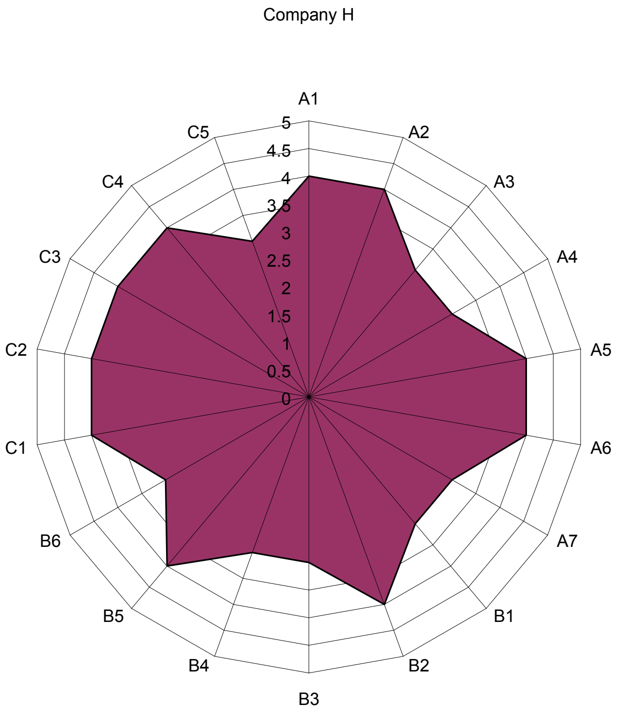


Radar Plots for Companies E to H.

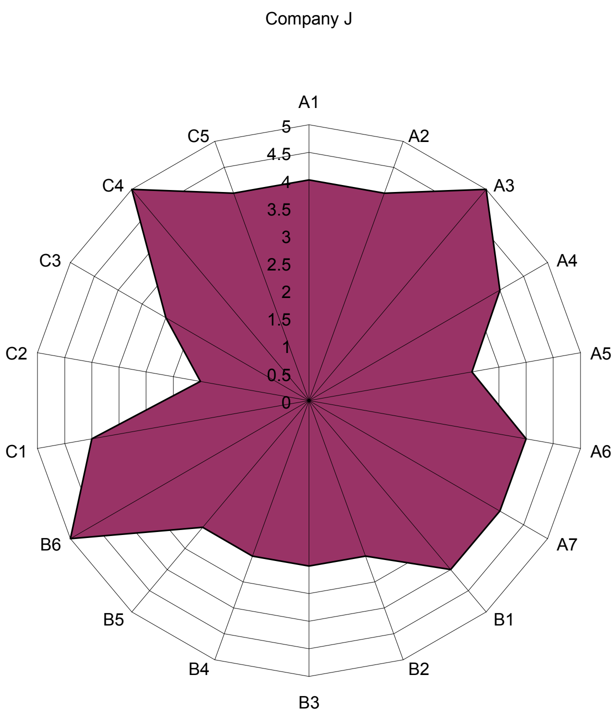


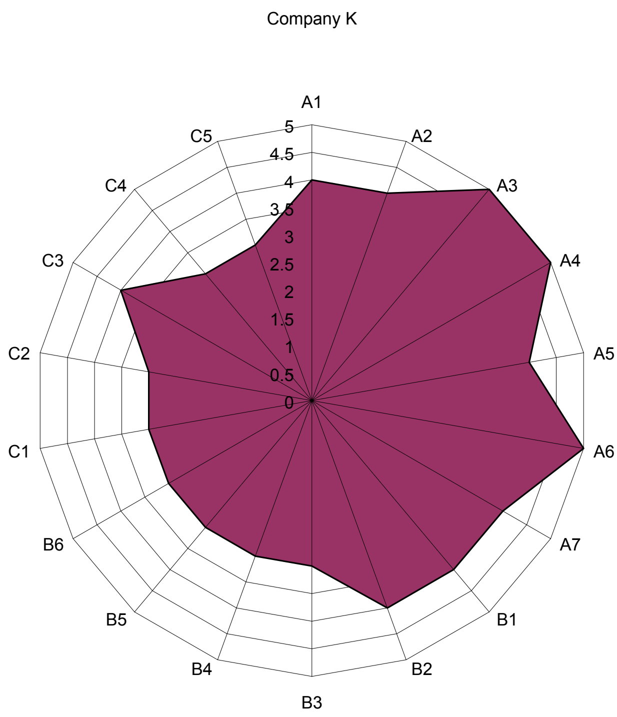


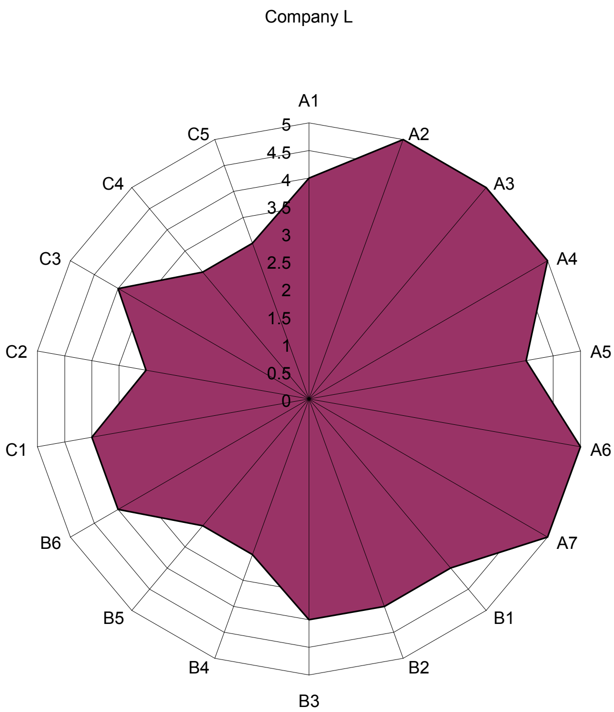


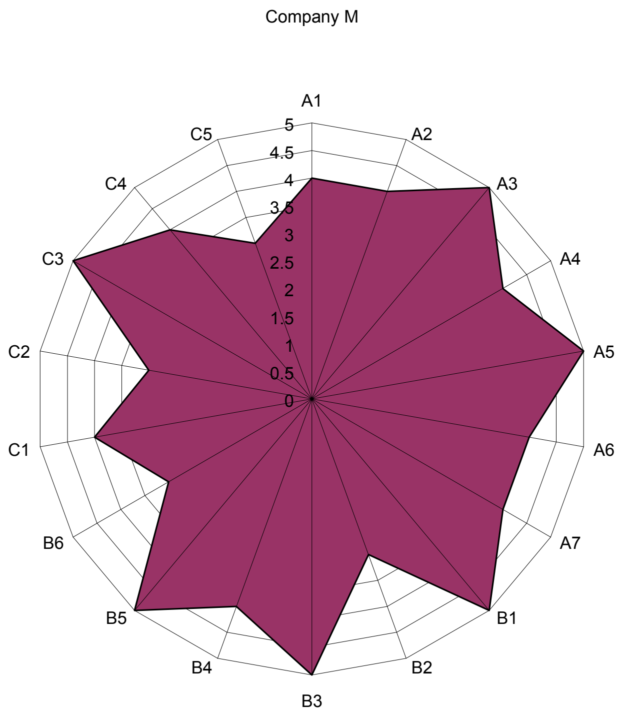


Radar Plots for Companies J to M.









Electricity Transmission Regulatory Reset

2008/09 – 2013/14

Appendix B

VENCorp Availability Incentive Scheme

SP AusNet
A member of Singapore Power Group

VENCorp Availability Incentive Scheme

The Network Agreement with VENCorp provides for rebates to be paid to VENCorp when network elements are not available for service. The scheme presents SP AusNet with substantial financial exposure directly related to the performance of its network.

The principal objectives for the scheme are to encourage:

- SP AusNet to seek plant outages at times when the expected cost to wholesale electricity market participants of an outage is minimal;
- asset management practices which assist in ensuring that the actual cost borne by market participants due to unavailability of transmission assets is minimised; and
- asset management practices which assist in ensuring that over the long run benchmark performance standards are achieved.

Basic Principles Of Operation

Network element outages are unavoidable. They are necessary, and planned, to conduct maintenance and construction activities. Unplanned outages also occur, largely at random, and resulting from a variety of causes including plant failure (e.g. an internal transformer fault) and consequential damage (eg, storm damage to transmission lines).

For the scheme to operate, the following process is required:

- SP AusNet is compensated via its regulated revenue for the expected rebate value associated with outages. The annual value is included as a component of the Company's opex forecasts;
- At the time of billing of revenue from VENCorp, the actual rebate value associated and the actual outages that have occurred is netted out from the gross revenue amount.

The annual cost of outages is the estimated cost of rebates that SP AusNet will pay to VENCorp in a year under the revised scheme. SP AusNet's financial exposure is in relation to the variance from predicted availability that may occur.

SP AusNet is penalised most severely if its work plans are significantly during peak period and also faces a severe potential penalty if its network is not in a state of readiness for the critical peak loading period.

SP AusNet's annual rebate payment liability in association with the scheme is capped, therefore, outages on a catastrophic scale not envisaged by the network planning criteria are not covered by the scheme.

To ensure that the scheme satisfies "incentive" objectives and can be reasonably costed, the terms agreed between VENCorp and SP AusNet incorporate liability limitations and rebate payment capping. SP AusNet's total liability under the current scheme is capped at $12.0 million per annum (real 2003/04 dollars). A value of around $6 million (real 2003 / 04 dollars) is targeted and included in SP AusNet's revenue forecasts. There is also a cap per event of $1 million (real 2003 / 04 dollars).

Outages required by third parties, such as connected customers, are currently excluded from the scheme.

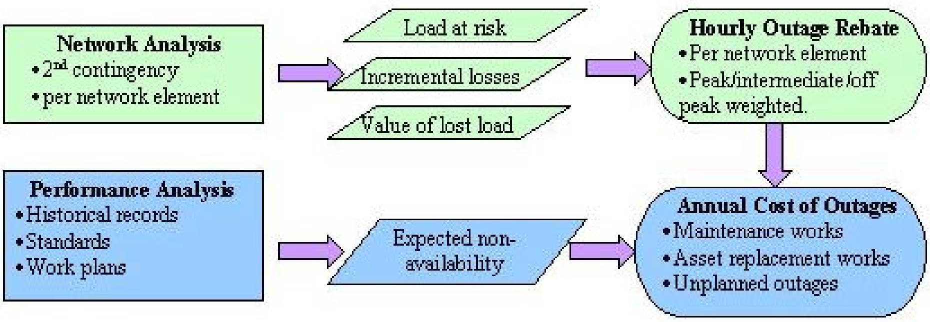
Calculation of Expected Annual Value

The network availability incentive scheme puts an explicit value on individual asset availability. The rate to be applied for an individual transmission system element is intended to reflect the criticality of its outage, and the time period in which the outage occurs.

Calculation of the expected value involved several elements:

- The peak period during which network availability is most critical was assigned (coinciding with the summer peak). An intermediate period (coinciding with the winter peak) was similarly assigned, and the residual period of the year, having lowest criticality was assigned as off-peak period. The peak period and intermediate period include both a seasonal and period of day dimension;
- For the outage of each network element, the In order to define the rates for the revised scheme, VENCorp undertook detailed network analysis to determine the "cost" of the outage to network users for the event of a second contingency event occurring (typically a random co-incident outage on a supporting network element) was determined through network analysis, considering the typical loading conditions relevant to the peak, intermediate and off-peak periods. For each network element, two potential impacts were considered in the analysis:
  - *Loss of load to customers (costed at VoLL); and*
  - *Loss of generator access to market (costed at marginal cost of generator rescheduling);*
- The incremental losses resulting from the outage of the network element was also costed, and added to the second contingency impact costs, on a per hour basis, to arrive at the total rebate rate for each network element; and
- The expected level of outages in a year was derived from benchmark standards, statistical plant failure rates, historical records and work plans. The product of the rebate rates and expected level of outages determines expected annual value of the scheme.

The process is summarised in the following diagram.



The calculation of the rebate rates can be seen to be reflective of the potential impact faced by network users whenever SP AusNet removes a network element from service. The signals presented to SP AusNet are not arbitrary, but are based on the results of comprehensive network analysis and individually targeted to each network element.

Electricity Transmission Regulatory Reset

2008/09 – 2013/14

Appendix C

SKM Report

SP AusNet
A member of Singapore Power Group

Escalation Factors affecting Capital Expenditure Forecasts

- Final
- 21 February 2007

Escalation Factors affecting Capital Expenditure Forecasts

- Final
- 21 February 2007

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Contents

SKM

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1.1	21.02.2007	J Butler	C Jones	21.02.2007	Additional 132kV estimate

Distribution of copies

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B	Electronic	1	SP AusNet
C	Electronic	1	SP AusNet
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Name of document:	Report
Document version:	Final
Project number:	QH10063

1. Executive Summary

After a prolonged period where costs used for the development of capital expenditure forecasts have increased generally in line with movements in the Australian Consumer Price Index (CPI), market cost pressures particularly over the last three years have grown substantially in excess of CPI.

The Reserve Bank of Australia has noted that " … *strong global growth over a number of years has added to demand for commodities and contributed to significant upward pressure on a wide range of resources prices. While world oil prices have declined from their peaks over recent months, other resources prices have remained high, with base metals prices on average around 60 per cent higher than at the beginning of the year. These levels of commodity prices are continuing to have a significant expansionary effect on the Australian economy, having boosted Australia's terms of trade by more than 30 per cent over the past three years. The impact of higher commodity prices over this period has only partly been moderated by the rise in the exchange rate of the Australian dollar.*"[1]

SKM has, for some time, been researching the rapidly increasing cost of capital infrastructure works, particularly in the electrical industry. Many of our transmission and distribution network clients have been reporting rapidly increasing costs of both individual projects (substations, transmission lines etc.) and also annual and five year capital works programs covering the full range of capital expenditure (projects and programs).

As part of this research, SKM has conducted a multi-utility strategic procurement study in which a total of nine (9) Australian transmission and distribution companies (including SP AusNet) provided confidential contract information for the purchase of their main items of plant, equipment and materials (such as power transformers, switchgear, cables and conductors) over the period 2002 to 2006.

SKM has also been privy to contract cost information for a number of turnkey substation and transmission line projects, including plant equipment, materials, construction, testing and commissioning.

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[1] Reserve Bank of Australia, *Statement on Monetary Policy*, 13 November 2006, pp 1

The results of SKM's research indicate that there are a number of factors driving the rapid rises in capital infrastructure costs, namely:

- the increase in world wide commodity prices that has occurred since 2002/03;
- subsequent increases in the purchase price of plant, equipment and materials, both locally produced and imported, although these increases are noted to lag increases in commodity prices by a period of 1 to 2 years;
- increases in the cost of local labour and related increases in construction industry costs; and
- general increases in the market price for contracted works in Australia caused by the current demand/supply imbalance and shortages in skilled labour and construction resources.

SKM has researched relevant historical and forecast data, and has constructed a model which captures the likely impact of input cost drivers on future electricity infrastructure costs. The overall output from this model suggests that on a weighted average cost basis, substation costs, transmission line costs and underground cable costs will increase, relative to 2002 costs, as shown in Table 1 and relative to 2006 as shown in Table 2. The projected factors for substations, transmission lines and cables are nominal; that is, they apply in the year in which they have been forecast to occur.

The substation values have been based on average component composition for a selected range of the most common 66kV and 220kV substation switchbays in the SP AusNet transmission network. Minor variations may occur for individual switchbay types.

Table 1 Cost increases for the period 2002 - 2006

Item	2002	2003	2004	2005	2006
Substations (excluding power transformers)	1.000	1.011	1.058	1.095	1.171
Power Transformers	1.000	0.982	1.000	1.048	1.183
CPI actual[2]	1.000	1.027	1.052	1.078	1.121

---

2 Based on Australian Bureau of Statistics *CPI All Groups, Weighted Average of Eight Capital Cities, Index Numbers* for June of each year

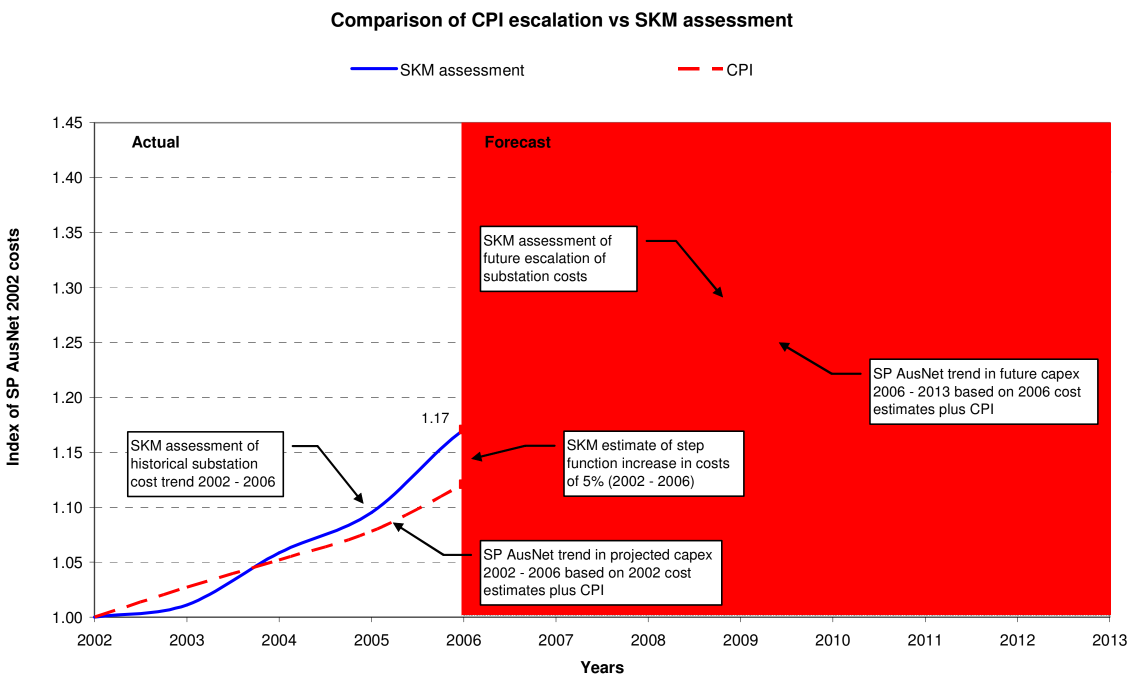
Table 2 Cost increases for the period 2006 - 2013

Item	2006	2007	2008	2009	2010	2011	2012	2013
Substations (excluding power transformers)	1.000	1.038	1.074	1.098	1.119	1.145	1.171	1.200
Power Transformers	1.000	1.058	1.215	1.197	1.139	1.105	1.087	1.083
CPI forecast	1.000	1.025	1.051	1.077	1.104	1.132	1.160	1.189

SKM would make the observation that beyond approximately 2010, many forecasts for commodity prices and foreign exchange are comparable with CPI, as there does not appear to be particular costs drivers built into the estimates more than 5 years out. As a result, the projections for escalation from 2010 to 2013 may be conservative.

Figure 1 below shows the known historical trend in escalation factors for substation assets (equipment, construction and labour), and SKM's projection of future substation costs against CPI trended costs as allowed for in the current SP AusNet 2003 - 2008 determination and as may be considered over the period 2008 - 2013. It should be noted that the 5% step increase in costs at 2006, which SKM assesses is the difference between actual project costs at this date against 2002 costs escalated at CPI.

- **Figure 1 Comparison of SKM historical and forecast substation costs indices and CPI**



It should be noted that the average annual CPI forecast for the period 2006 to 2013 shown in Figure 1 is 2.5% per annum (refer section 5.5). Should CPI exceed these estimates due to pressure on labour costs, it would have the effect of pushing both the CPI based forecast and the SKM projection lines higher.

A more detailed breakdown of the component cost increases is contained in Sections 6 and 7, and Appendices B and C.

2. Scope

Sinclair Knight Merz (SKM) was engaged by SP AusNet to analyse the likely drivers of cost escalation on capital expenditure forecasts over the remaining two years of the current determination (2006/07 and 2007/08), and for the next regulatory reset period (2008/09 to 2012/13, commencing 1 April 2008).

The scope of the assignment is as contained in the following documents/correspondence:

- SP AusNet request for proposal;
- SKM initial proposal of 29 September 2006; and
- SKM modified proposal (following discussions with SP AusNet staff) in a facsimile of 30 October 2006.

Specifically, SP AusNet sought independent advice from SKM regarding the impact that future cost escalation will have on the capital cost forecasts:

(a) From the reference date of 2006 to the end of the current regulatory period - 2006/07 and 2007/08, ending 31 March 2008; and

(b) For the whole of the next regulatory period - 6 years from 1 March 2008 to 1 March 2014.

SP AusNet also required SKM to develop a simple “guideline document” for use by procurement personnel, which quantified the approximate impact of input cost variables (commodity prices, exchange rates etc.) on the contract prices of groups of asset categories such as power transformers, underground cable, overhead conductor, steelwork and switchgear.

3. SKM Asset Valuation & Estimating Database

3.1 Initial Development

SKM first developed and consolidated its Australian asset valuation and estimating database for transmission assets and project costs in 1997. This was done with the co-operation of all of the TNSPs, who shared their project costings with SKM. These costings were compared with SKM's experience of project costs in the broader electrical contracting market place. While there were some differences between the TNSPs, and the broader industry costs, SKM was able to confidently develop a uniform set of transmission equipment and construction costs that were valid at that time (1997).

3.2 Updating and Refinement

SKM's database of capital costs has been progressively refined and updated since 1997 by various means, including:

- reviewing and updating supplier and contractor costs during subsequent asset valuation assignments;
- obtaining updated budget price information from suppliers and contractors for individual plant, equipment and projects;
- conducting multi-utility market price surveys and plant / equipment procurement studies whereby utilities share their pricing information on a confidential basis with SKM; and
- other external project costs for non-utility clients that are project managed by SKM.

3.3 Recent SKM Transmission Asset Valuation & Project Estimating Experience

Since the establishment of the centralised transmission asset valuation database, SKM has conducted a number of transmission valuations, each of which has required a review and updating of SKM's unit rates to current market prices. These valuations included:

- SPI PowerNet (Victoria) - 2000;
- ElectraNet (South Australia) - 2001;
- Transend (Tasmania) - 2002;
- Power and Water Authority (Northern Territory) - 2000 & 2002;
- NSW Treasury (EnergyAustralia, Integral Energy, Country Energy, Australian Inland) - 2002;
- Queensland Competition Authority (Energex, Ergon Energy) - 2003;
- TXU (Victoria) - 2004; and
- Western Power (Western Australia) - 2005.

In addition, SKM has conducted a number of overseas asset valuations and unit cost reviews for transmission companies which have given an insight into differing international pricing practices and the impact of international exchange rates on project costs. These valuations include:

- Transpower (New Zealand) - 1995 to 2002;
- Ontario Hydro (Canada) - 1999;
- SP PowerGrid (Singapore) - 2003;
- Transco (Philippines) - 2005; and
- Transpower (New Zealand) unit rate review - 2006.

Over this period, SKM has also conducted numerous feasibility studies, project cost estimates and project cost reviews for transmission projects in Australia and overseas that has given it an unparalleled insight into the cost drivers and pricing trends that are currently impacting the cost of electricity infrastructure in Australia.

3.4 Trends in Transmission Line and Substation Costs

Figure 2 shows the trends observed by SKM in commodity prices over the period 1997 to 2006. All rates are displayed relative to 1997, for comparison with values from the SKM database which was established in the same year. The following points to be noted are:

- CPI index (from the Australian Bureau of Statistics) increased 22.08% from December 1997 to December 2004;
- commodity prices (copper, aluminium and steel) generally fluctuated below their 1997 prices up until December 2002 (steel) and September 2003 (copper and aluminium);
- SKM did not witness any sustained reduction in transmission line prices or substation costs during this period (1997 to 2003);
- the weighted average value of all transmission line costs increased by 31.57% to December 2004, compared with CPI of 22.08%;
- the weighted average value of all substation asset costs increased by 19.44% to December 2004, compared with CPI of 22.08%;
- SKM has concluded that transmission line costs increased more rapidly than CPI due to the input cost effects of steel and aluminium, and also local labour and construction costs; and
- SKM has deduced that substation costs have increased less than CPI (up to 2002/03) due to efficiency gains in the technology and manufacturing of electrical equipment and the strengthening of the Australian dollar reducing the cost of imported equipment. This appears to have offset the higher-than-CPI increases in the local labour and construction component of substations.

SKM

Figure 2 Commodity price trends 1997 - 2006

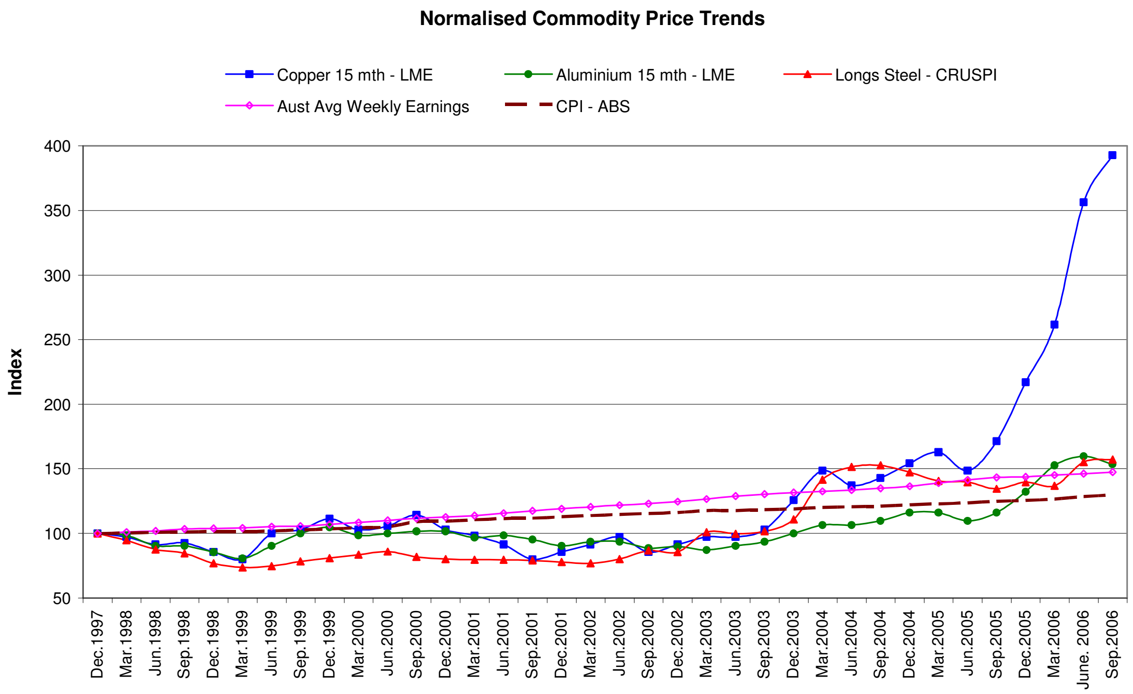


Figure 3 Trends in SKM transmission line and substation values 2002 - 2006

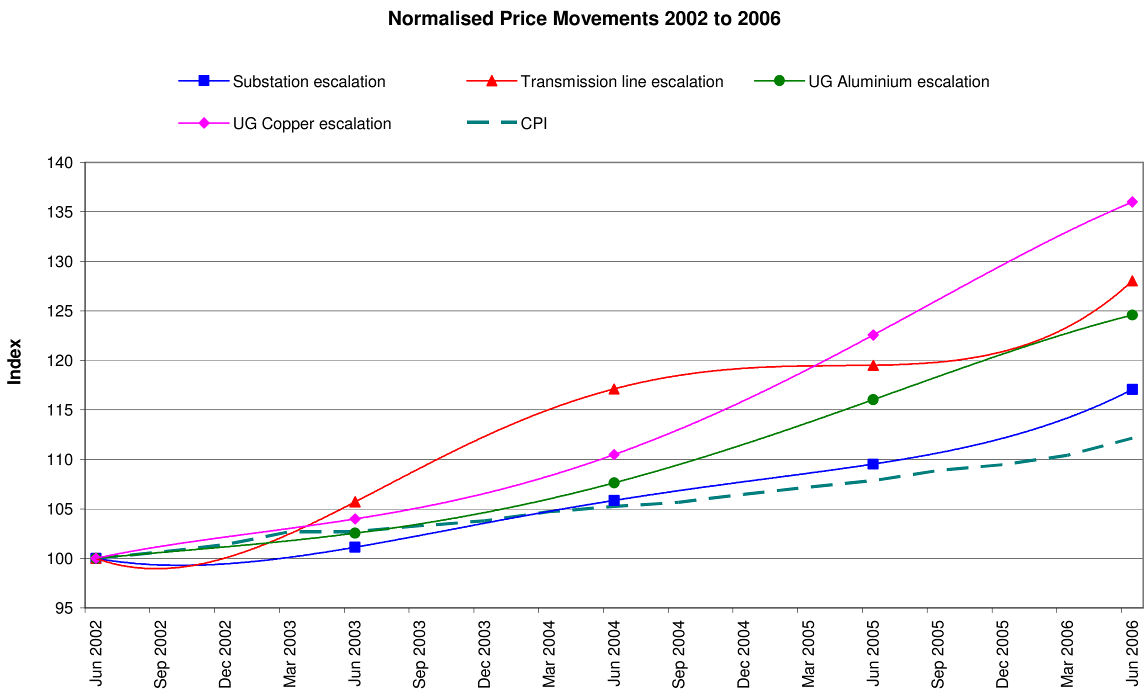


Figure 3 shows the trend of normalised price movements in substations, transmission lines and underground cables for the period 2002 to 2006 compared with CPI. It was during this period when movement in commodity prices became more volatile, and the effect on asset prices outstripped CPI. The movements in asset prices have been based on actual commodity cost indices between 2002 and 2006, with each driver weighted by contribution to the final cost of the asset (refer section 6).

The resultant curves show that in June 2006:

- Substation price movements exceeded CPI by 4.93%;
- Transmission line price movements exceeded CPI by 15.91%;
- Aluminium cable price movements exceeded CPI by 12.45%; and
- Copper cable price movements exceeded CPI by 23.86%.

3.5 Rapid Escalation in Equipment / Material Costs

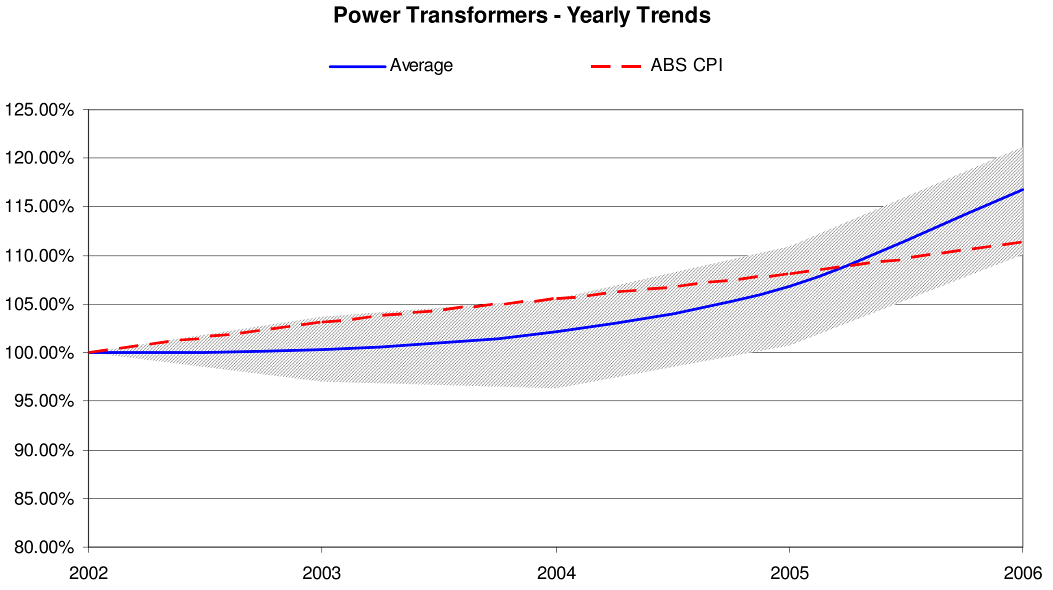
SKM has continually kept abreast of movements in the cost of both transmission and distribution electricity works, including conducting market price surveys in 2001, 2002 and 2003, and more recently (2006) a multi-utility study of procurement practices and prices for transmission and distribution plant, equipment and materials.

In this procurement study, SKM obtained from nine (9) Australian transmission and distribution companies, their actual contract prices for the purchase of their major items of plant, equipment and materials, that go into the construction of substations and transmission lines (overhead and underground). Prices were obtained for the period 2002 to 2006, so that yearly trends could be determined.

Some of the annual trend graphs for plant / equipment / materials that directly impact transmission project costs are shown in Figure 4 to Figure 11. A shaded area on a graph shows the range of reported prices for that particular asset category.

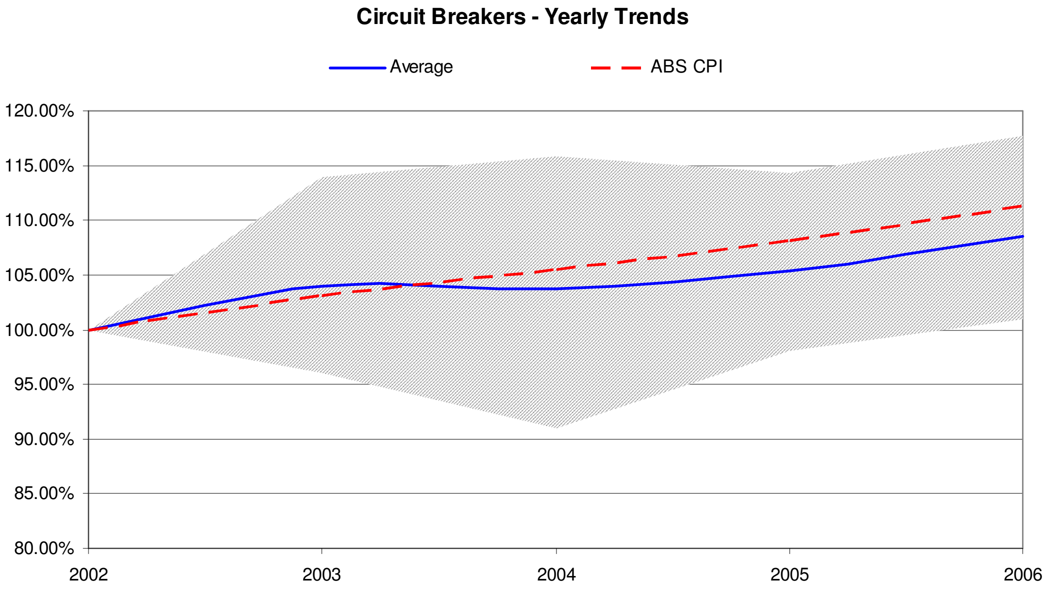
SKM

Figure 4 Annual trends in power transformer costs



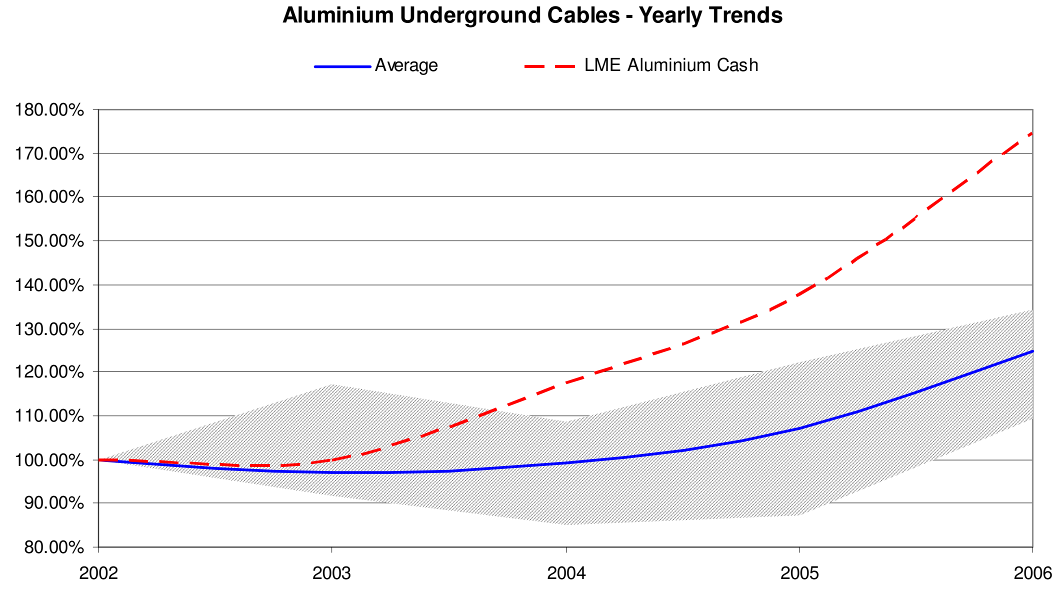
On average, power transformer costs increased by 6.79% from 2002 to 2005, and 9.29% in 2006.

Figure 5 Annual trends in circuit breaker costs



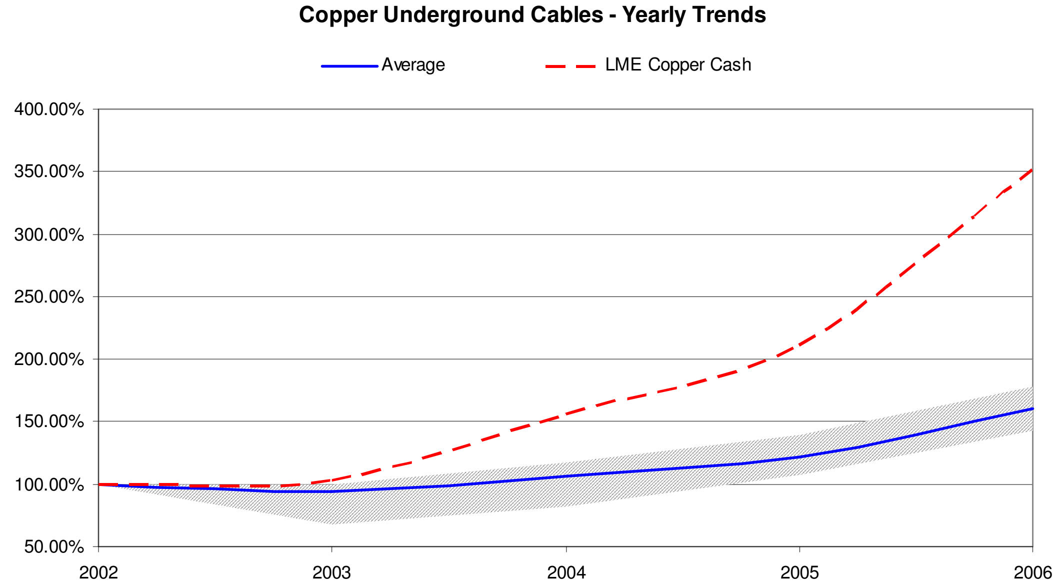
On average, circuit breaker prices increased by 5.35% over the period 2002 to 2005.

▪ **Figure 6 Annual trends in underground cable (aluminium) costs**



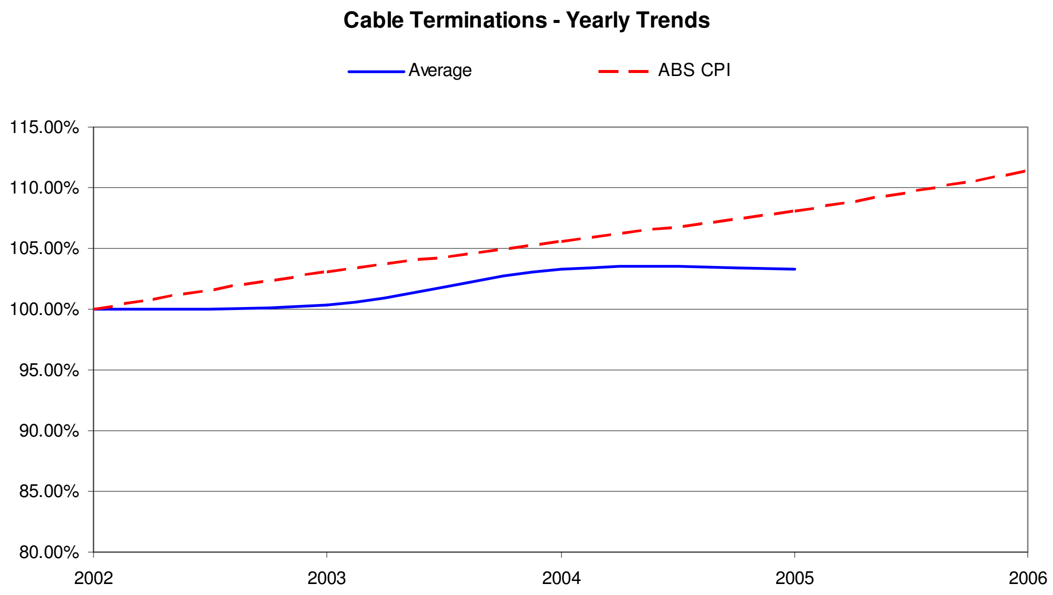
On average, the cost of aluminium cable did not increase from 2002 to 2004, but increased by 7.70% in 2005 and 16.67% in 2006.

▪ **Figure 7 Annual trends in underground cable (copper) Costs**



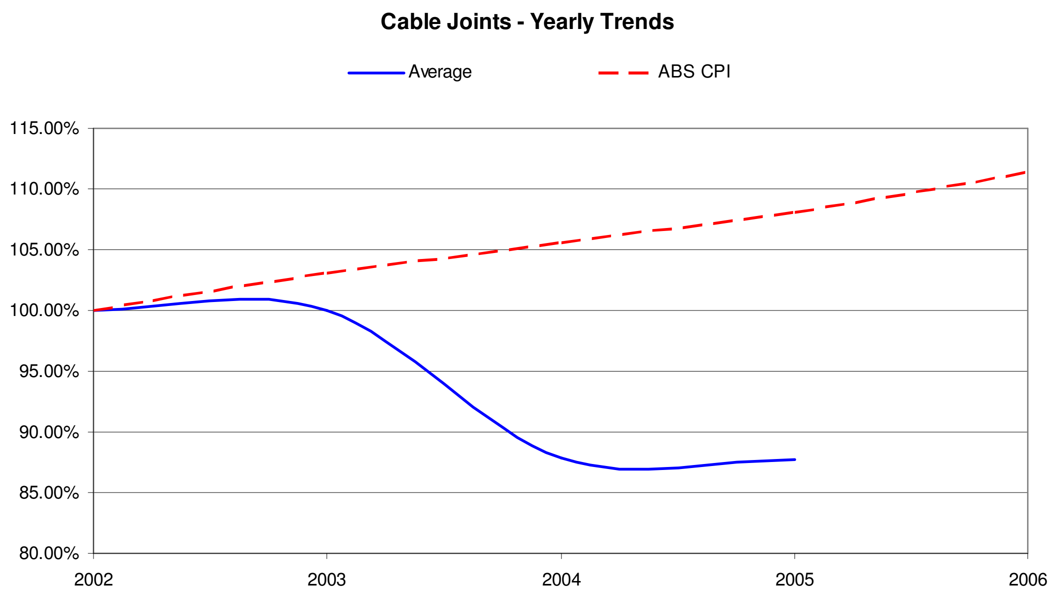
On average, the cost of copper cable increased 5.99% from 2002 to 2004, but then increased by 15.35% in 2005 and 30.91% in 2006.

- **Figure 8 Annual trends in cable termination costs**



On average, cable termination costs increased by a modest 3.26% over the period 2002 to 2005.

- **Figure 9 Annual trends in cable joint costs**



On average, cable joint costs decreased by 12.31% from 2002 to 2005.

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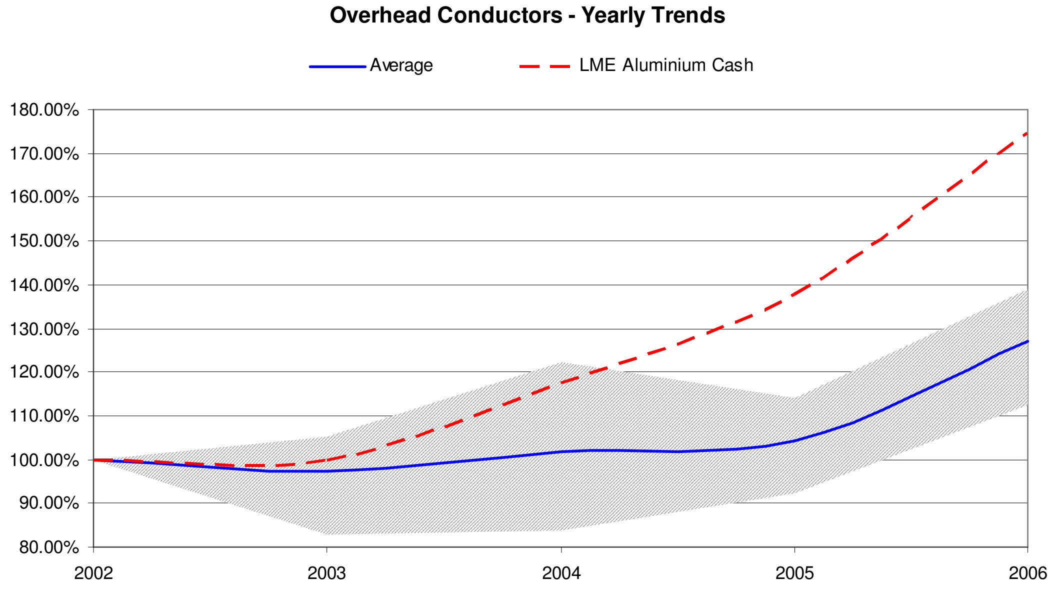
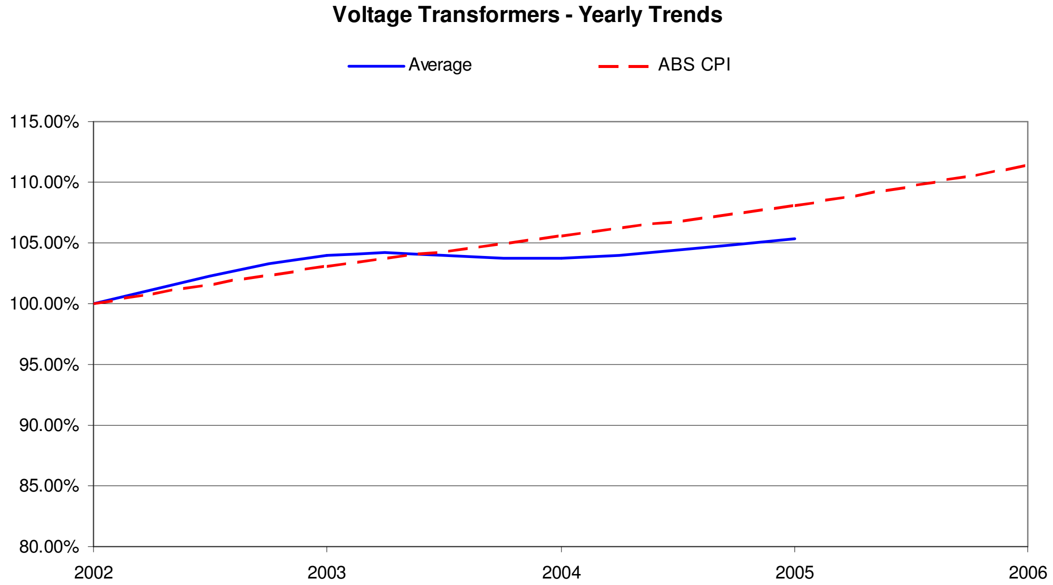
▪ **Figure 10 Annual trends in overhead conductor (AAC & AAAC) costs**



On average, AAC and AAAC overhead conductor costs increased only marginally (1.66%) from 2002 to 2004, but increased by 2.52% in 2005 and a further 21.86% in 2006.

▪ **Figure 11 Annual trends in voltage transformer costs**



On average, voltage transformer prices have increased by 5.35% over the period 2002 to 2005.

Some significant observations that may be made for these graphs are:

- Power transformer costs were relatively stable over the period 2002 to 2004, but began to rise significantly in 2005, increased by 9.29% in 2006 and are expected to rise by more than 10% in 2007;
- Costs of equipment that are more technology or manufacturing driven rather than commodity price driven (eg. circuit breakers, cable joints / terminations, voltage transformers) tended to be relatively stable during the period;
- Aluminium cable costs were stagnant between 2002 and 2004 (decreasing slightly in 2003), but have risen 27% over the past two years;
- Copper cable costs were also consistent between 2002 and 2004 (dropping slightly in 2003), but have increased 50% in the past two years; and
- AAC and AAAC overhead conductor costs were stagnant between 2002 and 2004 (decreasing slightly in 2003), but have risen by 27% in the past two years, with most of this increase occurring in 2006.

Table 3 summarises the increases relative to CPI.

- **Table 3 Material / Equipment price increases relative to CPI 2002 to 2006**

Item	2002 to 2005 (3 years)	2005 to 2006 (1 year)
CPI	7.99%	3.04%
Power transformers	6.79%	9.50%
Aluminium cable	7.02%	16.67%
Copper cable	22.26%	30.09%
AAC & AAAC conductor		21.86%

3.6 Time Lag Impact of Commodity Price Increases

It is of interest to note from the price trends shown, particularly in Figure 4, Figure 6, Figure 7 and Figure 10, that there appears to be a significant time lag between the rapid increases in commodity prices (which occurred for copper and aluminium between September / December 2003 and June 2005) and the time at which finished product prices began to rise. As an example, Figure 12 and Figure 13 show the time lag impact of approximately two years for aluminium and copper conductor and cables, relative to the respective commodity prices.

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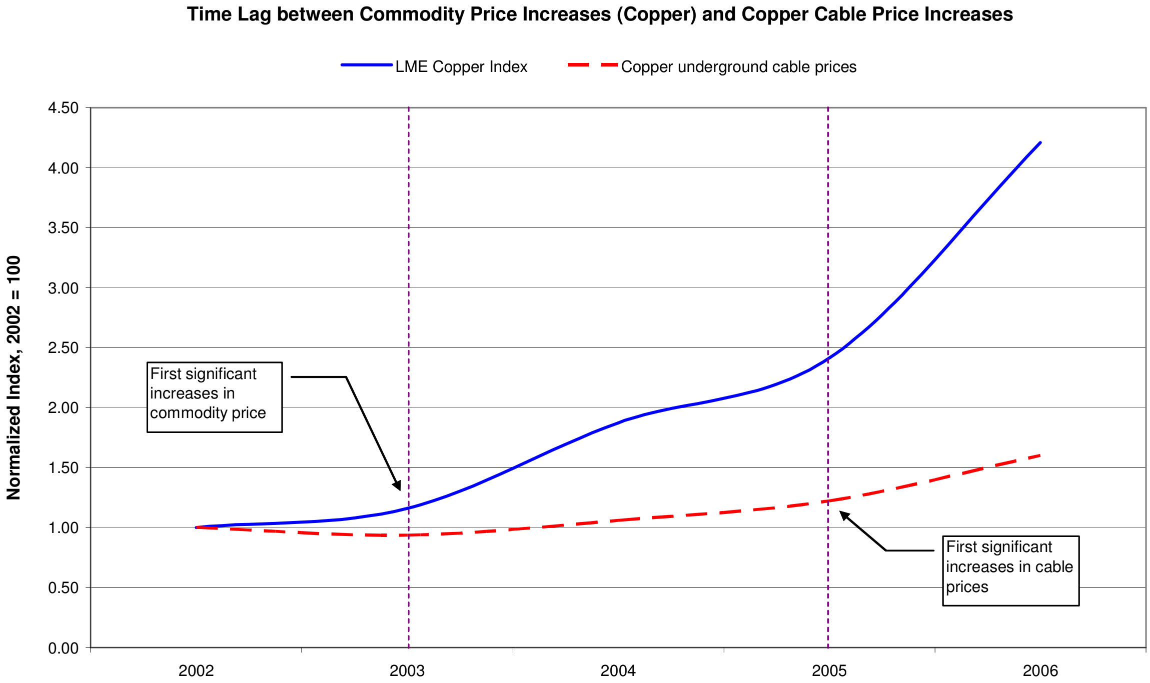
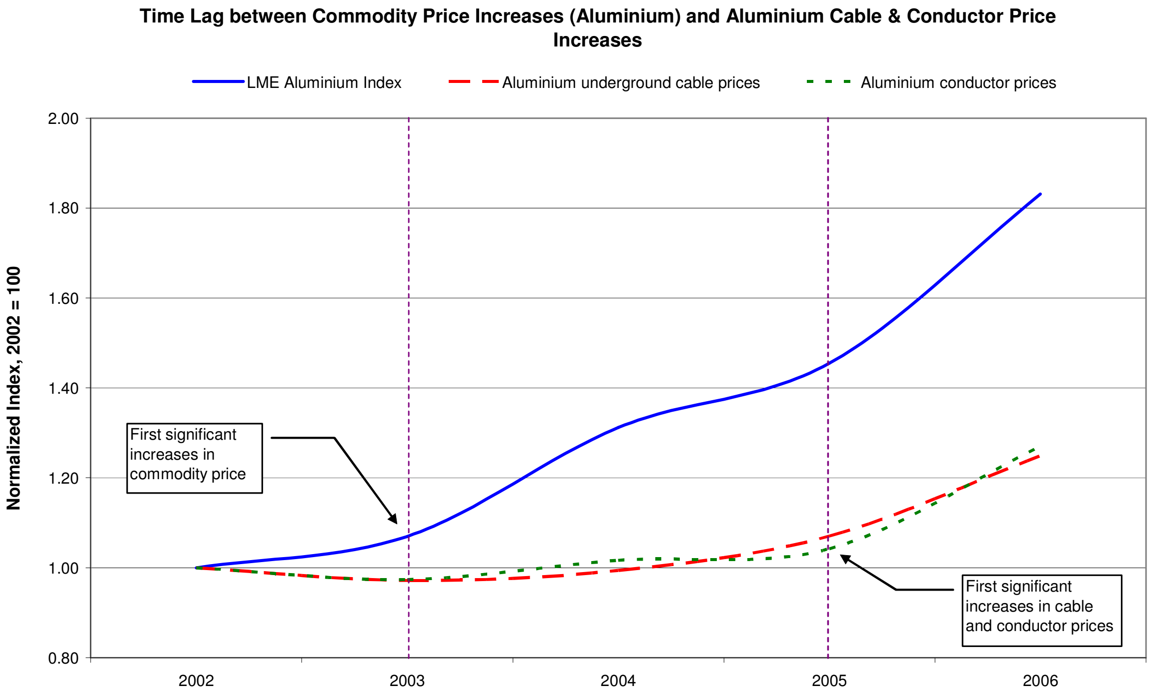
- **Figure 12 Time lag between commodity price increase (copper) and copper cable / conductor price increase**



- **Figure 13 Time lag between commodity price increase (aluminium) and AAC / AAAC conductor price increase**



This suggest that the contract prices for finished product, such as transformers, cables and conductors, will continue to rise well beyond the predicted peaks in commodity prices and likely into 2008. This view has been reinforced anecdotally through discussions with equipment manufacturers and suppliers. Depending on the market pressures for various finished products, the higher prices may be sustained potentially into 2009 or 2010.

4. International Markets

Global expansion over the past four years has resulted in significant increases in fuel and non-fuel commodity prices. Metal prices have risen sharply since 2002 to the present by 180% in real terms, whilst oil prices have increased by 157% during the same period.

Almost all periods of large upward movements in metal prices have been associated with strong world growth. However, the continued rise in metal prices during 2006 can in part be attributed to low investment in the metals sector in the late 1990s and early 2000s that followed a period of earlier price declines. The upward price cycle has also been caused by rapidly growing emerging markets (especially China) in the world economy.

China has become a key driver of dynamics in the prices of base metals. During 2002-05, China contributed to:

- almost all of the increase in world consumption of nickel and tin;
- greater than the net world consumption growth for lead and zinc; and
- 50% of the consumption growth for aluminium, copper and steel.

China has become the largest consumer of several key metals, generating about ¼ of the total world demand for aluminium, copper and steel.

Some financial analysts have suggested that rapid industrial growth, construction activity and infrastructure could sustain the growth of demand of emerging markets at high rates in the medium term. To offset this forecast, some of the current demand pressures could be temporary as the Chinese government is currently reviewing fiscal policy with regards to exchange rate and rebalancing of growth from investment to consumption. India has a considerably lower focus in its economy on the industrial sector, and as a result India's continued rapid growth is considered less likely to have a significant impact on metals markets in the future.

4.1 Price Movements

The international demand for metals has risen substantially during the last four years and caught the industry by surprise. Metal prices increased substantially during the same period as production lagged growth levels, particularly nickel, copper, and aluminium prices.

The price movements for metals are shown in Figure 14 and Figure 15. The forecast figures shown for copper and aluminium in 2007 are based on 87.5 percentile projections published by the IMF.[3]

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[3] IMF, *World Economic Outlook*, September 2006

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Figure 14 World copper and aluminium price movements

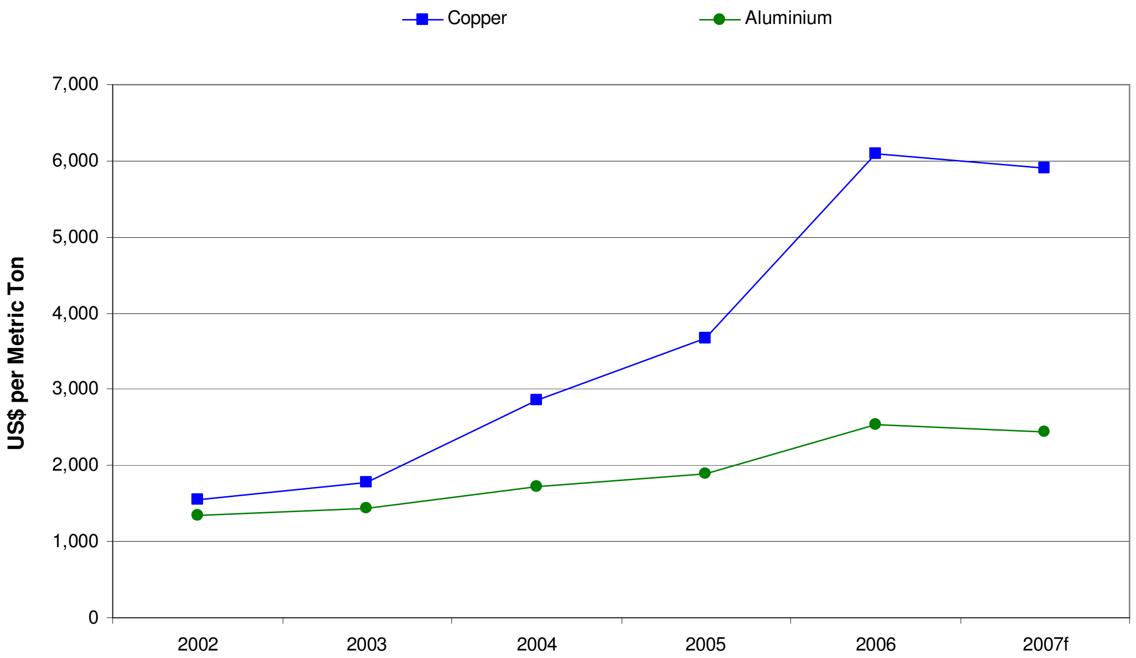
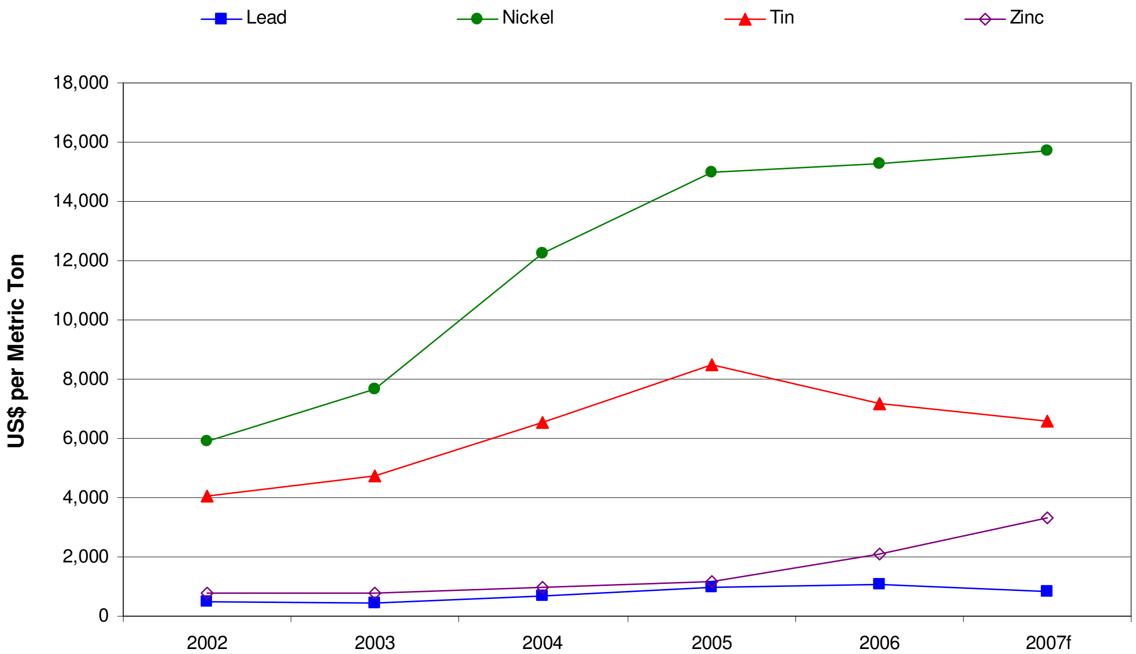


Figure 15 World base metals price movements

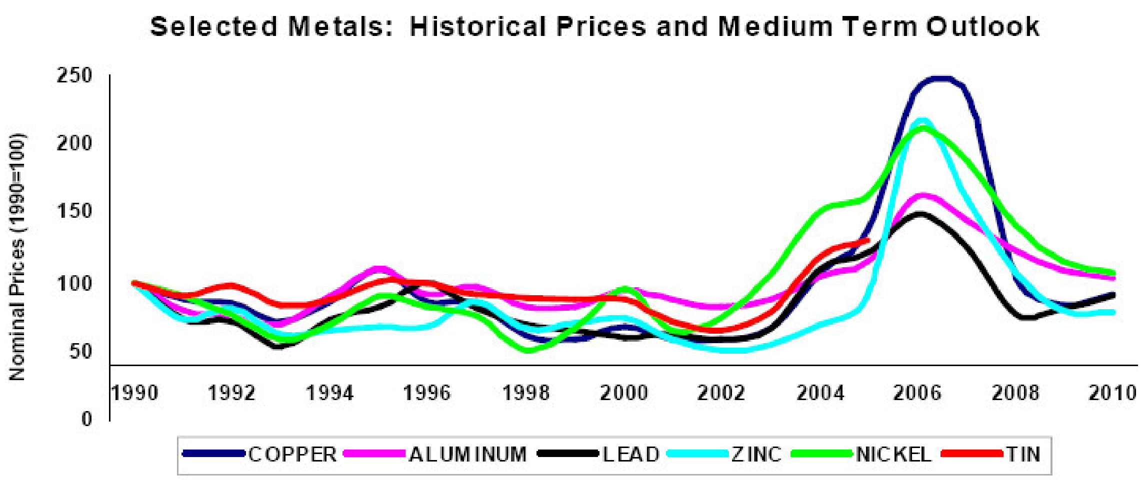


Recent economic growth rates in China and India have been very high and a major factor in the demand for metals. China is currently the largest consumer of all major metals and accounts for more than half of the growth in world demand. The Chinese demand growth has been driven by fast expansion in industrial production, investment in infrastructure, construction, and manufacturing.

Other large developing countries such as Brazil, Indonesia and Russia may also increase in economic importance in coming decades but China and India are by far the most populous developing economies and as such their continued rapid growth impacts largely on the global economy. Led by the strong growth in China, the demand for metals is expected to remain strong in the coming years.

Metal prices are however expected to begin to fall in 2007 and beyond, as production increases and the market moves back to surplus. One of the world's leading metals markets consultants, Commodity Research Unit (CRU), London, summarised the expected outlook on metal prices in a 2006 report to the World Bank Group, as " *… prices are expected to begin to fall back from current levels within the next year or two, but there is some probability that even within the next five years they will not retreat to the average levels of the 1990s.*"

- **Figure 16 Commodity Research Unit (CRU) metal price outlook**[4]



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[4] Sources: Background Paper – The Outlook for Metals Markets. Prepared for G20 Deputies meeting held in Sydney 2006; The World Bank Group. Oil, Gas, Mining and Chemicals Department, Washington, September 2006

5. Influences on Market Prices

5.1 Introduction

It has been apparent that many Australian transmission and distribution networks companies have been reporting rapidly increasing costs of both individual projects (substations and transmission lines), and annual and five year capital works programs covering the full range of capital expenditure.

As part of this research, SKM conducted a multi-utility strategic procurement study in which a total of nine (9) Australian transmission and distribution companies provided confidential contract information for the purchase of their main items of plant equipment and materials (power transformers, switchgear, cables, and conductors) for the period 2002 to 2006. Studies have also been undertaken on contract cost information for a number of turnkey substation and transmission line projects (including plant equipment, materials, construction, testing, and commissioning).

The results of SKM's research indicated that there are a number of factors driving the current rapid rises in capital infrastructure costs. The primary factors influencing cost movements are considered to be changes in market prices for:

- Base metals such as copper and aluminium, and steel;
- Oil;
- Labour;
- Construction; and
- Foreign exchange.

To appreciate the effect these factors have had on project costs, an examination has been made of the historical price movements, together with a review of reputable sources of forecast changes for the period 2007 to 2013.

5.2 Commodity Prices

Over the past 4 years, oil and other non-fuel commodity prices have increased significantly. Whilst the developments in the fuel markets, and in particular oil, have dominated the attention of governments and the public, the increase in commodity prices for copper and aluminium, amongst others, have been greater for the same period.

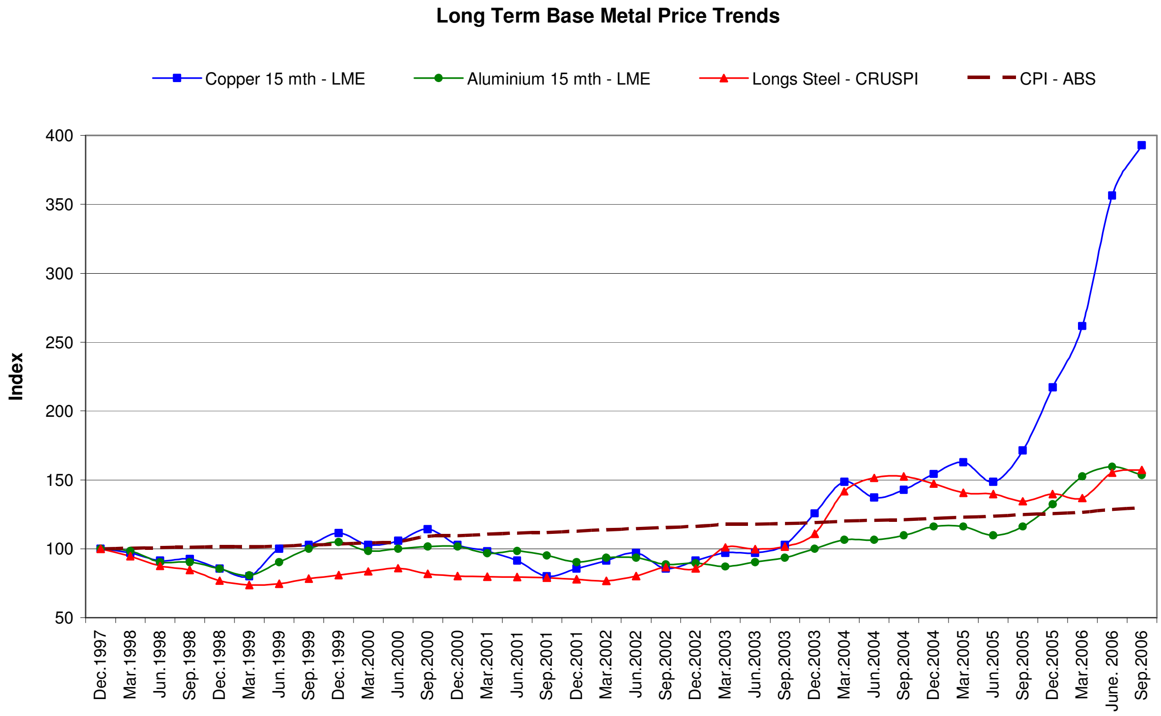
5.2.1 Base Metals

5.2.1.1 Historical Price Movements

Figure 17 below shows the trend in the London Metal Exchange (LME) 15 month contract price for copper and aluminium, as well as the Longs Steel price, all compared with the Australian Consumer Price Index (CPI)[5] over the period December 1997 to September 2006.

It is notable that aluminium and copper prices fell below the 1997 price until the third quarter of 2003, after which, copper has risen to almost 400% of the 1997 price, aluminium over 150% and steel over 200%.

- **Figure 17 Copper, aluminium and steel price trends 1997 - 2006**



5.2.1.2 Future Trends

While demand remains strong, supply concerns have also contributed to high and volatile prices. Many producers, particularly of copper, zinc, and nickel, have been affected by deteriorating ore quality, production disruptions caused by outages and earth slides, and labour disputes. Moreover,

5 Sourced from the Australian Bureau of Statistics (ABS)

global inventories remain at historically low levels, while the introduction of new capacity has been delayed because of high energy and equipment costs and labour shortages.

A surge in investor interest in commodities has come hand in hand with the tightening of market conditions, but empirical analysis by the International Monetary Fund (IMF)[6] suggests that speculative activity (measured as the number of net long non-commercial positions) has followed rather than been the cause of the high price levels. Looking forward, despite an expected capacity increase in metals this year, the tight market situation will probably continue into late 2007 to early 2008, until sufficient new capacity comes into operation

As a result, metal prices are expected to reduce over the medium term as new production comes on-line to meet the rising demand. However, prices may not fall back to their earlier levels, in part due to the higher energy prices and labour costs leading to increased production costs.

The IMF model base forecasts for copper and aluminium prices from 2007 to 2013 are shown in Figure 18 and Figure 20. These projections are based on four elements:

- Demand for each metal estimated as a function of industrial production and the real price for 17 country groups that make up about 90 percent of world metal consumption;
- A production function that incorporates information about planned increases in capacity, drawing on information from the Australian Bureau of Agricultural and Resource Economics (ABARE);
- The gap between supply and demand and fluctuations in the US Dollar (USD), as metal prices are typically expressed in USD; and
- For each of the 17 country groups, an estimate of industrial production and Gross Domestic Product (GDP) growth rates.

These analyses suggest that aluminium and copper prices should moderate over the period to 2013. However, the uncertainties about growth in the global economy and increases in production capacity result in a wide range of estimated prices. The upper and lower limits are shown by the shaded area.

With consideration of the time lag noted between changes in commodity prices and changes in equipment and conductor costs (refer section 3.6), Figure 19 and Figure 21 illustrate these IMF forecasts delayed by two years.

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[6] IMF, *World Economic Outlook*, September 2006

Figure 18 Forecast aluminium prices

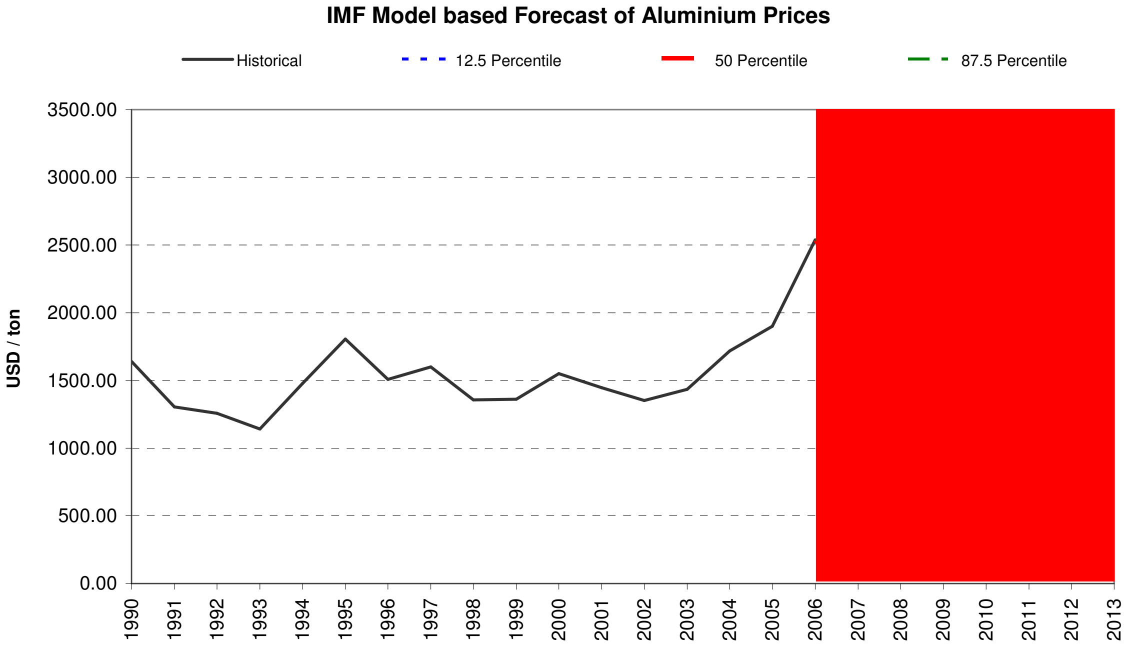
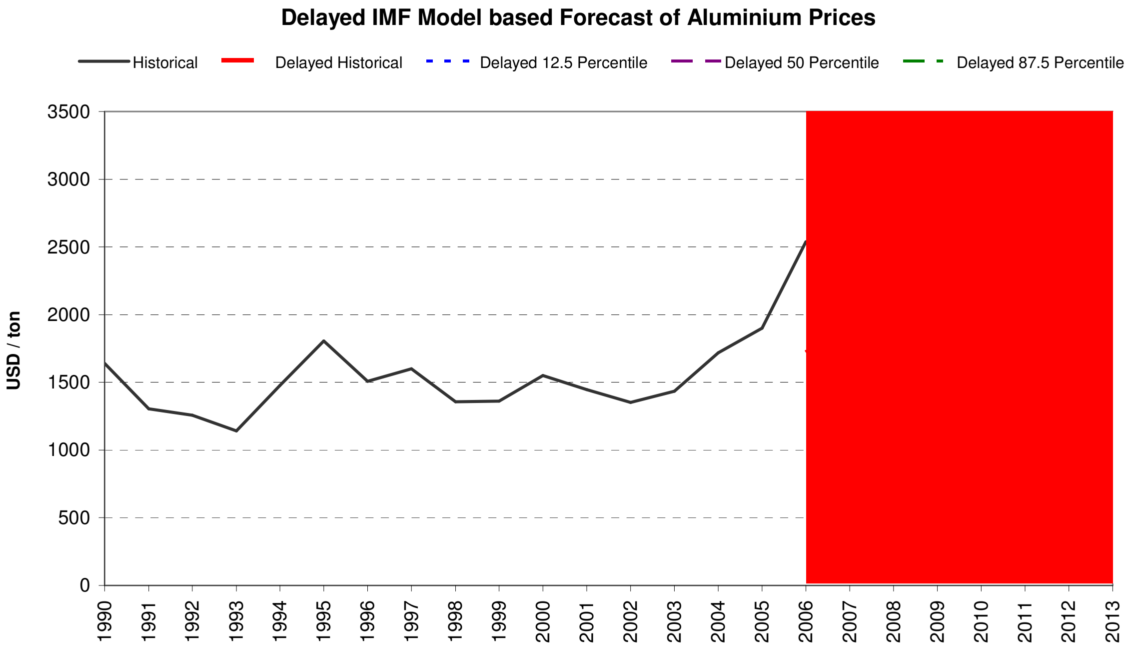
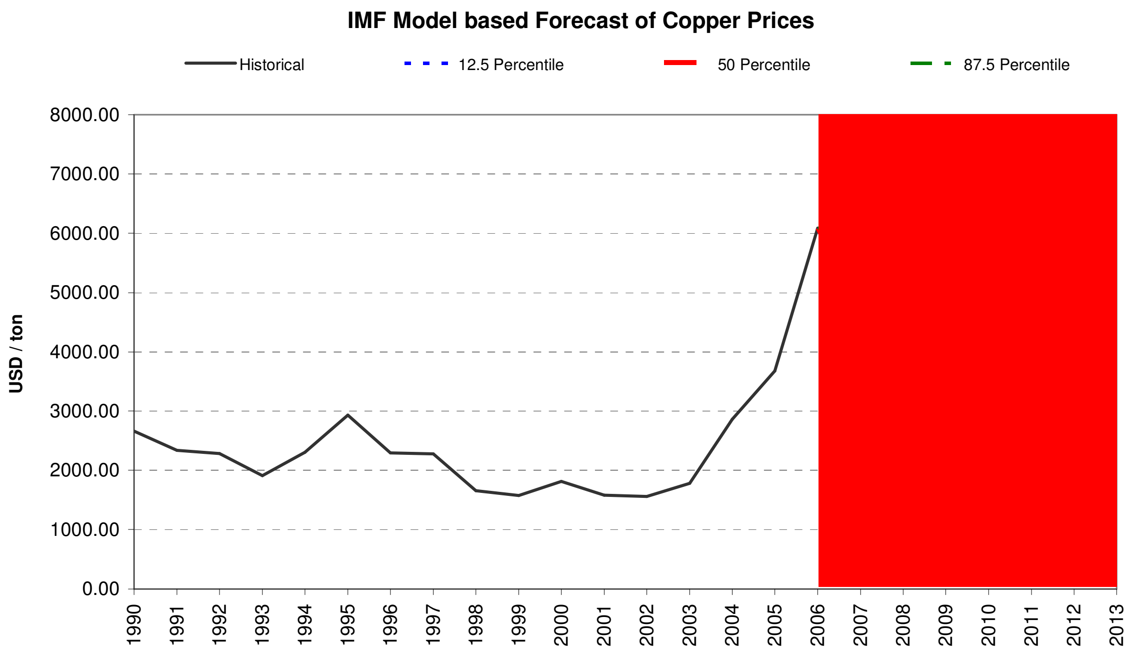


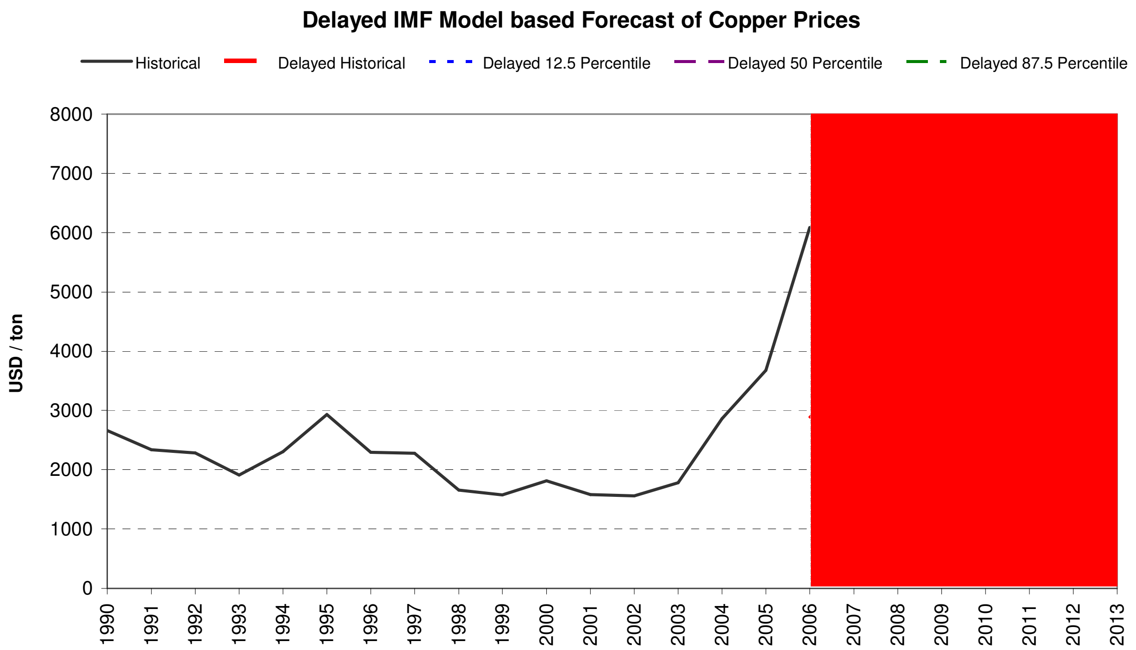
Figure 19 Forecast aluminium prices delayed 2 years



▪ Figure 20 Forecast copper prices



▪ Figure 21 Forecast copper prices delayed 2 years



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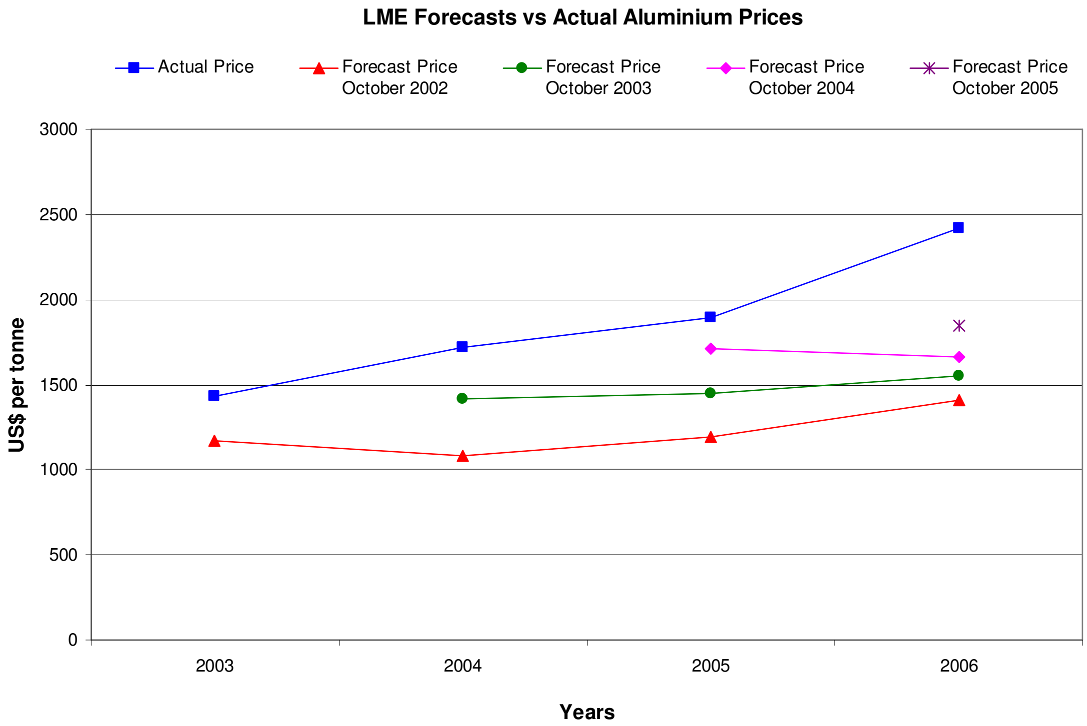
To demonstrate the difficulty in accurately predicting the price movements for commodity prices, Figure 22 illustrates the variance between the forecasts made by the London Metal Exchange between 2002 and 2005 of the projected aluminium price in 2006 with the actual prices recorded.

▪ **Figure 22 Variance between LME forecasts and actual aluminium prices**



The percentage variances between the forecasts and actual prices are shown below. All prices shown are in US$ per tonne.

▪ **Table 4 Percentage variance between LME forecasts and actual prices**

Year	Forecast Price October 2002	Variance to Actual Price	Forecast Price October 2003	Variance to Actual Price	Forecast Price October 2004	Variance to Actual Price	Forecast Price October 2005	Variance to Actual Price	Actual Price
2003	1170	(18.24%)							1431
2004	1084	(36.83%)	1419	(17.31%)					1716
2005	1197	(36.90%)	1450	(23.56%)	1713	(9.70%)			1897
2006	1407	(41.86%)	1555	(35.74%)	1660	(31.40%)	1848	(23.64%)	2420

As would be reasonably expected, the accuracy of the forecasts improved as the time between the date of the forecast and the projected year narrowed, but there remained about a 20% variance which understated the price.

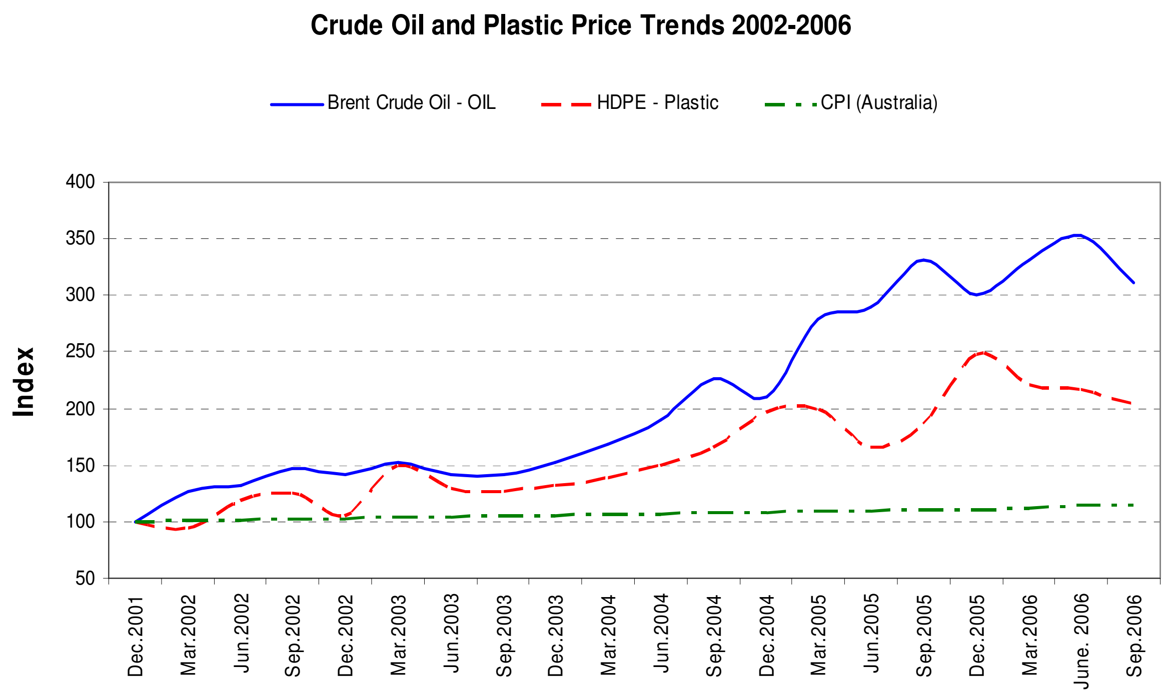
Therefore, SKM is of the view that to use the 50 percentile forecast figures shown in Figure 18 and Figure 20 would be most likely too conservative and understate the values for aluminium and copper. For this reason, SKM has chosen the 87.5 percentile values for use in its forecast modelling for the period 2006 to 2013.

5.2.2 Crude Oil and Plastics

5.2.2.1 Historical Price Movements

Figure 23 below shows the trend in the Brent Sea Sweet Crude Oil price, which is generally accepted as the worldwide benchmark of crude oil prices. In addition, the HDPE – Plastics index[7] is illustrated, which is a spot market for low grade plastic.

- **Figure 23 Oil and plastic trends 2002 - 2006**



[7] Sourced from the Plastics Exchange

5.2.2.2 Future Trends

In its long term strategy, the Organization of the Petroleum Exporting Countries (OPEC) recognizes the major uncertainties surrounding the future demand for oil stems from future world economic growth, and various countries' policies and technology development. OPEC have prepared a number of scenarios, based on a continuation of current world economic conditions, a strengthened demand and a softening of market conditions. These scenarios resulted in the projected amount of oil to be supplied by OPEC over the next 10 to 15 years could range by as much as 10 mbd[8] or more (potentially between 97 and 108 mbd in 2019).

However in reviewing this broad range of future demand for oil, OPEC considered that " … *in meeting the future growth of world oil demand, oil resources are large and sufficient, and oil supply will not peak within the considered timeframe* [to 2020]. *Moreover, the size of the global upstream investment challenge will not be markedly different from the past, despite the growing volumes, as capital will be increasingly used more efficiently in lower cost OPEC Countries. Over the longer-term, OPEC will be relied upon to supply most of the incremental barrel demanded.*

… The strategy re-emphasises OPEC's commitment to support oil market stability. It builds upon the fundamental recognition that extreme price levels, either too high or too low, are damaging for both producers and consumers, and points to the necessity of being proactive under all market conditions. Oil price volatility renders all the more difficult the interpretation of price signals, whether they are an indication of structural change or a reflection of temporary phenomena, and thereby affecting the ability to support longer-term market stability. Given the dynamic and complex behaviour of oil markets, there is a need to support fair and stable prices, sustainability of supply, and security of demand.

In a tight market environment, too high oil price levels may affect the prospects for economic growth, especially in developing countries, and therefore threaten future oil demand growth. On the other hand, low oil price levels would place strains upon the aspirations of OPEC Member Country populations for their economic development and social progress."[9]

It appears that OPEC will continue to remain in a position to meet world market demand, although the cartel retains a largely unchallenged ability to affect prices. SKM has used forecasts for possible oil prices in the period to 2013 provided by ABARE and the World Bank which have speculated that oil prices will effectively decrease.

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[8] Million barrels per day

[9] Organization of Petroleum Exporting Countries, *Long-Term Strategy*, March 2006, pp 13,17

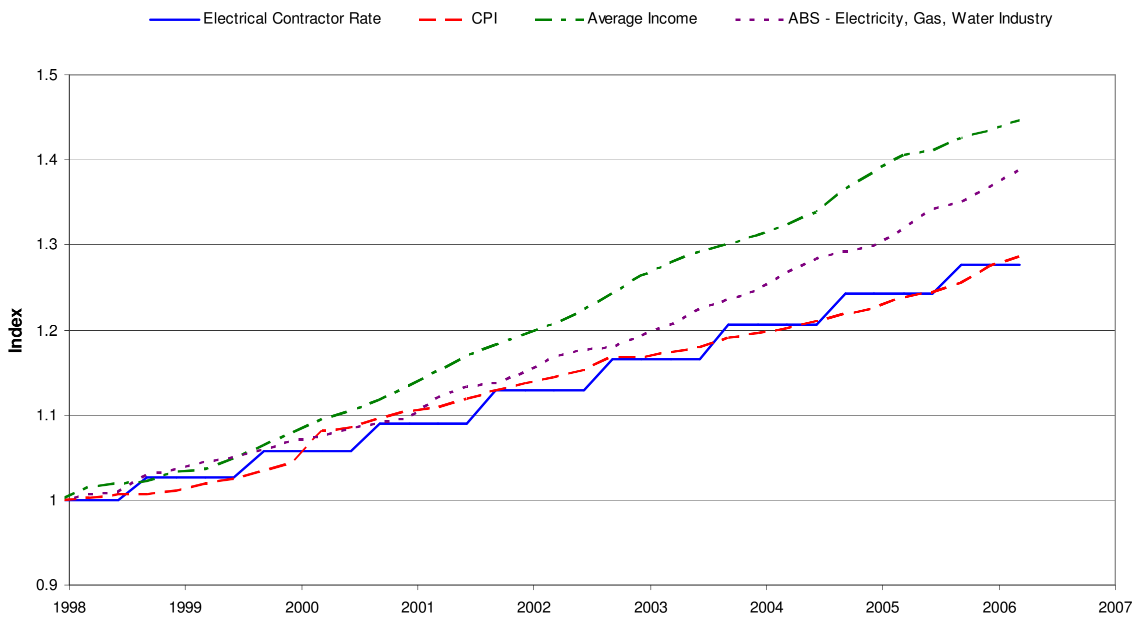
5.2.3 Labour Costs

5.2.3.1 Historical Price Movements

Figure 24 below shows the trend in average Australian weekly earnings, an indicative average electrical award rate for federally determined awards (South Australia, Victoria, Tasmania and ACT) and historical electricity, gas and water industry labour rates (provided by the ABS), compared with CPI.

All three graphs are shown relative to a 100% index value at December 1997.

- **Figure 24 Australian normalised labour rate index**



It is evident that the rate of increase of electrical award payments from 1997 to 2006 tracked the CPI index quite closely, finishing marginally ahead of CPI. However, the average Australian weekly earnings have grown at a higher rate than both electricity industry awards and CPI.

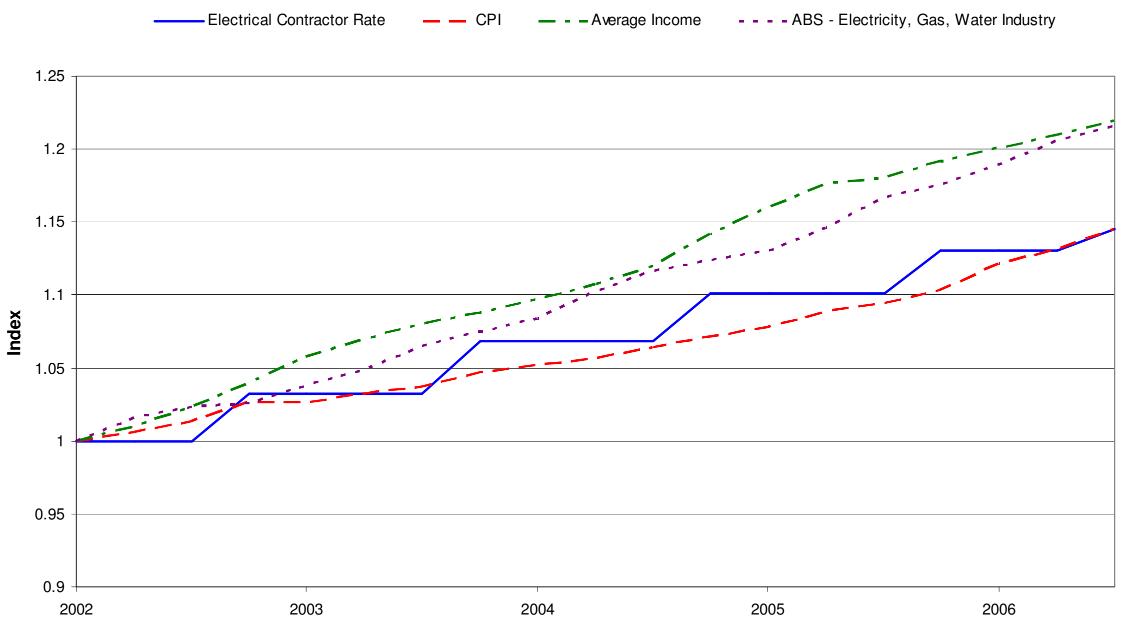
This latter observation is most likely a combination of two factors:

- An increase in average working hours per week, and
- Increasing over award payments.

There has been considerable discussion and speculation in industry and economic circles about the skills shortage in Australia and a number of the manufacturers / suppliers have suggested to SKM that the wages and salaries that must be paid to secure labour, both skilled and unskilled, has been increasing rapidly.

Figure 25 illustrates the trend in Australian average weekly income, compared with the mix of electrical awards, the electrical contractors' rate and CPI referenced to 2002 (the commencement of the current SP AusNet regulatory period).

- **Figure 25 Australian normalised labour rate index - reference 2002**



Since 2002, average weekly income, ABS and the portfolio of electrical awards have all exceeded CPI by the following amounts (as at March 2006):

- average weekly income by 8.00%;
- ABS by 6.46%; and
- electrical awards by 2.41%.

5.2.3.2 Future Trends

The 2006/07 Federal Budget included the following commentary in regards to future trends in labour costs, stating that " … .*Wage growth is forecast to remain solid in the near term, as the effects of tight conditions in the labour market in 2004-05 flow through to wages. However, with employment growth forecast to moderate, the recent momentum in wage growth should ease in 2006-07. The Wage Price Index is forecast to increase by 4 per cent in 2006-07, similar to the growth expected for 2005-06. Businesses continue to report skill shortages, but to date this has not led to significant generalised wage pressures. Strong labour demand in the mining and mining-related sectors may see wages grow temporarily faster in those areas, but they are unlikely to have a noticeable impact on aggregate wage outcomes given the relatively low share of the mining* *sector in total employment. There is a risk that strong wage growth in the mining, construction, health and education sectors over the past year may continue and lead to more widespread wage pressures.*"[10]

In a report commissioned by the Australian Energy Regulator, Access Economics noted that " … *after remaining close to the expected "long-term" rate of 4¼% until 2003-04, wage growth in the utilities sector has leapt sharply in the past few years, even as productivity levels have reversed … wages growth in the first few years* [from 2005/06] *is likely to remain relatively strong due to the current skills shortages prevalent in the utilities sector. These shortages are not caused solely by growth in the sector itself, but have flowed from the strength in other sectors - notably construction - in recent years and a similar shortage in the mining sector. Shortages in the construction sector from mid-2002 saw sharp short-term increase in wage growth which began to stabilise in mid-2005, partly as workers were drawn from other industrial sectors …* [it is expected] *the current surge in (relative) utilities sector wage growth would last for a similar period of time, keeping growth in utilities sector wages high compared to the broader economy. The gap* ***may*** *close slightly as overall wages growth picks up in response to changes in underlying inflation rates and a generally tight labour market.*"[11]

SKM noted that the annual nominal wages growth projected by Access Economics for the utilities sector on a national basis was higher than Reserve bank projections for CPI over the same period.

The SKM projections for labour increases have been based on forecasts from the Australian Treasury with a differentiation between general labour (regarded as design, project management and approvals) and site labour responsible for on-site construction. SKM would consider the bulk of work undertaken by a utility as "site labour".

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[10] Australian Government, *Budget Paper No. 1 Budget Strategy and Outlook 2006-07 - Statement 3: Economic Outlook*, section 3-27, pp 29

[11] Access Economics, *Wage growth forecasts in the utilities sector*, 17 November 2006, pp i

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▪ **Table 5 Annual labour escalation forecasts vs CPI - reference 2006**

Source	2006	2007	2008	2009	2010	2011	2012	2013
Access Economics[12]	1.000	1.059	1.114	1.152	1.191	1.238	1.280	1.324
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General Labour	1.000	1.040	1.082	1.122	1.164	1.208	1.253	1.300
Site Labour	1.000	1.054	1.100	1.148	1.199	1.252	1.307	1.365
CPI	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189

It can be seen that the labour forecast developed independently by SKM compares favourably with the Access Economics projections, with labour costs expected to escalate at a rate well in excess of CPI.

5.2.4 Construction Costs

5.2.4.1 Historical Price Movements

- Over the period of time 2002-2006, the cost of installed structural steelwork has almost doubled. Applying data from Rawlinsons Australian Construction Cost Handbook[13], the movement in erected steelwork was in excess of 80%. This number is supported by an increase in Longs Steel index over this same period.
- A similar review of Rawlinsons data for concrete foundations, suggests that this component of substation and transmission line costs has increased by approximately 24.2% over this period.
- Data from the Australian Bureau of Statistics indicates that non-residential construction costs have been increasing more rapidly than CPI. As seen below in Figure 26, over the past 8 years the average Australian costs have risen almost 20% more than CPI. Victoria's increases have lagged behind the national average over the past year, resulting in increases about 8% more than CPI over the 8 year period.

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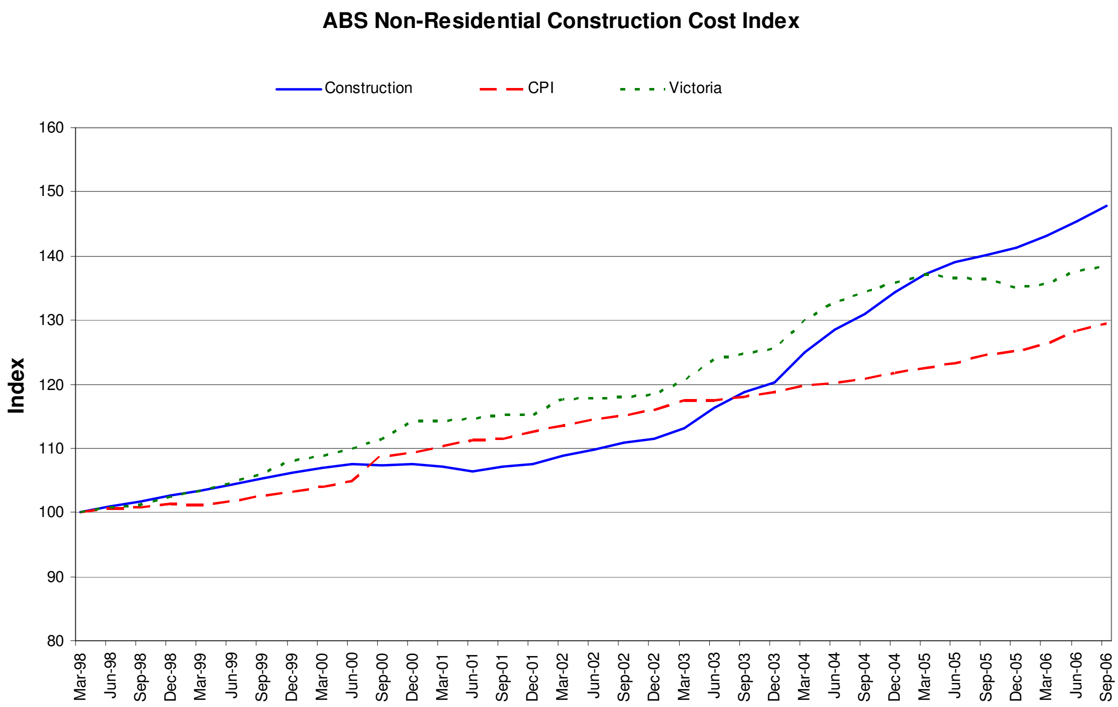
[12] Access Economics, *Wage growth forecasts in the utilities sector*, 17 November 2006, pp iii. Data based on projected national annual nominal wages growth and calculated as year-on-year accumulation relative to 2006/07.

[13] Rawlhouse Publishing Pty Ltd, *Rawlinsons Australian Construction Cost Handbook*, various editions 2003 to 2005

■ **Figure 26 Non-Residential construction costs**



5.2.4.2 Future Trends

A recent market survey has forecast a continuation of strong engineering and commercial (non-residential) construction activity in Australia, fuelled by an upturn in Government spending on infrastructure, strong resources investment and sustained economic growth.

An Australian Industry Group (Ai Group) – Australian Constructors Association (ACA) Construction Outlook survey has suggested that total construction work is expected to increase by 7.7% in 2006/07. The growth is in line with a solid project pipeline for the engineering construction sector, including work on infrastructure projects, such as private road and rail projects and electricity construction. The survey also recorded strong expansion in the mining construction sector, consistent with buoyant resources investment.

With the commercial and industrial property sectors continuing to exhibit strength, a sustained upturn is also expected in non-residential building through 2006/07, although growth is set to moderate on current levels.

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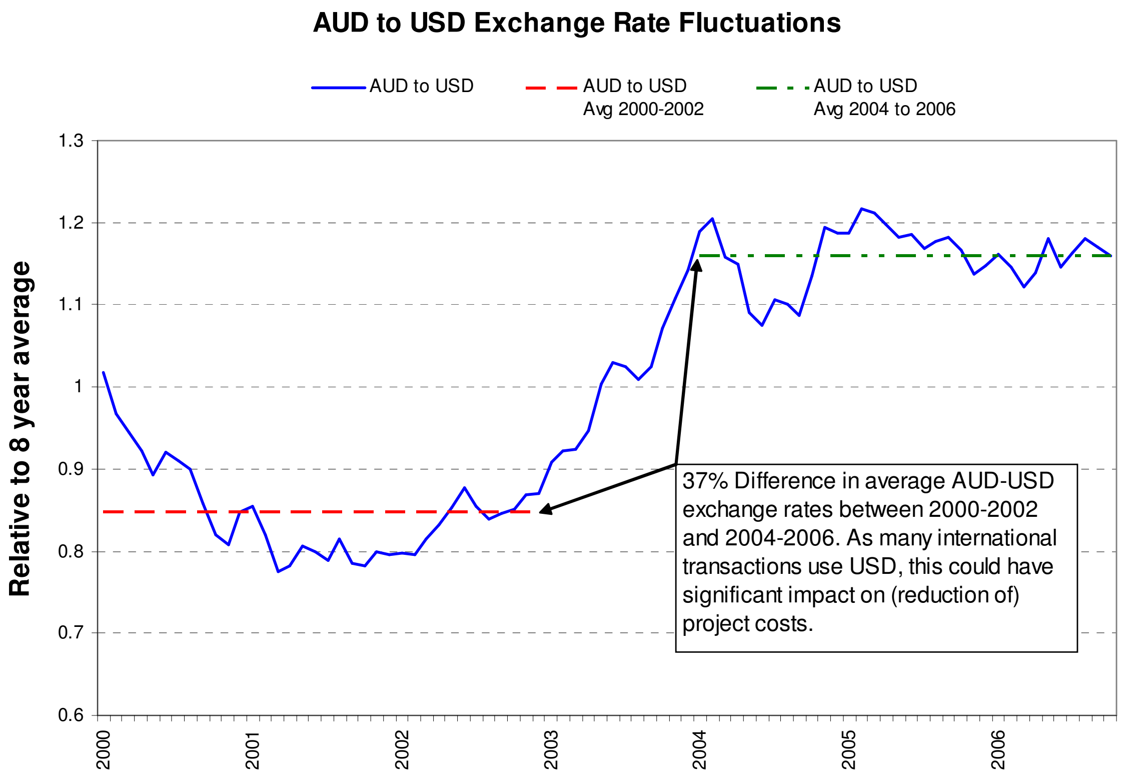
5.3 Foreign Exchange Rates

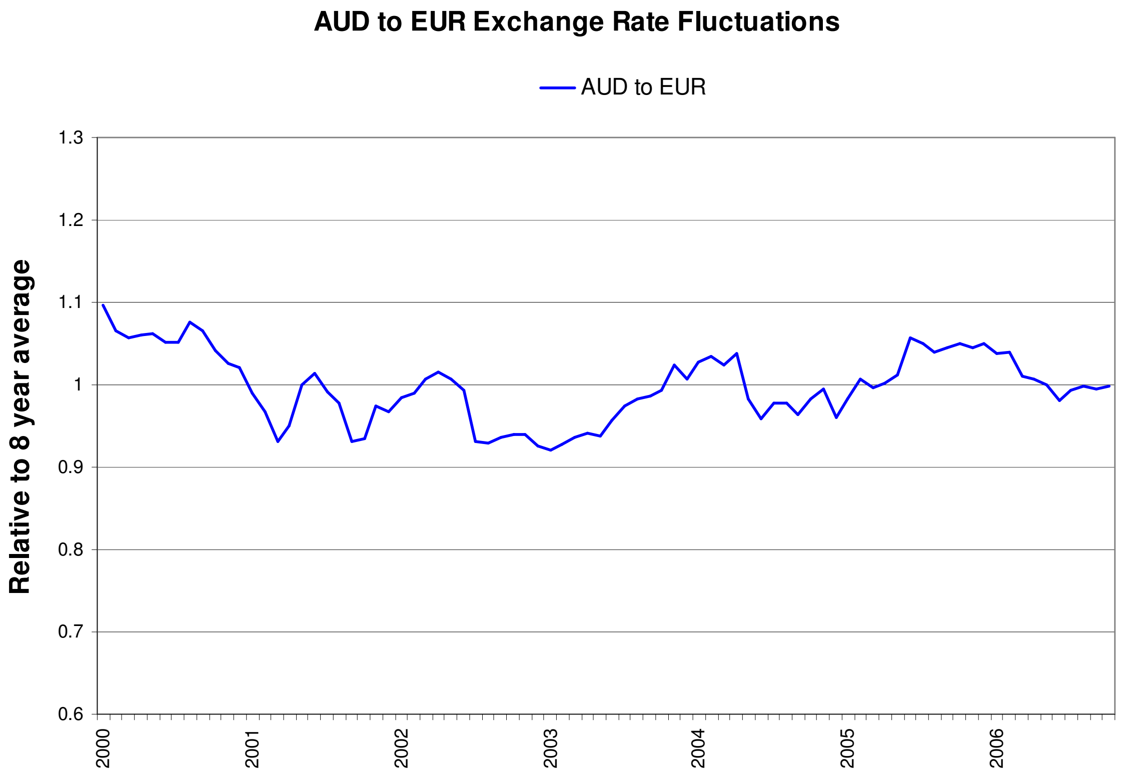
While there have always been fluctuations in foreign rates, there has been significant variation within the last decade. In particular the US Dollar to Australian rate has changed by 37% when looking at 3 year averages as seen in Figure 27 below. The US Dollar is important as it is often used as the basis for international transactions. Figure 28 shows that the exchange rate between the Australian Dollar and the Euro has been much more stable over the same period of time.

Foreign exchange has been considered as a factor affecting the cost of plant and equipment that is typically imported into Australia from overseas manufacturers. The two currencies examined in Figure 27 and Figure 28 are those SKM considers would be mostly commonly used in such transactions.

- **Figure 27 USD foreign exchange rates**



▪ **Figure 28 Euro exchange rate**



5.4 Supply-and-Demand Influence

There is evidence available suggesting that some electrical plant and equipment suppliers are receiving higher profit margins due to supply and demand pressures in the market, resulting form production rates not matching increased demand, particularly from emerging markets in Asia.

Whilst it is generally accepted throughout the industry that this is a likely influence on the prices being requested for equipment, it is not possible to accurately estimate the quantum of the impact. Some evidence that has been provided to SKM has suggested that this impact could be of the order of 15 to 20 per cent premium on labour and overhead prices (including profit margins).

SKM is of the view that in appraising the impact of fluctuations in commodity prices and other external price drivers, there is also a market influence on costs resulting from pressure on existing production capabilities. This influence is not reflected in any of the commodity price indices or forecast construction indices, but has been included as in factor in the site labour forecasts.

5.5 Projected Escalation Factors

Escalation factors have been calculated using production, demand and cost projections for commodity and financial items drawn from the following sources[14]:

- Australian Bureau of Statistics (ABS);
- ABARE;
- World Bank;
- Reserve Bank of Australia;
- International Monetary Fund;
- Australian Treasury department;
- Banking institutions from the United States; and
- Union organisations.

Projections for CPI are based on expectations for price movements and economic effects outlined in the Federal Budget of 2006/07. Whilst the Budget included a forecast of 2.5% to June 2007 only, the budget papers discuss international and domestic pressures on inflation in Australia and conclude that there is a reasonable expectation that it should remain around this level, at least for the short term. The monetary policy released by the Reserve Bank of Australia in November 2006 generally supported this conclusion, observing that " *... the generalised price pressures currently evident in the economy are likely to continue in the near term. The central forecast is that underlying inflation will remain at around 3 per cent over the next year. Thereafter, it may decline slightly but is likely to remain near the top of the target band* [of 2 - 3%]."[15]

Detailed accumulative and annual escalation forecasts for the base metal commodity prices, labour and other financial indicators are included in Appendix B.

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[14] More details of these forecast sources are contained in Appendix A

[15] Reserve Bank of Australia, *Statement on Monetary Policy*, 13 November 2006, pp 59

6. Relative Impact of Escalation Factors

Table 6 shows the relative impact that SKM considers applies to each of the components within the cost for substation switchbays and power transformers, overhead lines and underground cables.

- **Table 6 Substation components**

Component (based on standard SKM substation switchbay configurations)	Cost Factor									Delayed Cost Factor			
	Fixed costs[16]	Aluminium	Copper	Steel	Oil	General labour[17]	Site labour	CPI	Foreign exchange	Aluminium	Copper	Steel	Oil
Switchgear	-	-	3%	-	2%	-	20%	20%	50%	-	3%	-	2%
Transformers	44%	-	-	-	-	-	-	34%	-	-	10%	9%	4%
Structure	-	-	-	50%	-	-	50%	-	-	-	-	-	-
Foundations	-	-	-	-	-	10%	80%	10%	-	-	-	-	-
Civil	-	-	-	-	-	10%	80%	10%	-	-	-	-	-
Protection & Control	-	-	-	-	-	20%	50%	30%	-	-	-	-	-
Erection	-	-	-	-	-	-	100%	-	-	-	-	-	-
Commissioning	-	-	-	-	-	-	100%	-	-	-	-	-	-
Misc material	20%	-	-	-	-	30%	-	50%	-	-	-	-	-

Delayed cost factor applies where cost factor movement in base material / metal has a lag period before this is reflected in the assembled / manufactured components (can be 1 to 2 years).

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16 Fixed component covers fixed costs such as production facilities, rent, administration and delivery.

17 General labour relates to design, project management and approvals

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Table 7 Overhead AAC/AAAC transmission line components

Component (based on standard SKM transmission line components)	Cost Factor									Delayed Cost Factor			
	Fixed costs[18]	Aluminium	Copper	Steel	Oil	General labour[19]	Site labour	CPI	Foreign exchange	Aluminium	Copper	Steel	Oil
Conductor	5%	-	-	-	-	-	10%	20%	-	60%	-	5%	-
Earthwire	5%	-	-	-	-	-	10%	20%	-	60%	-	5%	-
Towers	-	-	-	50%	-	-	50%	-	-	-	-	-	-
Insulators	-	-	-	-	-	-	50%	50%	-	-	-	-	-
Fittings	-	-	-	-	-	-	50%	50%	-	-	-	-	-
Foundations	-	-	-	-	-	10%	80%	10%	-	-	-	-	-
Erection	-	-	-	-	-	-	100%	-	-	-	-	-	-

Table 8 Underground cable components

Component (based on standard SKM underground cable components)	Cost Factor									Delayed Cost Factor			
	Fixed costs	Aluminium	Copper	Steel	Oil	General labour	Site labour	CPI	Foreign exchange	Aluminium	Copper	Steel	Oil
Cable Al	20%	10%	-	-	-	-	10%	10%	-	45%	-	-	5%
Cable Cu	20%	-	10%	-	-	-	10%	10%	-	-	45%	-	5%
Pits	-	-	-	-	-	10%	80%	10%	-	-	-	-	-
Cable joints	20%	-	-	-	-	30%	-	50%	-	-	-	-	-
Cable terminations	20%	-	-	-	-	30%	-	50%	-	-	-	-	-
Installation	-	-	-	-	-	-	100%	-	-	-	-	-	-

18 Fixed component covers fixed costs such as production facilities, rent, administration and delivery.

19 General labour relates to design, project management and approvals

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7. Price Impacts on Electrical Plant

Based on the relative impact of the cost drivers for each network component, Table 9 summarises the accumulative escalation factors for the period between 2006 and 2013.

Detailed tables for accumulative and annual escalation factors are included in Appendix C. The projected factors for substations, transmission lines and cables and their components are nominal; that is, they apply in the year in which they have been forecast to occur.

Table 9 Accumulative escalation factors to 2013 - reference 2006

Component	2006	2007	2008	2009	2010	2011	2012	2013
Substation[20]	**1.000**	**1.038**	**1.074**	**1.098**	**1.119**	**1.145**	**1.171**	**1.200**
Switchgear	1.000	1.035	1.086	1.096	1.098	1.105	1.111	1.120
Transformers	1.000	1.058	1.215	1.197	1.139	1.105	1.087	1.083
Structure	1.000	1.014	0.970	0.958	0.941	0.947	0.953	0.960
Foundations	1.000	1.049	1.093	1.139	1.187	1.236	1.288	1.342
Civil	1.000	1.049	1.093	1.139	1.187	1.236	1.288	1.342
Protection & Control	1.000	1.043	1.082	1.123	1.165	1.208	1.254	1.301
Erection	1.000	1.054	1.100	1.148	1.199	1.252	1.307	1.365
Commissioning	1.000	1.054	1.100	1.148	1.199	1.252	1.307	1.365
Misc material	1.000	1.025	1.051	1.077	1.104	1.132	1.160	1.190
Overhead Line[21]	**1.000**	**1.040**	**1.073**	**1.085**	**1.093**	**1.114**	**1.138**	**1.166**
Conductor	1.000	1.148	1.121	1.085	1.065	1.052	1.055	1.061
Earthwire	1.000	1.148	1.121	1.085	1.065	1.052	1.055	1.061
Towers	1.000	1.014	0.970	0.958	0.941	0.947	0.953	0.960
Insulators	1.000	1.040	1.076	1.114	1.153	1.194	1.236	1.280
Fittings	1.000	1.040	1.076	1.114	1.153	1.194	1.236	1.280
Foundations	1.000	1.049	1.093	1.139	1.187	1.236	1.288	1.342
Erection	1.000	1.054	1.100	1.148	1.199	1.252	1.307	1.365
Underground Cable Aluminium	**1.000**	**1.082**	**1.098**	**1.115**	**1.139**	**1.165**	**1.200**	**1.236**
Underground Cable Copper	**1.000**	**1.155**	**1.160**	**1.145**	**1.149**	**1.172**	**1.202**	**1.234**
Cable Al	1.000	1.129	1.094	1.060	1.038	1.022	1.021	1.024
Cable Cu	1.000	1.396	1.303	1.136	1.029	0.980	0.953	0.924
Installation	1.000	1.054	1.100	1.148	1.199	1.252	1.307	1.365

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[20] Based on a selected number of 66,132,220 and 275kV substation bays

[21] Based on sample of 132,220 and 275kV transmission lines

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- **Table 10 Annual escalation factors to 2013 - reference 2006**

Component	2006 - 2007	2007 - 2008	2008 - 2009	2009 - 2010	2010 - 2011	2011 - 2012	2012 - 2013
Substation	**1.038**	**1.035**	**1.022**	**1.019**	**1.023**	**1.023**	**1.025**
Switchgear	1.035	1.049	1.009	1.002	1.006	1.005	1.009
Transformers	1.058	1.148	0.985	0.952	0.970	0.984	0.996
Structure	1.014	0.956	0.988	0.982	1.006	1.007	1.008
Foundations	1.049	1.042	1.042	1.042	1.042	1.042	1.042
Civil	1.049	1.042	1.042	1.042	1.042	1.042	1.042
Protection & Control	1.043	1.038	1.037	1.038	1.038	1.038	1.038
Erection	1.054	1.044	1.044	1.044	1.044	1.044	1.044
Commissioning	1.054	1.044	1.044	1.044	1.044	1.044	1.044
Misc material	1.025	1.025	1.025	1.025	1.025	1.025	1.025
Overhead Line	**1.040**	**1.032**	**1.011**	**1.008**	**1.019**	**1.021**	**1.025**
Conductor	1.148	0.977	0.968	0.982	0.987	1.003	1.006
Earthwire	1.148	0.977	0.968	0.982	0.987	1.003	1.006
Towers	1.014	0.956	0.988	0.982	1.006	1.007	1.008
Insulators	1.040	1.035	1.035	1.035	1.035	1.035	1.035
Fittings	1.040	1.035	1.035	1.035	1.035	1.035	1.035
Foundations	1.049	1.042	1.042	1.042	1.042	1.042	1.042
Erection	1.054	1.044	1.044	1.044	1.044	1.044	1.044
Underground Cable Aluminium	**1.082**	**1.015**	**1.016**	**1.021**	**1.024**	**1.029**	**1.031**
Underground Cable Copper	**1.155**	**1.005**	**0.987**	**1.003**	**1.020**	**1.026**	**1.027**
Cable Al	1.129	0.969	0.969	0.979	0.984	0.999	1.002
Cable Cu	1.396	0.934	0.872	0.906	0.953	0.972	0.969
Installation	1.054	1.044	1.044	1.044	1.044	1.044	1.044

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8. Brownfield Construction Factors

In investigating previous transmission project estimates, SKM developed a selected number of brownfield factors to reflect staged construction of assets in substations. These brownfield adjustments were based on a comparison of the labour hours typically included in an asset valuation building block, and actual labour hours recorded by an Australian TNSP for a limited number of contracts.

In developing the capital expenditure forecast, it will be necessary to allow for project specific conditions within the SP AusNet network that will have a direct impact on the final project estimate. These will most likely vary from site to site.

- **Table 11 SKM substation indicative brownfield factors**

Asset type	Brownfield Factor
132,275kV switchbays	1.23
11,33,66kV switchbays	1.29
CBs, CTs, VTs (all voltages)	1.10
275kV 160MVA transformer	1.018
275kV 225MVA transformer	1.016
132kV 10MVA transformer	1.067
132kV 25MVA transformer	1.054
132kV 60MVA transformer	1.038
Capacitor banks, reactors	1.018 - 1.067
Static VAr Compensators (SVCs)	1.018

Essentially, these brownfield factors demonstrate the increased costs, predominately increased labour costs, which stem from having to construct / reconstruct assets within the confines of a live substation. These extra costs arise from things such as forward / reverse switching, man-handling tools and equipment in a live substation, temporary works and generally lower productivity levels.

It should be noted that the SKM brownfield factors shown above relate to substation bays that are constructed as an extension to, or within an existing live substation. This is quite a different situation to that faced by SP AusNet, whereby many of their refurbishment projects involve the partial or full reconstruction of whole substations while maintaining adequate security of supply. Such reconstructions involve multiple stages of rebuild and associated higher engineering design and drafting costs, as well as the higher on-site construction costs. SKM would expect the brownfield factors associated with the type of refurbishment / reconstruction projects faced by SP AusNet to be significantly higher than those shown in Table 11.

9. Sample 2006 Switchbay Costs

SKM has provided a selected number of comparative estimates, which have incorporated the escalation factors determined for base metals and labour. The reference date for these estimates is 30 June 2006. The standard SKM switchbay configurations are based on a modern equivalent reference asset, which assumes average conditions for construction difficulty.

These building blocks are based on a large volume installation (typically 10 substation bays), as opposed to a one-off construction as may be more usual for capital expenditure projects.

These estimates include:

- any applicable indirect taxes (but are exclusive of GST);
- indirect costs associated with the acquisition and/or creation of the asset such as:
  - on-costs;
  - design and engineering costs;
  - project management;
  - freight; and
  - local delivery.

The labour rate applied is $81 per hour, and is based on wage rates established within the Power and Energy Industry Electrical, Electronic & Engineering Employees Award 1998 (updated 22 February 2006) and market average overheads and on-costs.

- **Table 12 Summary of SKM switchbay estimates**

Voltage	SP AusNet standard bay	SKM equivalent standard bay	Estimated Value as at 30 Jun 2006 ($k)
66kV	TM Single CB	Feeder incl CB	$ 423.03
132kV	TM Single CB	Feeder incl CB	$ 672.09
275kV	TI One & a Half CB	1.5 CB layout 3 CB	$ 3,226.96
275kV	TJ Double CB	Double Bus 2 CB	$ 1,969.90

SKM notes that the standard construction practices adopted by SP AusNet use similar switchgear, particularly circuit breakers, for both 220kV and 275kV installations. Similarly, the costs for 66kV bays will be dependent upon the nature of particular substation design and construction requirements.

The details of the estimates are included in Appendix D.

Appendix A Data Sources

SKM has used historical and forecast information that is publicly available from independent Australian and international authorities. The data sources used in the development of escalation factors were:

Historical

- Australian Bureau of Statistics (ABS)
- Reserve Bank of Australia
- London Metal Exchange (LME)
- CRU Group

Forecast

- Australian Government - Department of Treasury
- Australian Bureau of Agricultural and Resource Economics (ABARE)
- International Monetary Fund (IMF)
- World Bank
- Wachovia Corporation

In making use of the different forecasts available, SKM has applied weighting factors to give increased reliance to more recent documents, and forecasts considered to be more relevant to the Australian economy.

Also, SKM has relied upon contract price information provided under confidentiality arrangements for switchgear, transformers, overhead conductor and underground cable. The survey related to both distribution and transmission equipment and was conducted between February and September 2006.

A.1 Historical Data

A.1.1 Australian Bureau of Statistics

The Australian Bureau of Statistics (ABS) is Australia's national statistical agency, and has a key central role in expanding and improving the range of statistics available on the performance of the Australian economy, the well-being of the population, the condition of the environment, and the challenges faced by regional and rural communities.

The ABS collects, compiles, analyses and disseminates a wide range of statistics, and works with other federal, state and local government agencies to help them do likewise, with the vast array of data collected during the course of administrative processes.

The ABS:

- maintains an internet web site with a wide range of freely available statistics;
- design and conduct the five yearly national Census of Population and Housing;
- design and conduct complex surveys such as the Household Expenditure Survey and the Economic Activity Survey from which national economic indicators are derived;
- analyse and release the data collected to provide statistics, which are widely used by governments and businesses; and
- provide statistical consulting, modelling and data analysis, training and support .

SKM has used ABS historical data for labour wage indices and CPI figures (weighted average of 8 capital cities).

A.1.2 Reserve Bank of Australia

The Reserve Bank of Australia's (RBA) main responsibility is monetary policy. Policy decisions are made by the Reserve Bank Board, with the objective of achieving low and stable inflation over the medium term. Other major roles are maintaining financial system stability and promoting the safety and efficiency of the payments system. The Bank is an active participant in financial markets, manages Australia's foreign reserves, issues Australian currency notes and serves as banker to the Australian Government.

The information provided by the Reserve Bank includes statistics - interest rates, exchange rates and money and credit growth - and a range of publications on its operations and research.

Whilst most the data publicly available and reviewed by SKM was historical in nature, we have also examined and incorporated projections from the Reserve Bank in any general monetary statements that have been released. The historical information has been considered to be very reliable, and SKM has considered that some of the data contained in forecasts in the monetary statements may be speculative, and have therefore used RBA projections in conjunction with other authorities.

A.1.3 London Metal Exchange

The London Metal Exchange (LME) is one of the world's premier non-ferrous metals market with highly liquid contracts and a worldwide reputation.

The primary roles of the LME are:

- Hedging - providing a market where participants, primarily from non-ferrous base metal and plastics-related industries, have the opportunity to protect against risks arising from movements in base metals and plastics prices.

- Pricing - providing reference prices which are accepted globally and widely used in the non-ferrous metals and plastics industries for benchmarking.
- Delivery - providing for appropriately located storage and delivery facilities to enable market participants to make or take physical delivery of approved brands of LME traded contracts.

The London Metal Exchange has historical LME prices and other data for all contracts traded on the Exchange.

SKM has made use of historical data in relation to copper and aluminium prices between 2000 and 2006. This data is considered to be highly reliable.

A.1.4 CRU Group

CRU is an independent business analysis and consultancy group focused on the mining, metals, power, cables, fertilizer and chemical sectors. Founded in the late 1960s and still privately owned to ensure its independence, the group employs more than 150 experts in London, Beijing, Sydney and key centres within the United States.

CRU do not make forecasts publicly available, but SKM has made use of their steel price index from 2000.

A.2 Forecasts 2008 to 2013

A.2.1 Australian Government - Department of Treasury

Since its inception in 1901 following federation, Treasury was required to establish policy in areas such as public service pay and conditions, bank notes, the taxation system including land and income tax, pensions and other welfare payments, postage stamps and the collection of statistics. Today, the department focuses primarily on economic policy.

The department is divided into four groups, Fiscal, Macroeconomic, Revenue and Markets with support coming from the Corporate Services Division. These groups were established to meet four policy outcomes:

- Sound macroeconomic environment

  The Treasury monitors and assesses economic conditions and prospects, both in Australia and overseas, and provides advice on the formulation and implementation of effective macroeconomic policy, including monetary and fiscal policy, and labour market issues.
- Effective government spending and taxation arrangements

  The Treasury provides advice on budget policy issues, trends in Commonwealth revenue and major fiscal and financial aggregates, major expenditure programmes, taxation policy, retirement income, Commonwealth-State financial policy and actuarial services.

- Effective taxation and retirement income arrangements

  The Treasury provides advice and assists in the formulation and implementation of government taxation and retirement income policies and legislation as well as providing information on material changes to taxation revenue forecasts and projections.
- Well functioning markets

  The Treasury provides advice on policy processes and reforms that promote a secure financial system and sound corporate practices, remove impediments to competition in product and services markets and safeguard the public interest in matters such as consumer protection and foreign investment.

Speculation on future movements in labour costs are related to expectations in the resolution of the skills shortage currently being experienced in Australia. SKM has examined data made available by Treasury with regards to anticipated market influences on labour.

A.2.2 Australian Bureau of Agricultural and Resource Economics

The Australian Bureau of Agricultural and Resource Economics (ABARE), located in Canberra, is an Australian government economic research agency noted for its professionally independent research and analysis.

The bureau is responsible for the research methods employed, the conclusions reached and the dissemination of results. ABARE disseminates the results of its research through the media, their internet web site, the national Outlook conference, regional Outlook conferences around Australia and many other speaking engagements. All information on the web site is available free.

Their research contributes to some of the most important items on the Australian and international policy agendas:

- multilateral trade negotiations and more open agricultural markets;
- greenhouse gas emissions and climate change response policies;
- water policy reform;
- energy;
- minerals exploration and policies;
- issues in regional Australia;
- Australian farm performance; and
- Australian farm surveys.

In addition, ABARE produces regular quarterly forecasts for the full range of export commodities, to assist industries with future planning. The commodity results cover agriculture, minerals, energy,

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fisheries and forestry. ABARE is one of the few bodies producing medium term and regular quarterly forecasts for Australia's major export commodities.

SKM noted that ABARE was an authority often referred to by independent monetary organizations, and has relied heavily upon their forecasts for commodity items (aluminium, copper, steel, and oil), together with consideration of their forecasts for foreign exchange rates and CPI in conjunction with other authorities.

A.2.3 International Monetary Fund

The International Monetary Fund (IMF) is an international organization that oversees the global financial system by observing exchange rates and balance of payments, as well as offering financial and technical assistance when requested. Its headquarters are located in Washington, D.C.

IMF describes itself as "an organization of 184 countries, working to foster global monetary cooperation, secure financial stability, facilitate international trade, promote high employment and sustainable economic growth, and reduce poverty". With the exception of North Korea, Cuba, Liechtenstein, Andorra, Monaco, Tuvalu and Nauru, all UN member states either participate directly in the IMF or are represented by other member states.

SKM has relied upon an annual economic outlook document produced by the IMF, drawing upon statistical data from many international sources including International Iron and Steel Institute, World Bank, ABARE and Bloomberg Financial Markets, together with employing their own modelling and estimating techniques.

In the World Economic Outlook published in September 2006, the IMF stated that the following assumptions had been made:

" … *It has been assumed that real effective exchange rates will remain constant at their average levels during July 5–August 2, 2006, except for the currencies participating in the European exchange rate mechanism II (ERM II), which are assumed to remain constant in nominal terms relative to the euro; that established policies of national authorities will be maintained (for specific assumptions about fiscal and monetary policies in industrial countries, see Box A1); that the average price of oil will be $69.20 a barrel in 2006 and $75.50 a barrel in 2007, and remain unchanged in real terms over the medium term; that the six-month London interbank offered rate (LIBOR) on U.S. dollar deposits will average 5.4 percent in 2006 and 5.5 percent in 2007; that the three-month euro deposits rate will average 3.1 percent in 2006 and 3.7 percent in 2007; and that the six-month Japanese yen deposit rate will yield an average of 0.5 percent in 2006 and of 1.1 percent in 2007. These are, of course, working hypotheses rather than forecasts, and the uncertainties surrounding them add to the margin of error that would in any event be involved in* *the projections. The estimates and projections are based on statistical information available through end-August 2006.*"[22]

SKM has used IMF forecast data for movements in aluminium and copper prices (shown in Figure 18 and Figure 20), which have been developed using a model based on metal consumption, industrial output and "real" price of the metal. Comprehensive details of the model are publicly available in the World Economic Outlook 2006 document (Appendix 5.1) on the IMF internet website http://www.imf.org/external/pubs/ft/weo/2006/02/index.htm

A.2.4 World Bank

The World Bank is an important source of financial and technical assistance to developing countries around the world. It is made up of two unique development institutions owned by 184 member countries—the International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA). Each institution plays a different but supportive role in its stated mission of global poverty reduction and the improvement of living standards.

The IBRD focuses on middle income and creditworthy poor countries, while IDA focuses on the poorest countries in the world. Together these institutions provide low-interest loans, interest-free credit and grants to developing countries for education, health, infrastructure, communications and many other purposes.

SKM recognized that the World Bank draws its information from a number of different authorities around the world, and has considered their forecasts for copper, aluminium, iron ore, nickel and oil in developing the escalation factors.

A.2.5 Wachovia Corporation

Wachovia Corporation is the fourth largest bank holding company in the United States and third largest full-service retail brokerage firm. Their retail banking presence is predominantly on the East Coast, but also stretches across the Southeast and west to Texas and California.

SKM has used the Wachovia forecasts for copper, aluminium, steel, nickel and oil, but has placed a lower weighting on these forecasts as SKM is concerned that the focus of the estimates may potentially be more orientated to the United States market rather than the international market.

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[22] IMF, *World Economic Outlook*, September 2006, pp viii

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Appendix B Forecast Escalation Factors for Commodities & Labour

The following tables detail the forecast escalation factors for the base metals, labour and financial indicators that SKM consider impact on the price of substation equipment and material, overhead transmission line and underground cable. These projections have been presented as accumulative escalation from a nominated reference year.

- **Table 13 Accumulative escalation factors to 2008 - reference 2002**

Cost Driver	2002	2003	2004	2005	2006	2007	2008
Aluminium	1.000	1.070	1.312	1.455	1.831	1.745	1.650
Copper	1.000	1.159	1.873	2.413	4.208	3.934	3.274
Steel	1.000	1.255	1.801	1.685	1.819	1.798	1.610
Oil	1.000	1.077	1.452	2.192	2.423	2.259	2.125
General Labour	1.000	1.034	1.068	1.108	1.152	1.198	1.246
Site Labour	1.000	1.039	1.082	1.133	1.185	1.248	1.304
CPI	1.000	1.028	1.052	1.080	1.115	1.143	1.172
Foreign Exchange	1.000	0.894	0.829	0.809	0.820	0.831	0.854
Aluminium + 1 yr	1.000	0.956	1.022	1.253	1.390	1.749	1.668
Copper + 1 yr	1.000	1.033	1.197	1.934	2.492	4.346	4.063
Steel + 1 yr	1.000	1.041	1.307	1.875	1.754	1.894	1.872
Oil + 1 yr	1.000	1.118	1.204	1.624	2.452	2.710	2.526
Aluminium + 2 yrs	1.000	0.900	0.860	0.920	1.128	1.251	1.574
Copper + 2 yrs	1.000	0.841	0.869	1.007	1.628	2.097	3.657
Steel + 2 yrs	1.000	0.954	0.993	1.247	1.789	1.674	1.807
Oil + 2 yrs	1.000	0.795	0.889	0.957	1.291	1.949	2.154

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Table 14 Accumulative escalation factors to 2008 - reference 2004

Cost Driver	2002	2003	2004	2005	2006	2007	2008
Aluminium			1.000	1.109	1.396	1.331	1.258
Copper			1.000	1.288	2.247	2.100	1.748
Steel			1.000	0.935	1.010	0.999	0.894
Oil			1.000	1.510	1.669	1.556	1.464
General Labour			1.000	1.037	1.078	1.121	1.166
Site Labour			1.000	1.047	1.095	1.154	1.204
CPI			1.000	1.027	1.060	1.087	1.114
Foreign Exchange			1.000	0.975	0.988	1.002	1.030
Aluminium + 1 yr			1.000	1.226	1.360	1.711	1.632
Copper + 1 yr			1.000	1.616	2.082	3.631	3.395
Steel + 1 yr			1.000	1.435	1.342	1.449	1.433
Oil + 1 yr			1.000	1.348	2.036	2.250	2.097
Aluminium + 2 yrs			1.000	1.070	1.312	1.455	1.831
Copper + 2 yrs			1.000	1.159	1.873	2.413	4.208
Steel + 2 yrs			1.000	1.255	1.801	1.685	1.819
Oil + 2 yrs			1.000	1.077	1.452	2.192	2.423

Table 15 Accumulative escalation factors to 2008 - reference 2006

Cost Driver	2002	2003	2004	2005	2006	2007	2008
Aluminium					1.000	0.953	0.901
Copper					1.000	0.935	0.778
Steel					1.000	0.989	0.885
Oil					1.000	0.932	0.877
General Labour					1.000	1.040	1.082
Site Labour					1.000	1.054	1.100
CPI					1.000	1.025	1.051
Foreign Exchange					1.000	1.014	1.042
Aluminium + 1 yr					1.000	1.258	1.200
Copper + 1 yr					1.000	1.744	1.631
Steel + 1 yr					1.000	1.080	1.068
Oil + 1 yr					1.000	1.105	1.030
Aluminium + 2 yrs					1.000	1.109	1.396
Copper + 2 yrs					1.000	1.288	2.247
Steel + 2 yrs					1.000	0.935	1.010
Oil + 2 yrs					1.000	1.510	1.669

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Table 16 Accumulative escalation factors to 2013 - reference 2006

Cost Driver	2006	2007	2008	2009	2010	2011	2012	2013
Aluminium	1.000	0.953	0.901	0.867	0.839	0.832	0.829	0.827
Copper	1.000	0.935	0.778	0.672	0.625	0.600	0.571	0.542
Steel	1.000	0.989	0.885	0.834	0.772	0.748	0.722	0.697
Oil	1.000	0.932	0.877	0.831	0.769	0.733	0.703	0.671
General Labour	1.000	1.040	1.082	1.122	1.164	1.208	1.253	1.300
Site Labour	1.000	1.054	1.100	1.148	1.199	1.252	1.307	1.365
CPI	1.000	1.025	1.051	1.077	1.104	1.132	1.160	1.189
Foreign Exchange	1.000	1.014	1.042	1.088	1.121	1.138	1.138	1.138
Aluminium + 1 yr	1.000	1.258	1.200	1.134	1.090	1.055	1.046	1.043
Copper + 1 yr	1.000	1.744	1.631	1.357	1.173	1.090	1.046	0.996
Steel + 1 yr	1.000	1.080	1.068	0.955	0.901	0.834	0.807	0.780
Oil + 1 yr	1.000	1.105	1.030	0.969	0.918	0.850	0.811	0.777
Aluminium + 2 yrs	1.000	1.109	1.396	1.331	1.258	1.210	1.171	1.161
Copper + 2 yrs	1.000	1.288	2.247	2.100	1.748	1.510	1.405	1.347
Steel + 2 yrs	1.000	0.935	1.010	0.999	0.894	0.843	0.780	0.755
Oil + 2 yrs	1.000	1.510	1.669	1.556	1.464	1.386	1.284	1.224

Table 17 Accumulative escalation factors to 2013 - reference 2008

Cost Driver	2006	2007	2008	2009	2010	2011	2012	2013
Aluminium			1.000	0.961	0.930	0.922	0.920	0.917
Copper			1.000	0.864	0.803	0.770	0.734	0.697
Steel			1.000	0.943	0.873	0.845	0.816	0.787
Oil			1.000	0.947	0.877	0.836	0.801	0.765
General Labour			1.000	1.038	1.076	1.117	1.159	1.202
Site Labour			1.000	1.044	1.090	1.138	1.189	1.241
CPI			1.000	1.025	1.051	1.077	1.104	1.132
Foreign Exchange			1.000	1.044	1.076	1.092	1.092	1.092
Aluminium + 1 yr			1.000	0.946	0.909	0.880	0.872	0.870
Copper + 1 yr			1.000	0.832	0.719	0.669	0.641	0.611
Steel + 1 yr			1.000	0.895	0.844	0.781	0.756	0.730
Oil + 1 yr			1.000	0.941	0.891	0.825	0.787	0.754
Aluminium + 2 yrs			1.000	0.953	0.901	0.867	0.839	0.832
Copper + 2 yrs			1.000	0.935	0.778	0.672	0.625	0.600
Steel + 2 yrs			1.000	0.989	0.885	0.834	0.772	0.748
Oil + 2 yrs			1.000	0.932	0.877	0.831	0.769	0.733

Appendix C Projected Escalation Factors

The following tables detail the forecast escalation factors for the base metals, labour and financial indicators that SKM consider impact on the price of substation equipment and material, overhead transmission line and underground cable. These projections have been presented as accumulative escalation from a nominated reference year.

- **Table 18 Accumulative escalation factors to 2008 - reference 2002**

Component	2002	2003	2004	2005	2006	2007	2008
Substation[23]	**1.000**	**1.011**	**1.058**	**1.095**	**1.171**	**1.215**	**1.258**
Switchgear	1.000	0.958	0.971	1.012	1.119	1.159	1.216
Transformers	1.000	0.982	1.000	1.048	1.183	1.251	1.436
Structure	1.000	1.147	1.442	1.409	1.502	1.523	1.457
Foundations	1.000	1.037	1.078	1.125	1.175	1.233	1.285
Civil	1.000	1.037	1.078	1.125	1.175	1.233	1.285
Protection & Control	1.000	1.035	1.070	1.112	1.157	1.207	1.252
Erection	1.000	1.039	1.082	1.133	1.185	1.248	1.304
Commissioning	1.000	1.039	1.082	1.133	1.185	1.248	1.304
Misc material	1.000	1.024	1.046	1.072	1.103	1.131	1.160
Overhead Line[24]	**1.000**	**1.057**	**1.171**	**1.195**	**1.280**	**1.331**	**1.374**
Conductor	1.000	0.993	1.061	1.222	1.316	1.510	1.475
Earthwire	1.000	0.993	1.061	1.222	1.316	1.510	1.475
Towers	1.000	1.147	1.442	1.409	1.502	1.523	1.457
Insulators	1.000	1.033	1.067	1.106	1.150	1.196	1.238
Fittings	1.000	1.033	1.067	1.106	1.150	1.196	1.238
Foundations	1.000	1.037	1.078	1.125	1.175	1.233	1.285
Erection	1.000	1.039	1.082	1.133	1.185	1.248	1.304
Underground Cable Aluminium	**1.000**	**1.025**	**1.076**	**1.160**	**1.246**	**1.348**	**1.368**
Underground Cable Copper	**1.000**	**1.040**	**1.105**	**1.226**	**1.360**	**1.571**	**1.578**
Cable Al	1.000	1.000	1.065	1.212	1.361	1.536	1.489
Cable Cu	1.000	1.043	1.199	1.614	2.095	2.924	2.730
Installation	1.000	1.039	1.082	1.133	1.185	1.248	1.304

[23] Based on a selected number of 66,132,220 and 275kV substation bays

[24] Based on sample of 132,220 and 275kV transmission lines

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Table 19 Accumulative escalation factors to 2008 - reference 2004

Component	2002	2003	2004	2005	2006	2007	2008
Substation			**1.000**	**1.035**	**1.106**	**1.148**	**1.188**
Switchgear			1.000	1.043	1.153	1.194	1.253
Transformers			1.000	1.048	1.183	1.252	1.437
Structure			1.000	0.977	1.042	1.057	1.010
Foundations			1.000	1.044	1.090	1.144	1.192
Civil			1.000	1.044	1.090	1.144	1.192
Protection & Control			1.000	1.039	1.081	1.127	1.170
Erection			1.000	1.047	1.095	1.154	1.204
Commissioning			1.000	1.047	1.095	1.154	1.204
Misc material			1.000	1.025	1.054	1.081	1.108
Overhead Line			**1.000**	**1.020**	**1.093**	**1.137**	**1.173**
Conductor			1.000	1.153	1.241	1.424	1.390
Earthwire			1.000	1.153	1.241	1.424	1.390
Towers			1.000	0.977	1.042	1.057	1.010
Insulators			1.000	1.037	1.078	1.121	1.160
Fittings			1.000	1.037	1.078	1.121	1.160
Foundations			1.000	1.044	1.090	1.144	1.192
Erection			1.000	1.047	1.095	1.154	1.204
Underground Cable Aluminium			**1.000**	**1.078**	**1.158**	**1.252**	**1.271**
Underground Cable Copper			**1.000**	**1.109**	**1.231**	**1.422**	**1.428**
Cable Al			1.000	1.138	1.278	1.443	1.399
Cable Cu			1.000	1.346	1.746	2.438	2.276
Installation			1.000	1.047	1.095	1.154	1.204

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■ **Table 20 Accumulative escalation factors to 2008 - reference 2006**

Component	2002	2003	2004	2005	2006	2007	2008
Substation					**1.000**	**1.038**	**1.074**
Switchgear					1.000	1.035	1.086
Transformers					1.000	1.058	1.215
Structure					1.000	1.014	0.970
Foundations					1.000	1.049	1.093
Civil					1.000	1.049	1.093
Protection & Control					1.000	1.043	1.082
Erection					1.000	1.054	1.100
Commissioning					1.000	1.054	1.100
Misc material					1.000	1.025	1.051
Overhead Line					**1.000**	**1.040**	**1.073**
Conductor					1.000	1.148	1.121
Earthwire					1.000	1.148	1.121
Towers					1.000	1.014	0.970
Insulators					1.000	1.040	1.076
Fittings					1.000	1.040	1.076
Foundations					1.000	1.049	1.093
Erection					1.000	1.054	1.100
Underground Cable Aluminium					**1.000**	**1.082**	**1.098**
Underground Cable Copper					**1.000**	**1.155**	**1.160**
Cable Al					1.000	1.129	1.094
Cable Cu					1.000	1.396	1.303
Installation					1.000	1.054	1.100

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▪ **Table 21 Annual escalation factors 2002 to 2008**

Component	2002 - 2003	2003 - 2004	2004 - 2005	2005-2006	2006 - 2007	2007 - 2008
Substation	**1.011**	**1.047**	**1.035**	**1.069**	**1.038**	**1.035**
Switchgear	0.958	1.014	1.043	1.105	1.035	1.049
Transformers	0.982	1.018	1.048	1.128	1.058	1.148
Structure	1.147	1.257	0.977	1.066	1.014	0.956
Foundations	1.037	1.039	1.044	1.044	1.049	1.042
Civil	1.037	1.039	1.044	1.044	1.049	1.042
Protection & Control	1.035	1.035	1.039	1.041	1.043	1.038
Erection	1.039	1.042	1.047	1.046	1.054	1.044
Commissioning	1.039	1.042	1.047	1.046	1.054	1.044
Misc material	1.024	1.022	1.025	1.029	1.025	1.025
Overhead Line	**1.057**	**1.108**	**1.020**	**1.071**	**1.040**	**1.032**
Conductor	0.993	1.068	1.153	1.076	1.148	0.977
Earthwire	0.993	1.068	1.153	1.076	1.148	0.977
Towers	1.147	1.257	0.977	1.066	1.014	0.956
Insulators	1.033	1.033	1.037	1.039	1.040	1.035
Fittings	1.033	1.033	1.037	1.039	1.040	1.035
Foundations	1.037	1.039	1.044	1.044	1.049	1.042
Erection	1.039	1.042	1.047	1.046	1.054	1.044
Underground Cable Aluminium	**1.025**	**1.050**	**1.078**	**1.074**	**1.082**	**1.015**
Underground Cable Copper	**1.040**	**1.063**	**1.109**	**1.110**	**1.155**	**1.005**
Cable Al	1.000	1.065	1.138	1.123	1.129	0.969
Cable Cu	1.043	1.150	1.346	1.298	1.396	0.934
Installation	1.039	1.042	1.047	1.046	1.054	1.044

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Table 22 Accumulative escalation Factors to 2013 - reference 2006

Component	2006	2007	2008	2009	2010	2011	2012	2013
Substation	**1.000**	**1.038**	**1.074**	**1.098**	**1.119**	**1.145**	**1.171**	**1.200**
Switchgear	1.000	1.035	1.086	1.096	1.098	1.105	1.111	1.120
Transformers	1.000	1.058	1.215	1.197	1.139	1.105	1.087	1.083
Structure	1.000	1.014	0.970	0.958	0.941	0.947	0.953	0.960
Foundations	1.000	1.049	1.093	1.139	1.187	1.236	1.288	1.342
Civil	1.000	1.049	1.093	1.139	1.187	1.236	1.288	1.342
Protection & Control	1.000	1.043	1.082	1.123	1.165	1.208	1.254	1.301
Erection	1.000	1.054	1.100	1.148	1.199	1.252	1.307	1.365
Commissioning	1.000	1.054	1.100	1.148	1.199	1.252	1.307	1.365
Misc material	1.000	1.025	1.051	1.077	1.104	1.132	1.160	1.190
Overhead Line	**1.000**	**1.040**	**1.073**	**1.085**	**1.093**	**1.114**	**1.138**	**1.166**
Conductor	1.000	1.148	1.121	1.085	1.065	1.052	1.055	1.061
Earthwire	1.000	1.148	1.121	1.085	1.065	1.052	1.055	1.061
Towers	1.000	1.014	0.970	0.958	0.941	0.947	0.953	0.960
Insulators	1.000	1.040	1.076	1.114	1.153	1.194	1.236	1.280
Fittings	1.000	1.040	1.076	1.114	1.153	1.194	1.236	1.280
Foundations	1.000	1.049	1.093	1.139	1.187	1.236	1.288	1.342
Erection	1.000	1.054	1.100	1.148	1.199	1.252	1.307	1.365
Underground Cable Aluminium	**1.000**	**1.082**	**1.098**	**1.115**	**1.139**	**1.165**	**1.200**	**1.236**
Underground Cable Copper	**1.000**	**1.155**	**1.160**	**1.145**	**1.149**	**1.172**	**1.202**	**1.234**
Cable Al	1.000	1.129	1.094	1.060	1.038	1.022	1.021	1.024
Cable Cu	1.000	1.396	1.303	1.136	1.029	0.980	0.953	0.924
Installation	1.000	1.054	1.100	1.148	1.199	1.252	1.307	1.365

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Table 23 Accumulative escalation Factors to 2013 - reference 2008

Component	2006	2007	2008	2009	2010	2011	2012	2013
Substation			**1.000**	**1.022**	**1.041**	**1.065**	**1.090**	**1.117**
Switchgear			1.000	1.009	1.011	1.017	1.022	1.031
Transformers			1.000	0.985	0.938	0.910	0.895	0.891
Structure			1.000	0.988	0.970	0.976	0.983	0.990
Foundations			1.000	1.042	1.085	1.131	1.178	1.227
Civil			1.000	1.042	1.085	1.131	1.178	1.227
Protection & Control			1.000	1.037	1.076	1.117	1.159	1.203
Erection			1.000	1.044	1.090	1.138	1.189	1.241
Commissioning			1.000	1.044	1.090	1.138	1.189	1.241
Misc material			1.000	1.025	1.050	1.077	1.104	1.132
Overhead Line			**1.000**	**1.011**	**1.019**	**1.038**	**1.060**	**1.086**
Conductor			1.000	0.968	0.951	0.938	0.941	0.947
Earthwire			1.000	0.968	0.951	0.938	0.941	0.947
Towers			1.000	0.988	0.970	0.976	0.983	0.990
Insulators			1.000	1.035	1.072	1.109	1.149	1.189
Fittings			1.000	1.035	1.072	1.109	1.149	1.189
Foundations			1.000	1.042	1.085	1.131	1.178	1.227
Erection			1.000	1.044	1.090	1.138	1.189	1.241
Underground Cable Aluminium			**1.000**	**1.016**	**1.037**	**1.062**	**1.093**	**1.126**
Underground Cable Copper			**1.000**	**0.987**	**0.990**	**1.010**	**1.036**	**1.064**
Cable Al			1.000	0.969	0.949	0.934	0.933	0.936
Cable Cu			1.000	0.872	0.790	0.752	0.731	0.709
Installation			1.000	1.044	1.090	1.138	1.189	1.241

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■ **Table 24 Annual escalation Factors 2006 to 2013**

Component	2006 - 2007	2007 - 2008	2008 - 2009	2009 - 2010	2010 - 2011	2011 - 2012	2012 - 2013
Substation	**1.038**	**1.035**	**1.022**	**1.019**	**1.023**	**1.023**	**1.025**
Switchgear	1.035	1.049	1.009	1.002	1.006	1.005	1.009
Transformers	1.058	1.148	0.985	0.952	0.970	0.984	0.996
Structure	1.014	0.956	0.988	0.982	1.006	1.007	1.008
Foundations	1.049	1.042	1.042	1.042	1.042	1.042	1.042
Civil	1.049	1.042	1.042	1.042	1.042	1.042	1.042
Protection & Control	1.043	1.038	1.037	1.038	1.038	1.038	1.038
Erection	1.054	1.044	1.044	1.044	1.044	1.044	1.044
Commissioning	1.054	1.044	1.044	1.044	1.044	1.044	1.044
Misc material	1.025	1.025	1.025	1.025	1.025	1.025	1.025
Overhead Line	**1.040**	**1.032**	**1.011**	**1.008**	**1.019**	**1.021**	**1.025**
Conductor	1.148	0.977	0.968	0.982	0.987	1.003	1.006
Earthwire	1.148	0.977	0.968	0.982	0.987	1.003	1.006
Towers	1.014	0.956	0.988	0.982	1.006	1.007	1.008
Insulators	1.040	1.035	1.035	1.035	1.035	1.035	1.035
Fittings	1.040	1.035	1.035	1.035	1.035	1.035	1.035
Foundations	1.049	1.042	1.042	1.042	1.042	1.042	1.042
Erection	1.054	1.044	1.044	1.044	1.044	1.044	1.044
Underground Cable Aluminium	**1.082**	**1.015**	**1.016**	**1.021**	**1.024**	**1.029**	**1.031**
Underground Cable Copper	**1.155**	**1.005**	**0.987**	**1.003**	**1.020**	**1.026**	**1.027**
Cable Al	1.129	0.969	0.969	0.979	0.984	0.999	1.002
Cable Cu	1.396	0.934	0.872	0.906	0.953	0.972	0.969
Installation	1.054	1.044	1.044	1.044	1.044	1.044	1.044

Appendix D SKM Switchbay Estimates

- 66kV TM Single CB ~ SKM equivalent 66kV Feeder incl CB
- 132kV TM Single CB ~ SKM equivalent 132kV Feeder incl CB
- 275kV TI One & a Half CB ~ SKM equivalent 275kV 1.5 CB layout 3 CB
- 275kV TJ Double CB ~ SKM equivalent 275kV Double Bus 2 CB

SINCLAIR KNIGHT MERZ

Substation Switch Bay Configuration
Unit Cost in AUD

Voltage	66 kV	**Country**	Australia		
Configuration	Feeder incl CB	**Source**	SKM standard switch bay		
Date	07.02.2007	Labour rate AUD	**81.00** per hour	**Market**	rates

Equipment	Unit Rate	Quantity	Total
Current Transformer	13,000	3.0	39,000
Circuit Breaker	43,800	1.0	43,800
Cap Voltage Transformer	9,900	3.0	29,700
Isolator	7,700	1.0	7,700
Isolator + Earth Switch	12,000	1.0	12,000
Surge Diverter	1,900	3.0	5,700
Station Post	330	15.0	4,950
Subtotal			**142,850**

Structure	Unit Rate	Quantity	Total
Current Transformer	2,360	3.0	7,080
Cap Voltage Transformer	2,360	3.0	7,080
Isolator	5,900	1.0	5,900
Isolator + Earth Switch	5,900	1.0	5,900
Surge Diverter	980	3.0	2,940
Station Post	980	6.0	5,880
Towers	8,900	1.5	13,350
Beams	3,900	1.0	3,900
Subtotal			**52,030**

Foundations	Unit Rate	Quantity	Total
Circuit Breaker	2,500	1.0	2,500
Current Transformer	1,490	3.0	4,470
Cap Voltage Transformer	1,490	3.0	4,470
Isolator	1,860	1.0	1,860
Isolator + Earth Switch	1,860	1.0	1,860
Surge Diverter	1,000	3.0	3,000
Station Post	750	6.0	4,500
Towers	2,500	1.5	3,750
Subtotal			**26,410**

Installation - Equipment	455 hours	**36,815**
Civil - other		7,000
Minor material		12,000
Commissioning		22,000
Protection & control		55,000
Installation - PC	170 hours	13,750
Subtotal		**109,750**
Engineering Procurement and Contract Management (EPCM)	15%	**55,178**
Unit switch bay total		**423,033**

SINCLAIR KNIGHT MERZ SKM

Substation Switch Bay Configuration
Unit Cost in AUD

Voltage	275 kV	**Country**	Australia		
Configuration	1.5 CB layout 3 CB c/w surge diverters	**Source**	SP AusNet standard switch bay		
Date	07.02.2007	Labour rate AUD	**81.00** per hour	**Market**	rates

Equipment	Unit Rate	Quantity	Total
Current Transformer	32,800	9.0	295,200
Circuit Breaker	193,000	3.0	579,000
Cap Voltage Transformer	18,100	6.0	108,600
Isolator + Earth Switch	43,300	6.0	259,800
Isolator + 2 Earth Switch	51,500	2.0	103,000
Surge Diverter	10,500	3.0	31,500
Line Trap & Coupling Set	57,900	2.0	115,800
Coupling Capacitor Set	27,300	2.0	54,600
Station Post	1,800	6.0	10,800
Subtotal			**1,558,300**

Structure	Unit Rate	Quantity	Total
Current Transformer	1,900	9.0	17,100
Cap Voltage Transformer	1,900	6.0	11,400
Isolator + Earth Switch	10,500	6.0	63,000
Isolator + 2 Earth Switch	10,500	2.0	21,000
Surge Diverter	1,400	3.0	4,200
Line Trap & Coupling Set	4,200	2.0	8,400
Coupling Capacitor Set	4,200	2.0	8,400
Station Post	1,050	6.0	6,300
Towers	25,500	3.0	76,500
Beams	11,100	3.0	33,300
Subtotal			**249,600**

Foundations	Unit Rate	Quantity	Total
Circuit Breaker	5,600	3.0	16,800
Current Transformer	2,700	9.0	24,300
Cap Voltage Transformer	2,700	6.0	16,200
Isolator + Earth Switch	4,400	6.0	26,400
Isolator + 2 Earth Switch	4,400	2.0	8,800
Surge Diverter	1,500	3.0	4,500
Line Trap & Coupling Set	2,700	2.0	5,400
Coupling Capacitor Set	2,700	2.0	5,400
Station Post	1,000	6.0	6,000
Towers	12,900	3.0	38,700
Subtotal			**152,500**

Installation - Equipment		2,839 hours	**229,953**
Civil - other			23,500
Minor material			128,000
Commissioning			59,200
Protection & control			324,000

SINCLAIR KNIGHT MERZ

Substation Switch Bay Configuration
Unit Cost in AUD

Voltage	275 kV	**Country**	Australia			
Configuration	1.5 CB layout 3 CB c/w surge diverters	**Source**	SP AusNet standard switch bay			
Date	07.02.2007	Labour rate AUD	**81.00**	per hour	**Market**	rates

Installation - PC	1,000	hours	81,000
Subtotal			**615,700**
Engineering Procurement and Contract Management (EPCM)	15%		**420,908**
Unit switch bay total			**3,226,961**

SINCLAIR KNIGHT MERZ

Substation Switch Bay Configuration
Unit Cost in AUD

Voltage	275 kV	**Country**	Australia		
Configuration	Double Bus 2 CB	**Source**	SKM standard switch bay		
Date	07.02.2007	Labour rate AUD	**81.00** per hour	**Market**	rates

Equipment	Unit Rate	Quantity	Total
Current Transformer	32,800	6.0	196,800
Circuit Breaker	193,000	2.0	386,000
Cap Voltage Transformer	18,100	6.0	108,600
Isolator + Earth Switch	43,300	4.0	173,200
Isolator + 2 Earth Switch	51,500	1.0	51,500
Station Post	1,800	6.0	10,800
Subtotal			**926,900**

Structure	Unit Rate	Quantity	Total
Current Transformer	1,900	2.0	3,800
Cap Voltage Transformer	1,900	2.0	3,800
Isolator + Earth Switch	10,500	4.0	42,000
Isolator + 2 Earth Switch	10,500	1.0	10,500
Station Post	1,050	6.0	6,300
Subtotal			**66,400**

Foundations	Unit Rate	Quantity	Total
Circuit Breaker	5,600	2.0	11,200
Current Transformer	2,700	2.0	5,400
Cap Voltage Transformer	2,700	2.0	5,400
Isolator + Earth Switch	4,400	4.0	17,600
Isolator + 2 Earth Switch	4,400	1.0	4,400
Station Post	1,000	6.0	6,000
Subtotal			**50,000**

Installation - Equipment	1,651 hours	**133,728**
Civil - other		41,100
Minor material		56,200
Commissioning		77,000
Protection & control		289,300
Installation - PC	893 hours	72,325
Subtotal		**535,925**
Engineering Procurement and Contract Management (EPCM)	15%	**256,943**
Unit switch bay total		**1,969,896**

Electricity Transmission Regulatory Reset

2008/09 – 2013/14

Appendix D

Major Project List

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Major Projects List

Project Number	Project Name	Customer	Roll-in Value
Z110	Additional Connection Services associated with Somerton Power Station works at Thomastown Terminal Station	AGL	359.1
Z134	2nd 220 / 66 kV Transformer for Altona Terminal Station (ATS)	PowerCor	5,048.1
Z160	New Mine Supply 'D' and 'E' 220 / 22 kV transformer projects	Yallourn Energy	2,634.4
Z164	Augmented SNOVIC Interconnector Services Project	VENCorp	16,199.7
Z172	Additional Network Services Agreement -Augmented SNOVIC Interconnector service project	VENCorp	1,111.1
Z178	Additional connection services associated with upgrade of SVTS-OE 66kV feeder protection for CDA Zone Sub.	Alinta	103.8
Z201	WG zone sub project - FBTS-FB No1 & 2 66 kV Feeders uprating to 1200 A summer rating.	CitiPower	97.7
Z208	SNOVIC Tower Construction	VENCorp	0.0
Z212	Additional Network Services Agreement -Cranbourne Terminal Station Project	TRU Energy	26,065.6
Z216	Modify protection at TTS on sub VCO 66 kV feeder "X" and "Y".	AGL	112.5
Z219	Supplemental Agreement to the Additional Connection Services Agreement COB feeder exit upgrade and X & Y distance protection replacement	PowerCor	79.3
Z220	Supplemental Agreement to the Additional Connection Services Agreement - CLC/WIN feeder exit upgrade and X & Y distance protection replacement	PowerCor	61.5

Project Number	Project Name	Customer	Roll-in Value
Z222	Install new 66kV feeder bay for Sunshine East zone sub ex KTS, in addition rename & protection mod SU2 and SU1 feeders	PowerCor	531.0
Z225	West Melbourne Terminal Station (WMTS) No 3&4 66kV Bus Connection	CitiPower	174.9
Z227	22kV protection upgrade at Richmond Terminal Station (RTS)	CitiPower	42.4
Z234	TGTS - KRT#1 & 2 feeder exit upgrade and Y distance protection replacement at Terang Terminal Station (TGTS)	PowerCor	151.6
Z243	CVT Monitoring	Loy Yang Power	4.8
Z264	Additional network services for provision of ROTS A1 220 kV CB.	VENCorp	686.1
Z300	Install 2 x 12MVar 22 kV Cap Banks at RWTS	Alinta	817.1
Z301	Intertripping on BATS-BAN 1&2 and HOTS-STL 1&2 66 kV feeders	PowerCor	101.3
Z306	Replacement of the B4 transformer 220 kV circuit breaker	AGL	238.8
Z311	Interface works for NSW Runback scheme.	Murraylink Transmission Company	51.3
Z319a	Additional Network Services Agreement - 4th 500 kV Transmission Line Upgrade Project	VENCorp	6,925.2
Z319b	Additional Network Services Agreement - 4th 500 kV Transmission Line Upgrade Project	VENCorp	298.5
Z319c	Additional Network Services Agreement - 4th 500 kV Transmission Line Upgrade Project	VENCorp	2,098.4
Z322	Provision of additional connection services associated with the installation of a 3rd 220 / 66 /22 kV transformer at KGTS.	PowerCor	4,259.0

Project Number	Project Name	Customer	Roll-in Value
Z325	Murraylink Regulated Status Run-back Scheme	VENCorp	10,974.5
Z332	Provision of additional connection services with the upgrading of HTS-M & HTS-BR 66 kV feeders	Alinta	170.3
Z335	Additional Network Services Agreement- For Transmission upgrade to Geelong Area KTS Fast Loadshedding scheme	VENCorp	440.7
Z336	Additional Network Services Agreement- For Transmission upgrade to Geelong Area MLTS Spare Phase Transformer	VENCorp	4,405.1
Z337	Upgrade feeder protection to dual distance on SHL1, 2 & CHA 66 kV feeders	PowerCor	76.5
Z334	Provision of additional connection services associated with the uprate TSTS DC #2 66 kV feeders to 960A	Alinta	6,264.9
Z345	New JA 66 kV feeder at West Melbourne Terminal Station (WMTS)	CitiPower	1,283.4
Z407	Provision of Connection Services to Yallourn Energy for D and E Auxiliary Transformers	TRU Energy (Yallourn)	4,642.2
Z411	New 66 kV feeder exit Douglas Zone Substation (DLS) ex Horsham Terminal Station (HTS)	PowerCor	553.0
Z424	Additional Network Services Agreement - For Brooklyn Series Reactors Project	VENCorp	6,532.3
Z434	TTS 66 kV Circuit Breaker Protection Modification	PowerCor	2,909.4
Z439	Supplemental Agreement to the Additional Connection Services Agreement KTS - new SBY No 2 66 kV feeder	AGL	398.1
Z441	Supplemental Agreement to the Additional Connection Services Agreement KTS - new SBY No 2 66 kV feeder	AGL	342.3
Z448	Basslink - purchase of Connection Assets	AGL	6,195.2

Transmission Regulatory Reset

Project Number	Project Name	Customer	Roll-in Value
Z500	ROTS-SVTS 220 kV line terminations upgrade	VENCorp	2,394.6
Z503	ROTS-RTS 220 kV line termination plant upgrade	VENCorp	1,523.5
Z508	MLTS-BATS Line Wind Monitoring	VENCorp	24.4
Z539	SVTS - Replace line protection relays	Alinta	620.4
	Total		**118,003.6**

Electricity Transmission Regulatory Reset

2008/09 – 2013/14

Appendix E

Asset Management Strategy

SP AusNet
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Asset Management Strategy

Victorian Electricity Transmission Network

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ISSUE/AMENDMENT STATUS

Issue Number	Date	Description	Author	Approved by
5	12/12/2006	Editorial review following feedback from Regulatory & Business Strategy group.	G. Lukies D. Postlethwaite	G.Towns
6	23/02/2007	Editorial following external review. Published to support TRR submission.	D. Postlethwaite G. Lukies	G.Towns

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Foreword

SP AusNet owns and operates the Victorian electricity transmission network, directly serving the energy needs of Australia's second largest economy. SP AusNet also serves the National Electricity Market (NEM) via the national transmission grid.

This network transfers bulk power from NEM generators to the electricity distributors who service in excess of 2.2 million Victorian households and businesses. It interconnects high voltage customers such as the Portland Aluminium Smelter and the transmission networks of neighbouring New South Wales, South Australia and Tasmania. In total, this network transferred over 41,706 GW hours of energy in 2005/06 and serviced a peak demand of 8730 MW.

The Victorian Energy Network Corporation (VENCorp) and Victoria's electricity distributors jointly plan the augmentation of Victoria's electricity transmission network. They forecast that continuing augmentation is necessary to meet the 0.9% p.a. growth in Victorian electricity consumption and the 1.9% p.a. growth in maximum demand over the next decade.

SP AusNet's vision is to be ***"the best networks business".*** Our mission is to ***"deliver energy and associated services safely, reliably, responsibly and profitably to enhance the lives of our customers today and into the future".***

The SP AusNet company values are:

- **Commitment** to the highest standards of service and performance when creating value for customers, the public, employees and shareholders
- **Integrity** to act with honesty and to practise the highest ethical standards
- **Passion** to take pride and ownership in all that we do
- **Teamwork** – to support, respect and trust each other, with continual learning through sharing of ideas and knowledge

This Asset Management Strategy (AMS) is a key tool in achieving the SP AusNet vision. This AMS facilitates delivery of agreed performance levels and optimised asset life cycles.

With a time horizon of 2020, this AMS and its supporting documentation provides the technical direction for responsible stewardship of Victoria's electricity transmission assets on behalf of the NEM, energy generators, stakeholders, regulators, government and energy users.

Norm Drew
General Manager,
Network Development Division

Table of Contents

1 Executive Summary

This Asset Management Strategy (AMS) is a primary resource in the management of Victoria's power transmission assets, determining the delivery of quality services to customers and value to shareholders. It summarises the medium-term strategic actions to achieve regulatory and business performance targets, which are implemented via the programs of work listed in Asset Management Plans.

1.1 Aims

The aims of asset management for the electricity transmission network are to:

- Create sustainable asset and network risk-profiles to underpin future performance
- Meet reliability and availability performance targets
- Improve health, safety, environment and infrastructure security performance
- Comply with codes and regulations
- Minimise life-cycle costs

1.2 Asset Management Drivers

The Business Environment Assessment section of this AMS explores the main influences on network performance and therefore future network investment.

The following are significant drivers:

- Sustainable Network Risks – Reliability and availability expectations, maintenance of asset condition and sustainable network and asset risk profiles are driving high maintenance, refurbishment and replacement volumes
- Network Augmentation Levels – Continuing growth in demand, increasing network fault level restraints and high equipment utilisation levels are increasing the levels of network augmentation
- Performance Improvements – Code compliance, and health and safety, environment and infrastructure security performance improvements
- Efficiency – Continuing efficiency demands elevated asset management practices
- Technology - Emerging viability of new technologies
- Workforce – Potential workforce skilling demands

1.3 Key Metrics

The following figure (Figure 1) summarises metrics, defining the current performance and future trends of the Victorian electricity transmission network.

Key Metrics – Victorian electricity Transmission Network		
Metric	**Recent Performance[1]**	**2011 Forecast**
Annual Energy Transmitted	41,706 GWH	+ 0.9 % p.a.
Summer Maximum Demand	8730 MW	+ 1.9 % p.a.
Winter Maximum Demand	7644 MW	+ 1.3 % p.a.
Average Transformer Utilisation[2]	95 % of N-1 capacity	+ 2.2 % p.a.
Average 220kV Fault Levels[2]	17 kA	+ 1 % p.a.
Reliability (retail interruptions)	4 p.a.	
Reliability (system minutes)	0.5 p.a.	
Availability (Peak Critical Circuit)	99.945 %	Meet ACCC Target
Availability (Peak Non-critical circuit)	99.857 %	Meet ACCC Target
Availability (Intermediate Critical Circuit)	99.745 %	Fail ACCC Target
Availability (Intermediate Non-critical Circuit)	98.210 %	Fail ACCC Target
Availability Lines	99.5 %	Meet VENCorp Target
Availability Transformers	99.7 %	Renegotiate Target
Availability Capacitors	99.3 %	Meet VENCorp Target
Availability SVAR Compensators	98.1 %	Renegotiate Target
Availability Synchronous Condensers	90.0 %	Meet VENCorp Target
Network Risk	Improving	Stable
Reliability Risk	Improving	Stable
Availability Risk	Increasing	Increasing
Health and Safety Risk	Improving	Improving
Environmental Risk	Improving	Improving
Infrastructure Security Risk	Improving	Improving
Code Compliance Risk	Improving	Improving
Average Network CAPEX		
Average Network OPEX		

Figure 1 – Key Metrics

[1] Refer to Section 5, Performance, for measurement details.
[2] Established by Distribution Business and VENCorp planning processes.

2 Introduction

This section provides relevant context and background to the AMS through summaries of the following areas:

- Purpose
- Scope
- Asset management process
- Structure
- Network overview
- Asset summary
- Development history
- Asset Age
- Economic regulation
- Victorian planning framework

2.1 Purpose

With a time horizon of 2020, the AMS and its supporting documentation provide robust technical direction for the responsible stewardship of electricity transmission assets. SP AusNet is steward of these assets on behalf of Victoria's energy users, generators, shareholders, regulators, government and the NEM more broadly.

This stewardship includes:

- Assessment of the dynamic business environment
- Consideration of stakeholders interests and needs
- Commitment to sustainable risk, value and performance levels
- Skilled and expert management of critical assets through rigorous analysis, sophisticated policy and robust operating processes

2.2 Scope

The scope of this AMS includes electricity transmission assets in Victoria including:

- Transmission lines[3], power cables and associated easements and access tracks
- Terminal stations, switching stations, communication stations and depots including associated electrical plant[4], buildings and civil infrastructure
- Protection, control, metering and communications equipment
- Related functions and facilities such as spares, maintenance and test equipment

[3] 500 kV, 330 kV, 275 kV and 220 kV transmission lines and cables
[4] 500 kV, 330 kV, 275 kV, 220 kV, 66 kV and 22 kV switchgear and transformers

- Asset management processes and systems such as System Control and Data Acquisition (SCADA) and asset management information systems (including MAXIMO)

More specifically, the AMS relates to the electricity transmission sites and facilities:

- Listed in the Network Agreement between SP AusNet (then PowerNet Victoria) and VENCorp (then the Victorian Power Exchange) 1994
- Listed in 1994 Connection Agreements between SP AusNet and connected parties largely consisting of generators, direct connect customers and distributors
- Listed in various supplementary network and connection agreements, detailing SP AusNet's unregulated transmission assets
- Illustrated on SP AusNet's system diagram T1/209/84

The AMS excludes the assets and infrastructure owned by:

- Generators
- Exit customers
- Other companies providing transmission services within Victoria

The AMS excludes SP AusNet corporate processes and associated information technology systems such as business communication, human resources and financial management systems. It does not include information on corporate offices or general business equipment such as computers and motor vehicles.

2.3 Asset Management Process

This AMS is informed by corporate visions, business plans and an assessment of the external business environment. It is a critical guide for the development of longer-term asset management plans as well as more immediate work programs for enhanced performance and efficiency.

As illustrated in the figure below (Figure 2), this AMS is a pivotal step in the SP AusNet asset management process.

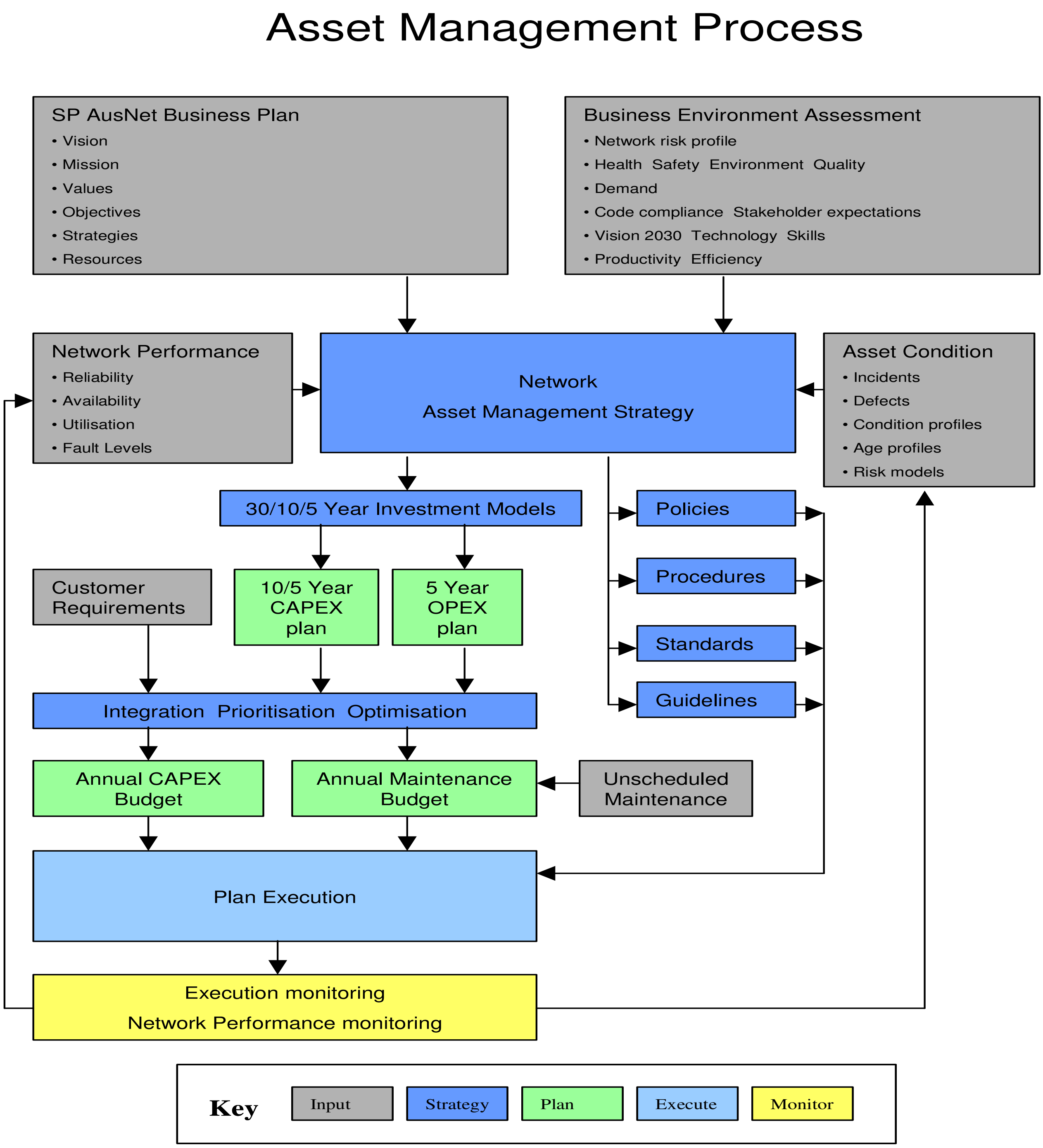


Figure 2 – Asset Management Process Flowchart

2.4 Asset Management Strategy Structure

This AMS forms the apex of a three-tiered hierarchy of documents that guide the asset management process. The hierarchy covers strategy, policy, procedures and plans for asset management. The resource documents in the Foundation and Implementation levels support the AMS, as illustrated in the figure below (Figure 3).

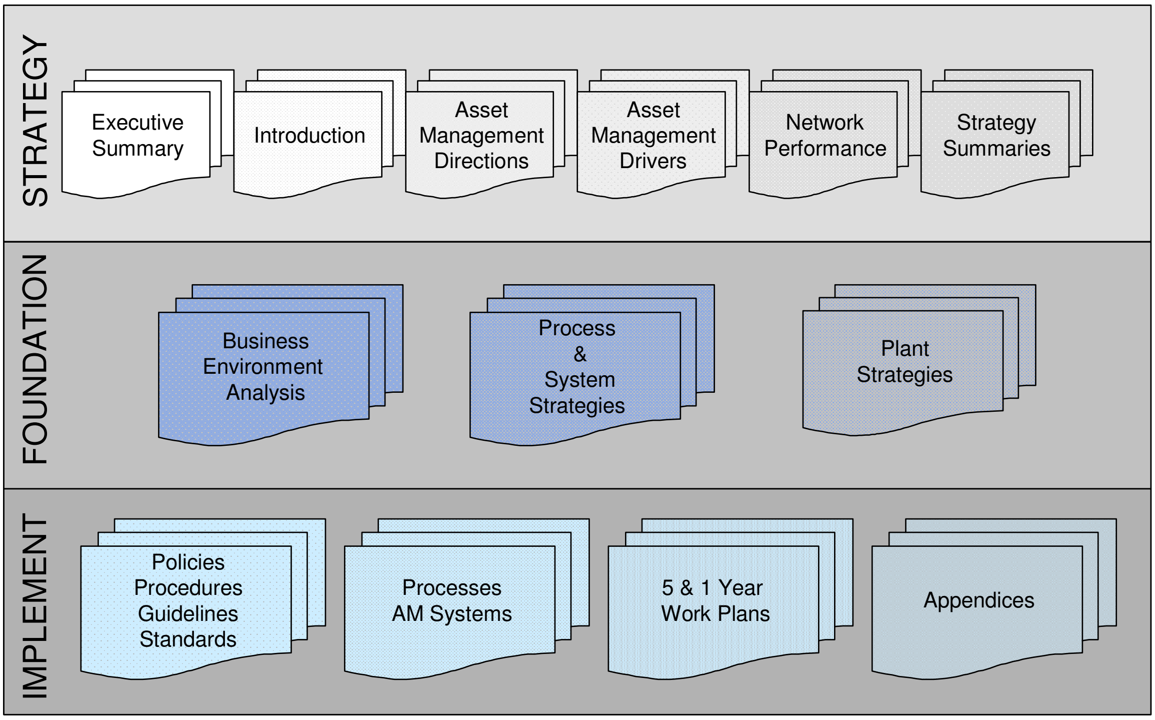


Figure 3 – Hierarchy of the Asset Management Strategy

At the highest level, the AMS brings together the external influences, investment drivers, business values and asset management directions with a high-level summary of the required resources and the strategies selected to deliver challenging and sustained performance for the benefit of stakeholders. Hyperlinks integrate this highest level with supporting documents in the foundation and implementation levels.

The second level contains the foundation documents that the AMS is built upon. This level includes a detailed analysis of the business environment that the network must operate within. This level also details the assets, issues and investment drivers behind each technical, procedural and support system strategy that is necessary to achieve agreed performance outcomes.

The third level outlines the implementation of the AMS. At this level, strategies are integrated with SP AusNet's business systems and practices, providing direct links between strategies for asset management and company policies, procedures, support system developments, work programs and plans.

2.5 Network Overview

SP AusNet's electricity transmission network interconnects generators, distributors, high voltage customers and the transmission systems of neighbouring New South Wales, South Australia and Tasmania. It serves approximately 5 million Victorians living in an area of approximately 227,600 square kilometres.

A 500 kV network backbone runs from the Latrobe Valley through to Melbourne and across the south-western part of the state to Heywood. This 500 kV network facilitates the transfer of power between the coal and gas-fired generators in Gippsland, hydro-electric generators in the Victorian Alps and the significant load centres of Melbourne, Geelong and the Portland aluminium smelter.

As illustrated in Figure 4, the 500 kV network is reinforced by a 220 kV circuit around Melbourne, two 220 kV rings in rural Victoria and interconnections to neighbouring states.

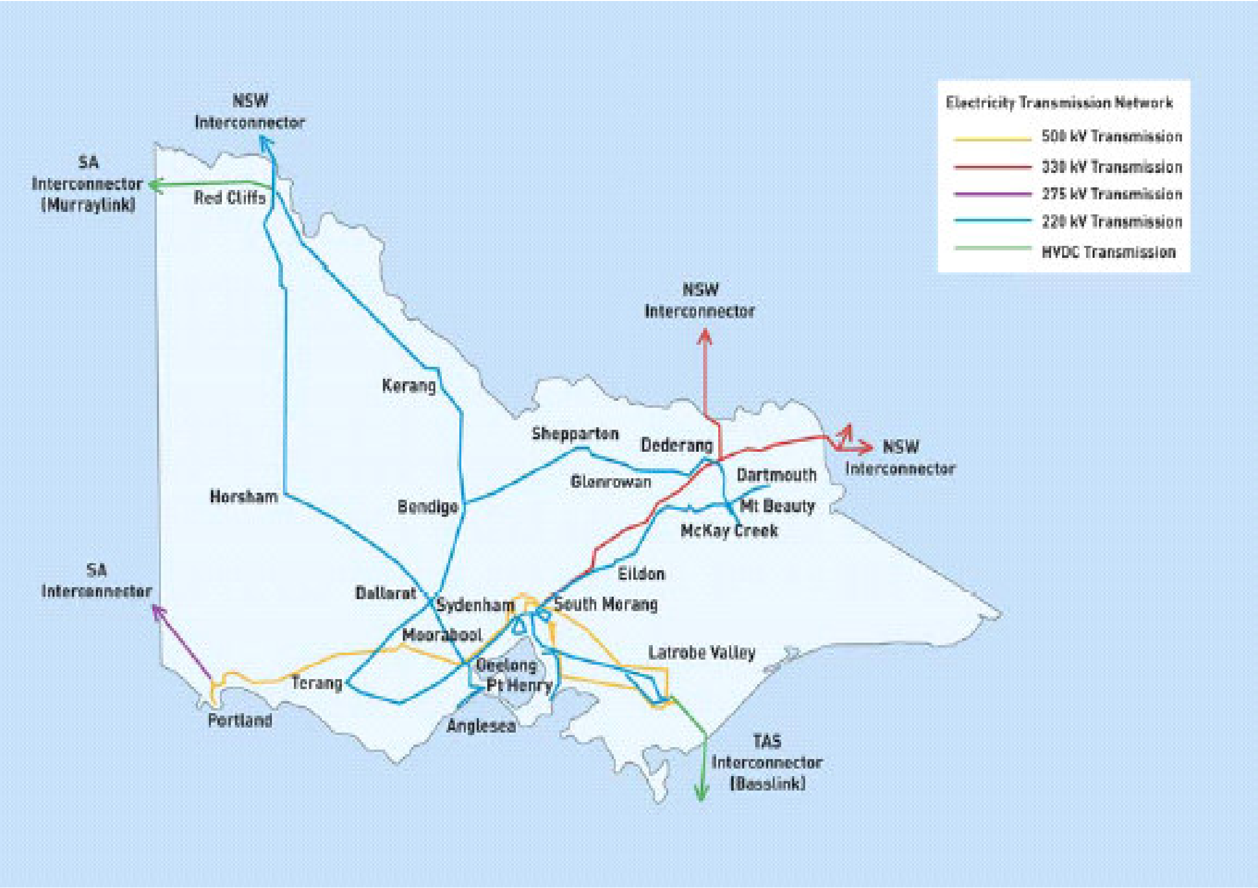


Figure 4 – Victorian Electricity Transmission Network

2.5.1 Metropolitan Melbourne

The 500 kV and 220 kV networks serving metropolitan Melbourne are shown in the following figure (Figure 5),

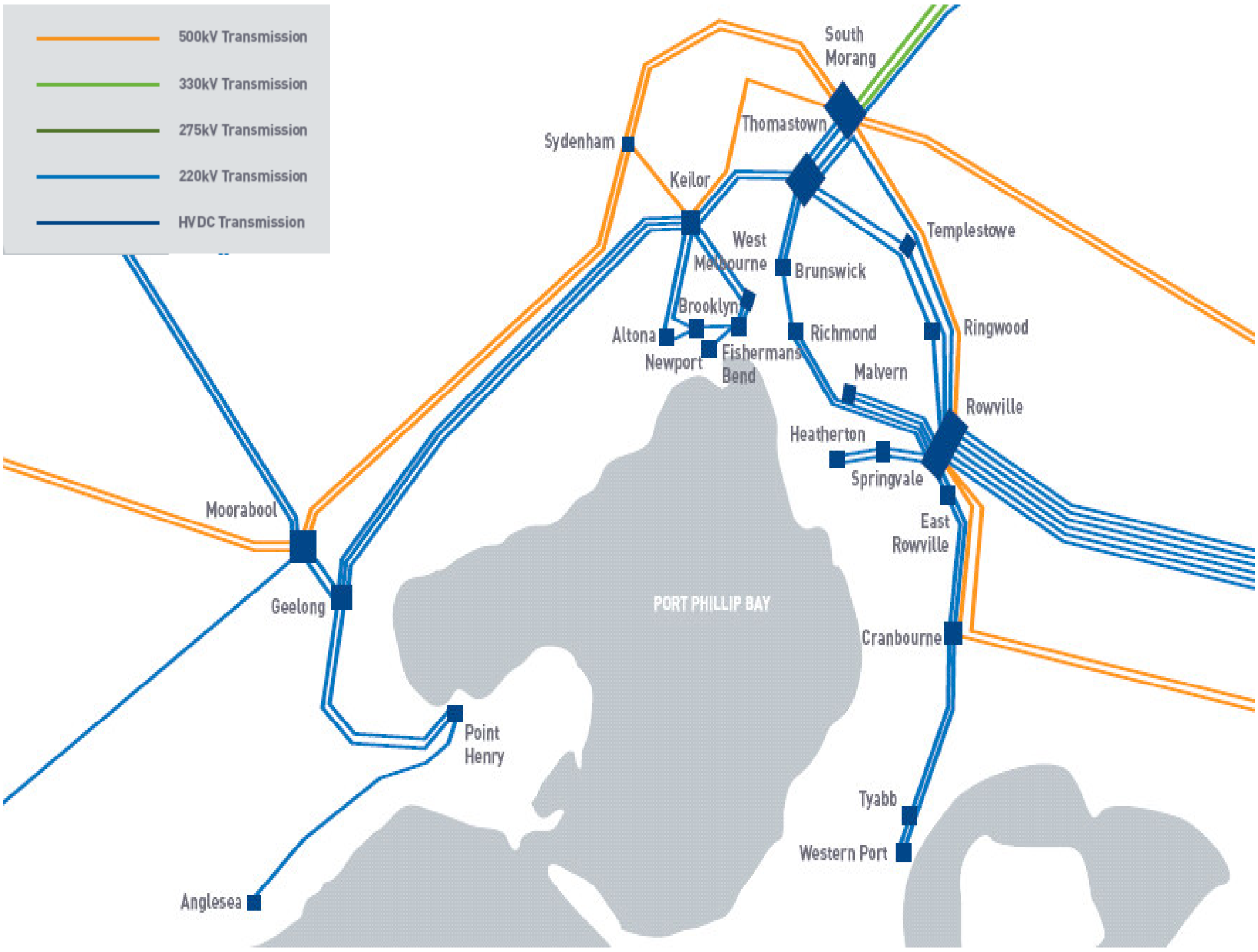


Figure 5 – Metropolitan Melbourne Electricity Transmission Network

The Latrobe Valley to Melbourne transmission link comprises four 500 kV lines and six 220 kV lines. The 500 kV network supplies power from the Loy Yang and Hazelwood power stations to Keilor, South Morang, Rowville and Cranbourne Terminal Stations. The 220 kV network transfers power from the Hazelwood and Yallourn generation into the eastern metropolitan area at Rowville Terminal Station.

2.5.2 Regional Network

Regional Victoria is supplied via a 220 kV network from terminal stations at Geelong, Terang, Ballarat, Bendigo, Shepparton, Glenrowan, Kerang, Horsham and Red Cliffs. This network is energised by 500 kV to 220 kV transformation at Moorabool, Keilor and South Morang Terminal Stations. Morwell Terminal Station provides the supply to Gippsland and the Latrobe Valley.

A 500 kV connection supplies the single largest regional load – the Portland aluminium smelter in the state's far west.

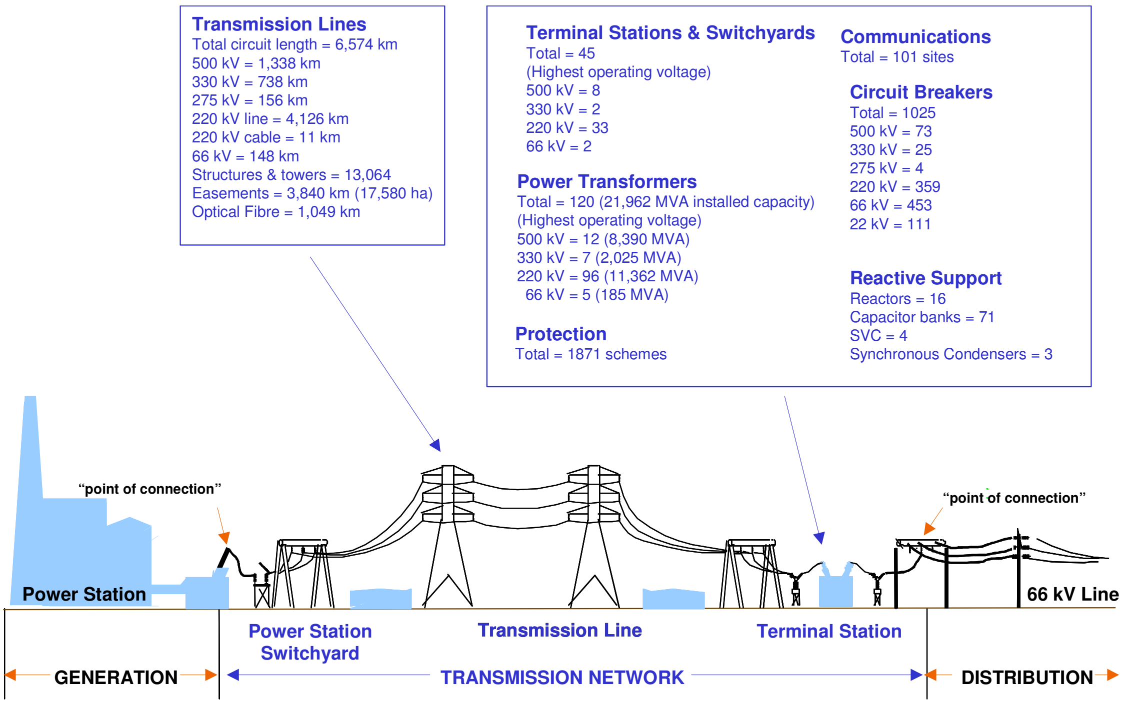
2.5.3 Interstate Connections

The NEM interconnections include:

- Two 330 kV lines from Dederang Terminal Station, to the Murray Switching Station (NSW)
- One 330 kV line from Wodonga Terminal Station to Jindera (NSW)
- One 220 kV line from Red Cliffs Terminal Station to Buronga (NSW)
- Two 275 kV lines from Heywood Terminal Station to South East Substation (SA)
- One 220 kV circuit from Red Cliffs Terminal Station to Berri (SA)
- One 300 kV circuit from Loy Yang to Bell Bay (TAS)

2.6 Asset Summary

Summarised in the figure below (Figure 6), are the major facilities, assets and systems of the Victorian electricity transmission network.



Source – MAXIMO December 2006

Figure 6 – Summary of Facilities and Assets in the Victorian Electricity Transmission Network

2.7 Development History

The development of the Victorian electricity transmission network commenced in the 1940s with connection of metropolitan Melbourne to hydroelectric generators located in the Victorian Alps.

The brown coal fired generators in the Latrobe Valley were interconnected in the mid 1950s via a 220 kV network. This network developed progressively through the 1960s to interconnect the rural areas of Victoria.

The first elements of the 500 kV transmission network were established in 1970 and later elements were added in the mid 1980s. The first interstate connections occurred with the establishment of the NSW interconnector in the early 1970s. Interconnection with South Australia occurred in 1991 from Heywood and 2001 from Redcliffs via the Murray Link DC interconnector. Interconnection with Tasmania via an undersea DC cable link was effected late in 2005. The development history of this network is summarised in the figure (Figure 7) below.

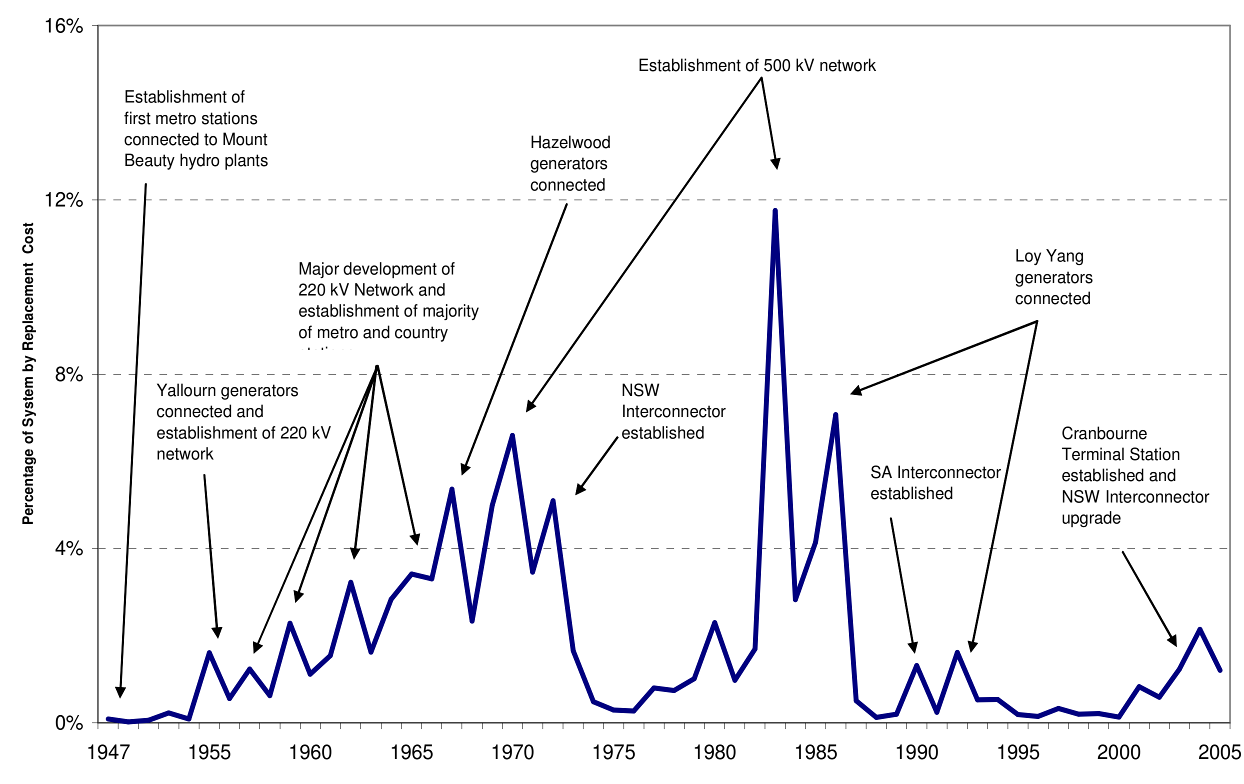


Figure 7 – Development of the Victorian Electricity Transmission Network

2.8 Asset Age

Consistent with its development history, assets forming the Victorian electricity transmission network are relatively old when compared with assets in other Australian and international networks.

The figure below (Figure 8) compares the average age of assets in the Victorian network with those of 19 international and four other Australian networks participating in the 2005 ITOMS[5] benchmarking exercise.

[5] ITOMS 2005 Report - International Transmission Operations & Maintenance Study – Revision 6 May 2006

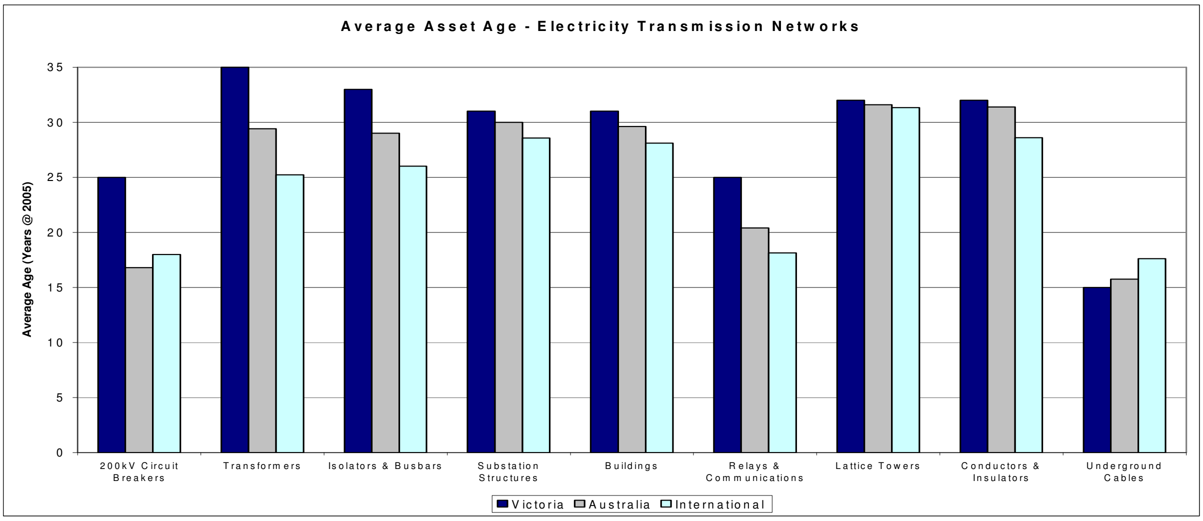


Figure 8 – Average Asset Age

Of particular note are the significant differences between the average ages of circuit breakers, power transformers, isolators & busbars and relays & communications equipment in the Victorian network compared with its Australian and international peers. These age differences are the major driver for the terminal station refurbishment program, which commenced in 2001.

2.9 Economic Regulation

This section outlines the regulatory framework and economic policy pertaining to the electricity industry in Victoria. It summarises the NEM regulatory and statutory bodies from the perspective of transmission asset management. The following figure (Figure 9) illustrates the commercial relationships described in the subsequent text.

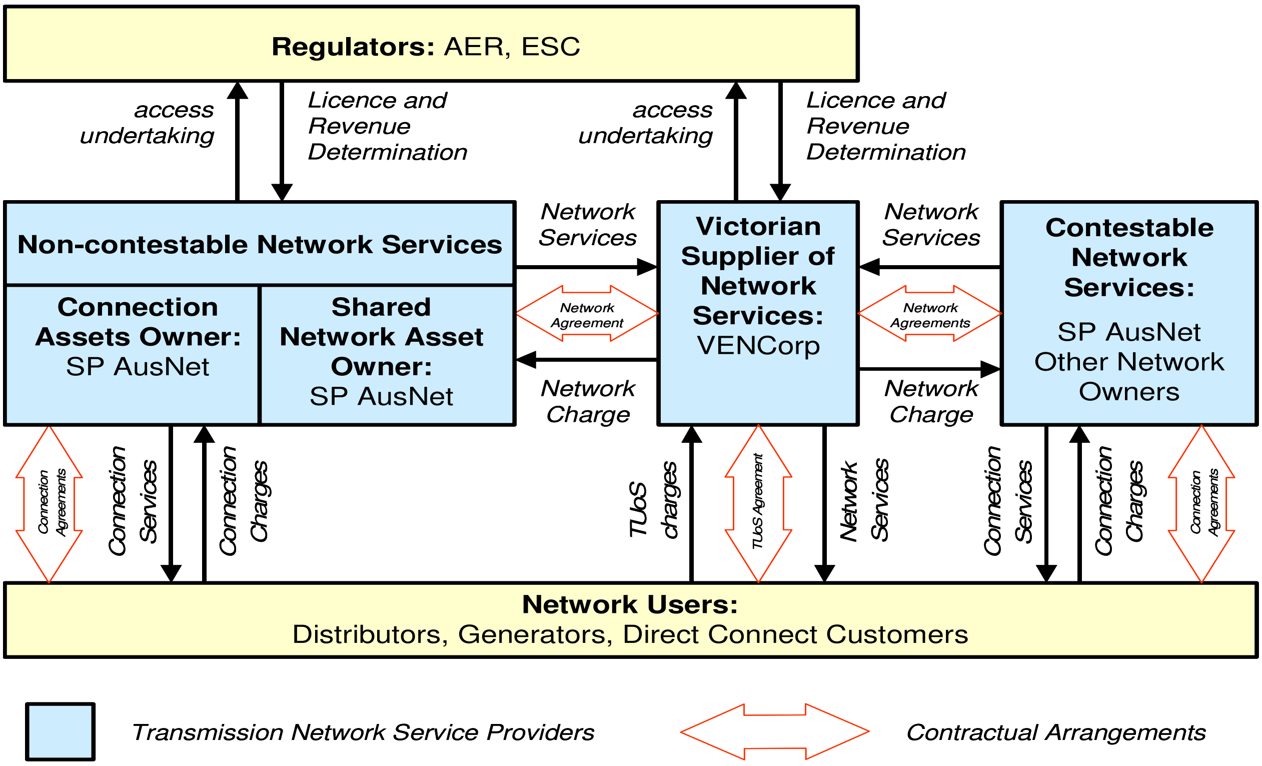


Figure 9 – Regulatory Commercial Framework

2.9.1 New National Electricity Law and Rules

Reforms to governance arrangements were implemented in the National Electricity Law (NEL) and National Electricity Rules (NER) finalised in early 2005. Energy specific regulatory bodies, including the Australian Energy Regulator (AER) and Australian Energy Market Commission (AEMC) commenced operations on 1 July 2005.

The AER is responsible for economic regulation (replacing the ACCC and eventually the state regulators in this role) and rule enforcement (replacing NECA functions in this area) in the energy sector. It has been established under recent amendments to the Trade Practices Act 1974.

The AEMC is responsible for rule-making and market development for the energy sector (replacing NECA functions and ACCC authorisation in this area). It has been established under the Australian Energy Market Establishment Act 2004, a South Australian Act.

The ACCC continues to perform its regulatory functions, as outlined the Trade Practices Act, including the assessment of mergers and acquisitions in the energy industry.

A Memorandum of Understanding between the ACCC, the AER and the AEMC guides interaction between these bodies and their functions. It provides a balance between development and implementation of energy market rules, industry regulation and general competition regulation.

2.9.2 Australian Energy Regulator

Clause 6.2.2 of the NER sets out the objectives of the transmission revenue regulatory regime to be administered by the AER. In terms of asset management, the AER is seeking to ensure transmission businesses deliver:

- The appropriate standard and scope of services
- An efficient level of investment within the transmission sector
- Efficient operating and maintenance practices
- Efficient use of existing infrastructure

2.10 Victorian Planning Framework

Under Victorian governance, planning functions are separated from the ownership and operation of the transmission network.

2.10.1 NEMMCO

The National Electricity Market Management Company Limited (NEMMCO) is a government owned company with primary responsibility for the operation and development of the wholesale market in the NEM. It also has specific responsibilities for the maintenance and improvement of power system security and for undertaking the coordination and planning of augmentations to the national electricity system. NEMMCO provides relevant information via the Annual National Transmission Statement and the Annual Statement of Opportunities.

2.10.2 VENCorp

VENCorp is a non-profit entity owned by the State Government and it is an integral part of Victoria's privatised gas and electricity industries. VENCorp is responsible for the overall coordination, planning and augmentation of the shared transmission network. Principle VENCorp information resources are an Annual Planning Report, Demand Forecasts, Network Planning Criteria and a 25 year network Vision for energy transmission in Victoria.

2.10.3 Connected Parties

In Victoria, connected parties are responsible for the planning and augmentation of their connection assets.

The five distribution businesses (DBs) have responsibility for planning and directing the augmentation of those facilities that connect their distribution systems to the shared transmission network. DBs plan and direct the augmentation in a way that minimises costs to customers, taking into account distribution losses and transmission losses that occur within the transmission connection facilities. Other connected parties (major consumers or generators) are responsible for their own connection planning. They can choose to delegate this task to a DB if they wish.

In the event that a new connection, or augmentation of an existing connection, is required the connected parties must consult with and meet the reasonable technical requirements of VENCorp, SP AusNet and other affected parties.

Each year the DBs publish a Transmission Connection Planning Report that assesses the risk of lost load, network planning criteria and options for meeting forecast demand.

3 Asset Management Directions

The Australian Energy Regulator has established a single, clear national objective for a competitive, open and unbiased electricity energy market:

> To promote efficient investment in, and use of, electricity services for the long-term interests of consumers of electricity with respect to price, quality, reliability and security of supply and the safety, reliability and security of the national electricity system.

3.1 Vision

Acknowledging the national objective, SP AusNet's corporate vision *"to recognised as the leading supplier of reliable, safe and efficient energy-delivery services"* underpins the asset management Vision, below:

> To be recognised as a leader and an innovator in the management of transmission assets.

3.2 Aims

The asset management aims for the electricity transmission network are:

- Create sustainable asset and network risk profiles to underpin future performance
- Meet reliability and availability performance targets
- Improve health, safety, environment and infrastructure-security performance
- Comply with codes and regulations
- Minimise life-cycle costs

4 Asset Management Drivers

4.1 Introduction

The performance and efficiency of the Victorian electricity transmission network continues to benchmark well against the transmission networks of other service providers. However, SP AusNet faces significant challenges from:

- Sustainable Network Risks – Reliability and availability expectations, maintenance of asset condition and sustainable asset/network risk profiles are driving high maintenance, refurbishment and replacement volumes
- Network Augmentation Levels – Continuing growth in demand, increasing network fault level restraints and high equipment utilisation are increasing network augmentation levels
- Performance Improvements – Code compliance and health and safety, environment and infrastructure security performance improvements
- Efficiencies – Continuing efficiency demands are elevating asset management practice
- Technology – Emerging viability of new technologies
- Workforce – Potential workforce skilling demands

The following sections summarise each of the main influences on network performance. Further analysis and quantification can be found in the Business Environment Assessment section.

4.2 Sustainable Risk Profiles

> "Reliability and availability expectations, maintaining asset condition and sustainable asset/network risk profiles are driving high maintenance, refurbishment and replacement volumes"

4.2.1 Risk Modelling

The Risk Management section of this strategy contains more detail on the risk modelling that is summarised in this section.

Over the last 18 months SP AusNet has invested significant intellectual and practical effort in improving the sophistication, accuracy and reliability of its risk modelling practices to aid comprehension of historic, current and possible future risk positions. Failure histories, asset condition and contingency consequences have been quantified. Models have been constructed, calibrated and integrated to illustrate the relationships between management initiatives and maintenance, refurbishment and replacement programs on performance risk.

The hierarchy illustrated in the following figure (Figure 10) has been established to define the concepts of asset risk, program risk and ultimately network risk.

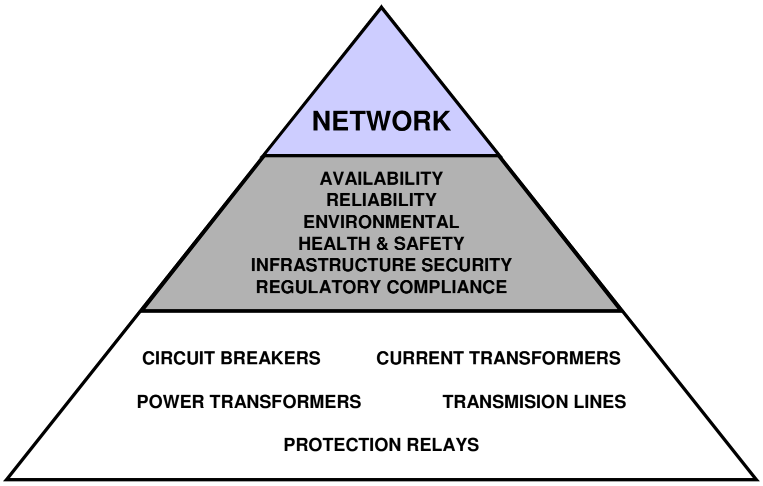


Figure 10 – Risk Model Hierarchy

Individual asset failure risk forms the base of SP AusNet's modelling. Models have been created for each of the circuit breaker, current-transformer, power-transformer, transmission line and protection relay fleets. Each model is based on the condition and hence probability of failure of individual items within the fleet and the consequences of failure of each item. Changes in the summated risk of failure are compared for a variety of asset replacement scenarios to assist in determining the volume and timing of proposed replacement programs necessary to deliver a selected risk profile.

Program risk models in the areas of network availability, network reliability, environment, health and safety, infrastructure security and regulatory compliance form the next tier. These models use historical data on unplanned events and assessments of the degree of control SP AusNet has over these events through asset replacement programs (as represented by the asset failure risk models) and management improvement programs.

Network risk is measured by aggregating the program risks to a single assessment, which enables comparisons of sustainability over time.

4.2.2 Asset Failure Risks

4.2.2.1. Circuit Breakers

The SP AusNet circuit breaker fleet is now one of the oldest operated by international Transmission Network Services Providers[6] and the circuit breaker failure rate now exceeds the average of international TNSPs[7].

The 2008 failure risk profile shows that most circuit breakers are within the Low and Medium/Low risk rankings but significant groups of 500 kV and 220 kV circuit breakers are within the Very High ranking as shown in the following figure (Figure 11).

Also of concern is the huge volume of old 66 kV bulk oil circuit breakers which will migrate from the Medium/Low risk band in to the Medium risk band over the period 2008 to 2013.

[6] ITOMS 2005 Report - International Transmission Operations & Maintenance Study – Revision 6 May 2006

[7] G Mazza, R Michaca, "The first International Enquiry on Circuit Breaker Failures and Defects in Service" Electra No. 79 Dec 1981.

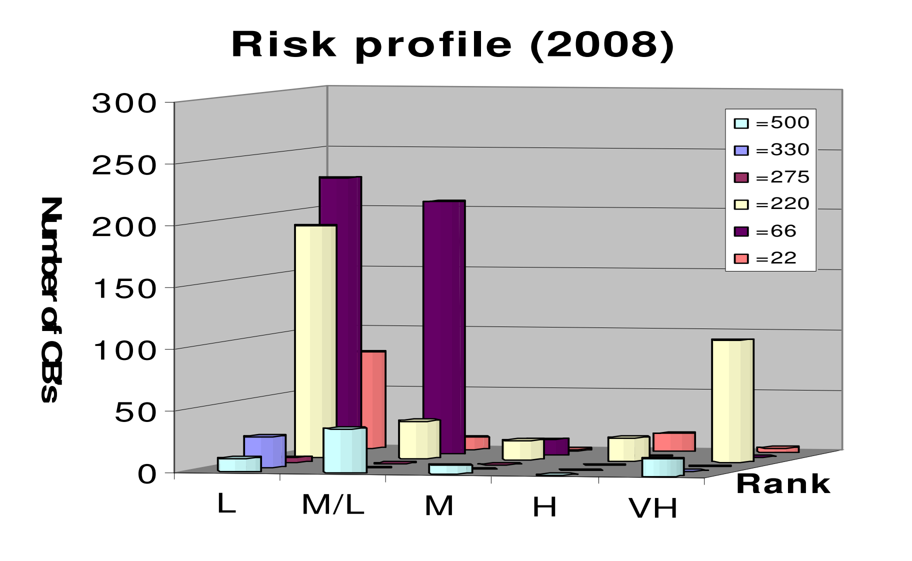


Figure 11 – Circuit Breaker Risk Profile

The integrated work program for 2006 – 2013 will improve circuit breaker risk through the progressive replacement of 260 air blast and bulk oil circuit breakers at Brooklyn, Dederang, Geelong, Glenrowan, Hazelwood, Horsham, Kerang, Morwell, Redcliffs, Ringwood, Rowville, Springvale, and Thomastown terminal stations and the Loy Yang and Hazelwood power station switchyards. The following figure (Figure 12) illustrates the:

- Risk compared with an old CB fleet (100 % of CBs with remaining life = 0 years)
- Rapid rise in risk if no renewal is undertaken
- Theoretical reduction in risk if no new or unforeseen issues arise in the old CB fleet, and
- Practical outcome of the renewal program (based on the difference observed between theoretical models and practical outcomes over the period 2002 to 2006.)

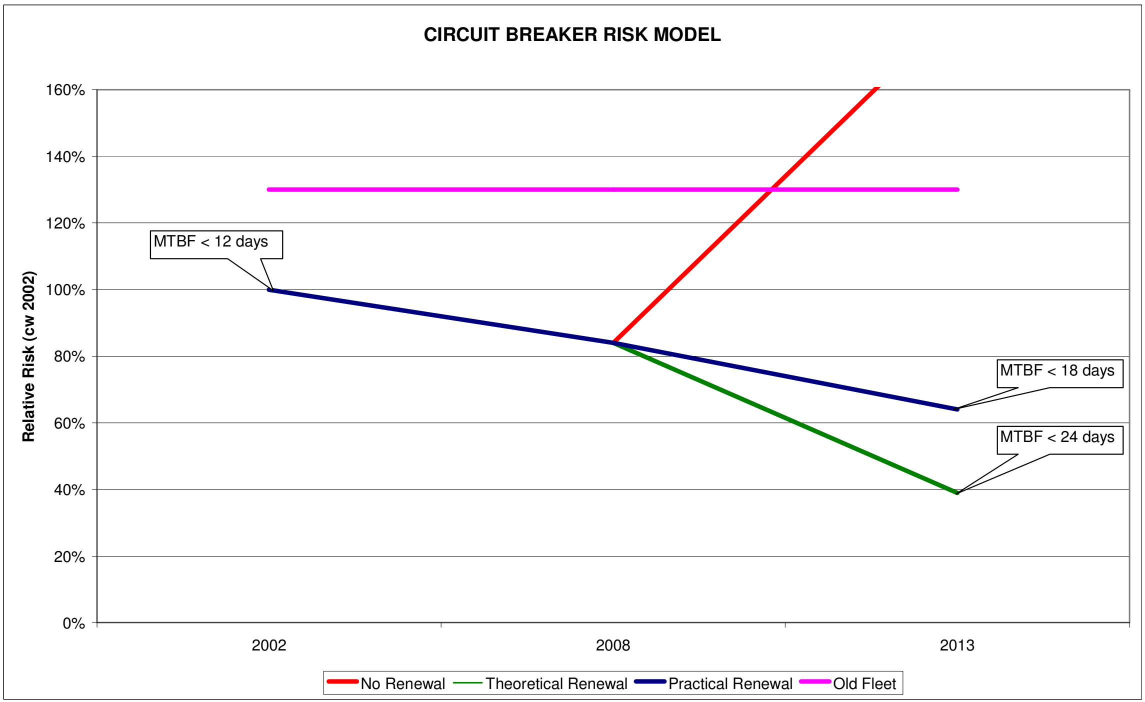


Figure 12 – Circuit Breaker Risk Summary

4.2.2.2. Current Transformer Risks

Several explosive failures[8] and the current, 120 day, Mean Time Between Failure (MTBF) rate confirm that single phase porcelain clad, oil insulated current transformers units now present an unacceptable risk of incurring availability penalties, supply outages, collateral equipment damage, environmental damage and possible injury to staff. A progressive replacement program has commenced in favour of toroidal CTs incorporated within plant such as dead-tank circuit breakers.

SP AusNet will remove a minimum of 580 single phase oil insulated CTs at Altona, Dederang, Fishermans Bend, Geelong, Moorabool, South Morang, Tyabb, Templestowe and Wodonga terminal stations by 2013 as part of a portfolio of terminal station refurbishment projects, bay replacements and like for like replacements.

This is the minimum acceptable risk reduction program consistent with the deterioration of single-phase oil insulated CTs as illustrated in the following figure (Figure 13).

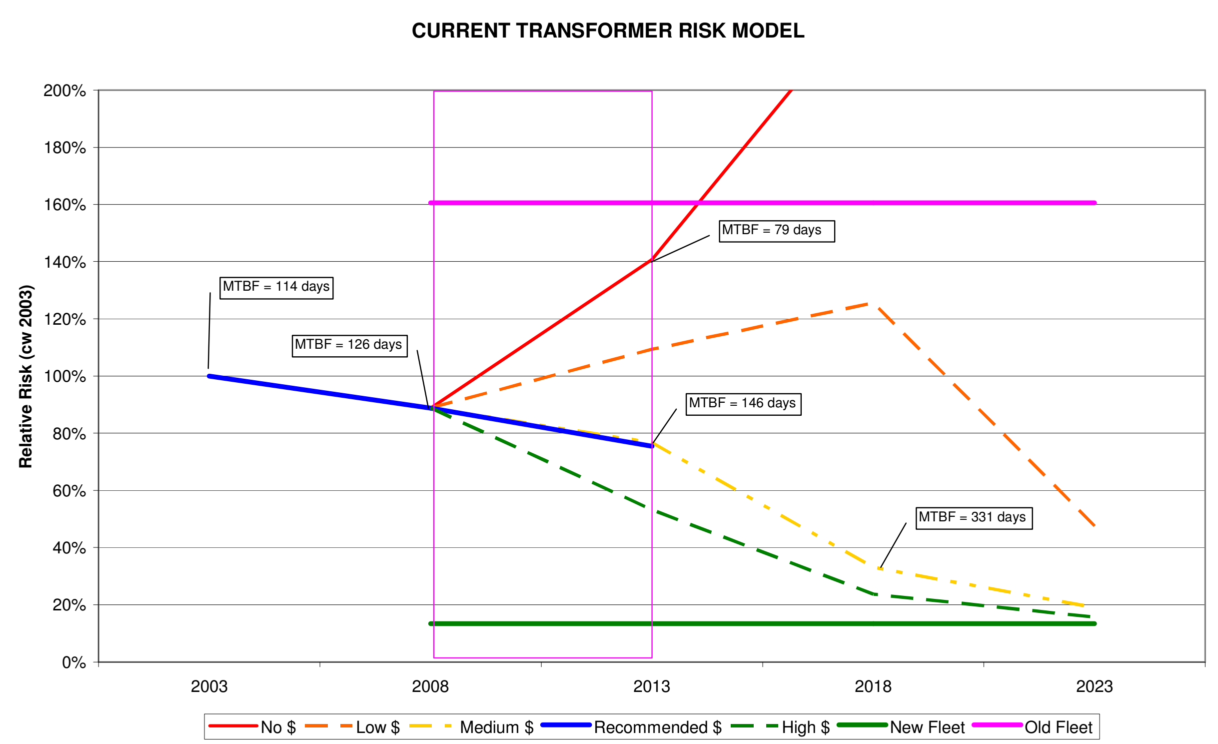


Figure 13 – Current Transformer Risk Summary

Also illustrated in the figure above (Figure 13) are the risks associated with a replace-on-failure strategy (No $) and comparisons with the risk position of an entire fleet of old CTs with no remaining life or alternatively the risk position of an entirely new fleet of oil insulated CTs. The issues driving current transformer risk are summarised in Section 7.2.

4.2.2.3. Transmission Line Insulator Risks

The decline in the line insulator MTBF rate since 1998 represents an unacceptable safety risk to society in the form of potential bushfires or motor vehicle accidents and an unacceptable business risk to SP AusNet through line availability penalties and potential liability claims associated with EHV conductors falling to ground.

[8] Moorabool Terminal Station 2002 & 2005, Jeeralang Terminal Station 2003, Ballarat Terminal Station 2006 and Terang Terminal Station 2006.

As shown in the following figure (Figure 14) the 2008 – 2013 insulator replacement program is focussed on maintaining a stable risk profile through the replacement of approximately:

- 9600 off 16mm pin diameter insulator strings located on 3200 tower-sides on 220 kV lines
- 1500 insulator strings located on 500 tower-sides on the Murray Switching Station to Dederang Terminal Station 330 kV lines, and
- 1500 insulator strings located on 250 tower-sides on the Hazelwood Terminal Station to South Morang Terminal Station and South Morang Terminal Station to Keilor Terminal Station 500 kV lines

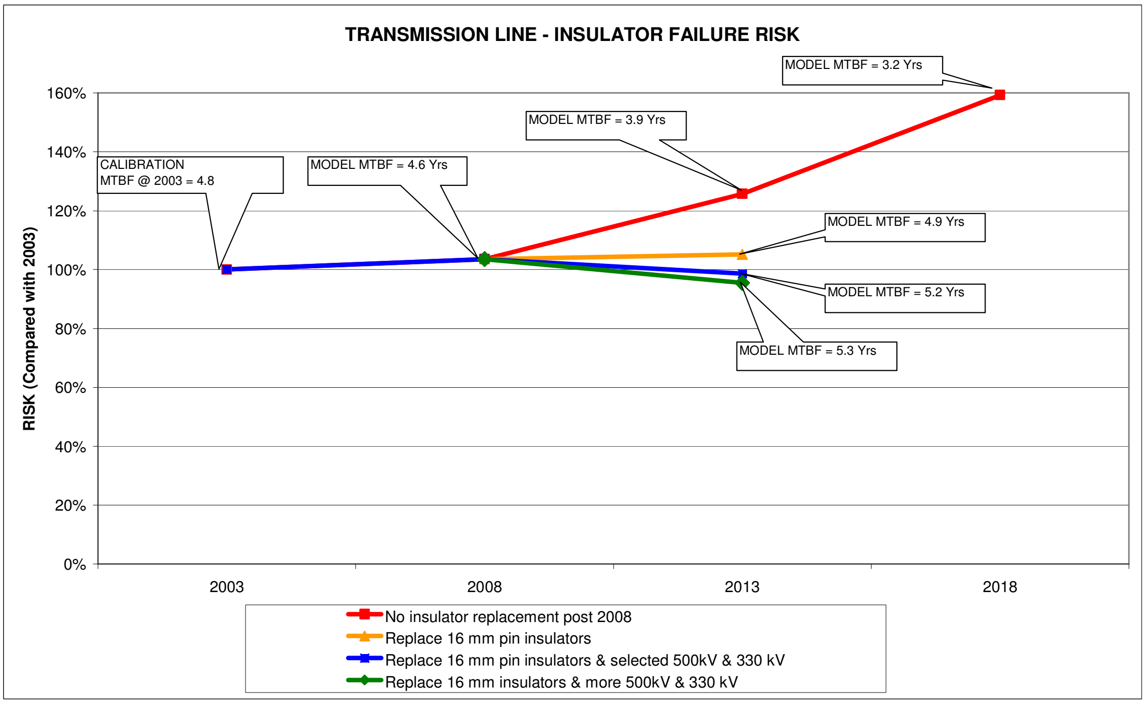


Figure 14 – Transmission Line Insulator Risk

The principle factors driving transmission line reliability and the remedial actions underway are summarised in Section 7.3.

4.2.2.4. Power Transformer Risks

The 2006 Power Transformer risk model is a quantitative model, which simulates the safety, environmental, reliability, availability and business risks associated with major failures on the entire fleet of more than 200 power transformers.

SP AusNet has set an objective of a sustainable risk position with respect to power transformers for the next decade.

The 2008 to 2013 work program includes replacement of two 3 phase units at Geelong Terminal Station and 57 single phase units at Bendigo, Brunswick, Dederang, Glenrowan, Ringwood, and Thomastown Terminal Stations and the removal of the Group 5 units at Yallourn Power Station to provide the stable risk position shown in the figure below (Figure 15).

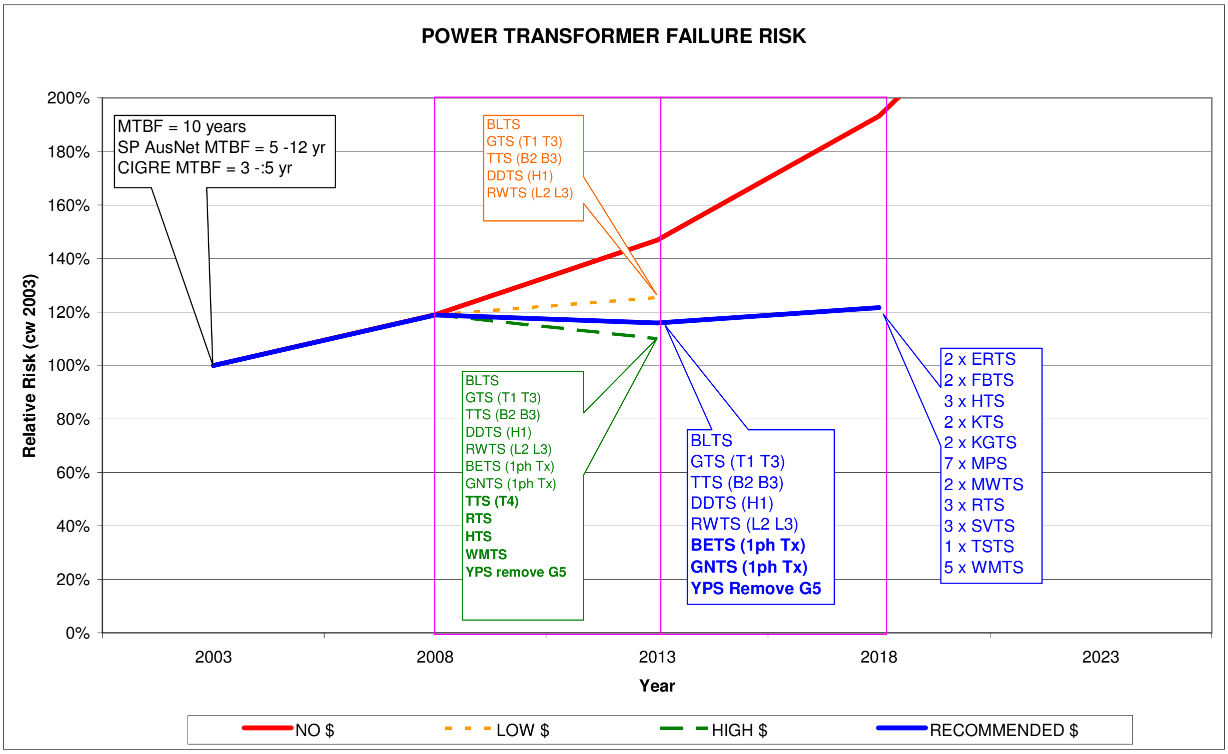


Figure 15 – Power Transformer Risk

Preliminary modelling of the period 2013 to 2018 indicates that replacement of a further 26 (mostly) three-phase transformers will continue to provide a stable risk position.

4.2.2.5. Protection Relay Risks

The protection relay model quantifies the functionality risk of more than 2300 measurement relays protecting lines, transformers, buses and reactive plant. It calculates, over time, the relative reduction in functionality of each relay when compared with that of an equivalent electronic digital relay and the associated risk of incurring unnecessary operating costs to ensure that protection schemes operate correctly, remain calibrated and meet the regulatory demands for increased operating speed and verifiable availability.

Acknowledging the low estimated remaining life of secondary systems, SP AusNet set an objective to improve the risk position of protection relays for the period 2008 to 2013 and scenarios were modelled to quantify the work required to deliver this outcome as illustrated in the following figure (Figure 16).

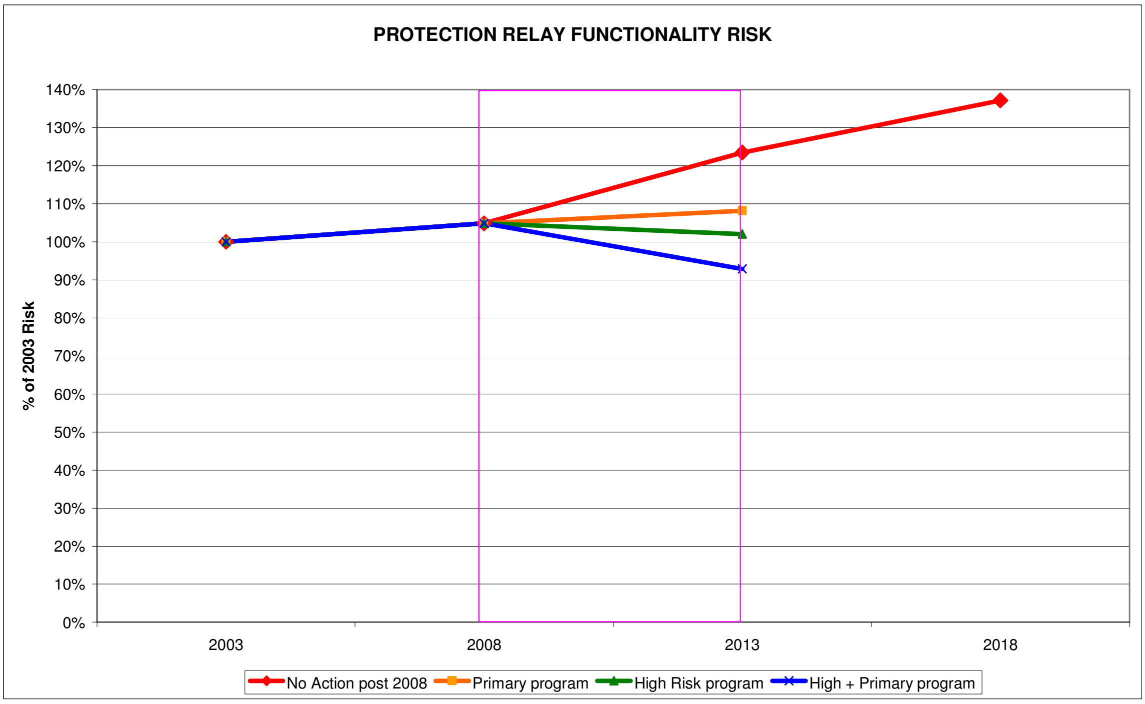


Figure 16 – Protection Relay Functionality Risk

The ‘High + Primary program’ in the figure above (Figure 14) includes replacement of 433 relays (19% of fleet) either, in conjunction with high-risk primary equipment or as stand-alone high-risk relay replacement projects. This program is a key factor in meeting the NER requirements for operating speed, protection availability and redundancy. It is the minimum acceptable risk reduction program which, based on current models, will provide a 7% improvement over the 2003 risk position.

4.2.3 Program Risk

Models in the areas of network-availability, network-reliability, environment, health and safety, infrastructure security and regulatory compliance form the program tier. Program models use historical data to establish the frequency and consequences of unplanned events and assessments of changes in the degree of control SP AusNet has over these events through completion of asset replacement programs (as represented by the asset failure risk models) and management improvement programs.

4.2.3.1. Reliability Risk

Modelling indicates a stable risk profile based around a long-run average of four retail interruptions and 0.5 system minutes unsupplied per annum. Over time the number of unplanned interruptions, numbers of system incidents, levels of equipment utilisation and the value of energy not supplied are placing upward pressure on reliability risk.

The base level of network reliability is established through network configuration, the levels of asset redundancy and equipment utilisation set by the five distribution businesses and VENCorp.

SP AusNet’s condition monitoring, contingency preparations and maintenance, refurbishment and replacement programs are pivotal in stabilising reliability risk at levels equivalent or slightly better than the previous decade.

4.2.3.2. Availability Risk

Modelling suggests an increasing wedge of availability risk in future years that is driven by:

- The relatively high number of planned outages essential to the maintenance, refurbishment and replacement of deteriorating assets
- Increases in incentive rates and broadening of the scope of the incentive schemes to include customer projects
- Increasing exposure to incentive downside due to the higher utilisation of lines and transformers
- The high number and complexity of control system switching sequences needed to manage system fault levels

The volume of planned maintenance, refurbishment and replacement work that is necessary to manage the reliability of deteriorating assets is the main control over availability risk. Online condition monitoring, improved risk modelling and sophisticated outage planning will only partially offset the impact of planned outages.

> SP AusNet also notes that VENCorp's VISION 2030 foresees the need to up-rate a number of 220 and 330 kV circuits prior to 2015. If these projects were included within the scope of an availability incentive scheme then the dynamics rating of the availability model would feature a sharp rise. They have not been included in this edition of this model as the need and timing are yet to be confirmed in the VENCorp Annual Planning Report.

Modelling suggests an increasing wedge of availability risk in future years that is driven by increasing financial consequences and the increasing high volumes of maintenance, refurbishment and replacement projects necessary to manage deteriorating asset condition.

4.2.3.3. Health and Safety Risk

Factors in an improving health and safety risk for the forecast period include:

- Gradual improvement in the number of health and safety incidents
- Slow linear increase in the consequential costs of health and safety events
- Replacement programs for transmission line insulators and oil insulated single phase current transformers
- Removal of Asbestos Containing Materials (ACMs)
- Progressive completion of tower safe access, working at heights, fire detection and suppression, cooling tower operation, RF field and EMF mitigation programs

Modelling suggests a measurable improvement in health and safety risks through the next decade, largely driven by continuing progress on replacement programs for line insulators, oil insulated current transformers and ACMs.

4.2.3.4. Environmental Risk

Environmental risk has varied in recent years. Modelling indicates stability in the number of environmental events and a very slow linear increase in the consequence of events. Key factors in the assessment of improving control over environmental risks include:

- Power transformer, current transformer and circuit breaker replacement programs that will significantly reduce the volume of oil-insulated equipment in service over the next decade

- Progressive completion of oil spill containment and site water treatment programs at terminal stations
- Systematic improvements in transformer noise emissions, switchgear SF_6 gas emissions, vegetation management, bushfire mitigation, PCB removal and visual impact of major installations.

Modelling suggests a measurable improvement in environmental risks driven predominantly by a significant reduction in the volume of insulating oils in service and improved oil spill control and site water treatment.

4.2.3.5. Infrastructure Security Risk

Infrastructure security risk has been driven by cyclic variations in the numbers of security events and the increasing consequences associated with public safety. Terrorism has emerged as a new factor in the last eight years.

The majority of security events are attempted thefts, motivated by high scrap metal prices for copper and aluminium. However, the recent changes in anti-terrorism legislation highlight the potential for an extreme consequence event, should an intruder damage key equipment causing loss of supply to large numbers of customers. The risk associated with a member of the public suffering an electric shock following unauthorised access to infrastructure continues.

Sound progress is being made on an extensive security enhancement program that includes measures to deter, delay, detect and respond to intruders. This is improving control over security risk.

Modelling indicates a stable and declining security risk with observable performance improvements. This modelling is heavily dependent on the prioritised completion of electronic access controls, security fencing, building exterior hardening, motion detection, CCTV, continuous alarm monitoring, emergency management and contingency planning for terminal stations.

4.2.3.6. Code Compliance Risk

After a significant increase in code compliance risk associated with the re-structuring of the Victorian electricity industry and the emergence of a National Electricity Market, recent years have seen a gradual improvement as these regimes mature. Models suggest slow linear increases in the volume and complexity of regulation. Process transparency expectations and due diligence expectations are also providing upward pressure on compliance risks.

A regulatory management team and a formal compliance management process, which includes risk assessments, reviews and audits is providing stability and improving control.

SP AusNet's protection and communication investments contribute to improving code compliance in the areas of EHV protection operating-speeds and redundancy. Significant investments are required in communication systems to enable full compliance with the technical requirements of the National Electricity Rules.

Overall progressive improvement is expected in Code Compliance risk.

4.2.4 Network Risk

As represented in the following figure (Figure 17), the network risk profile includes historic, current and forecast risk. Aggregating the aforementioned assessments of reliability, availability, health and safety, environment, infrastructure security and code compliance risks creates a Network Risk profile for the period 1995 to 2015 which suggests improving and stabilizing risk for the Victorian electricity transmission network.

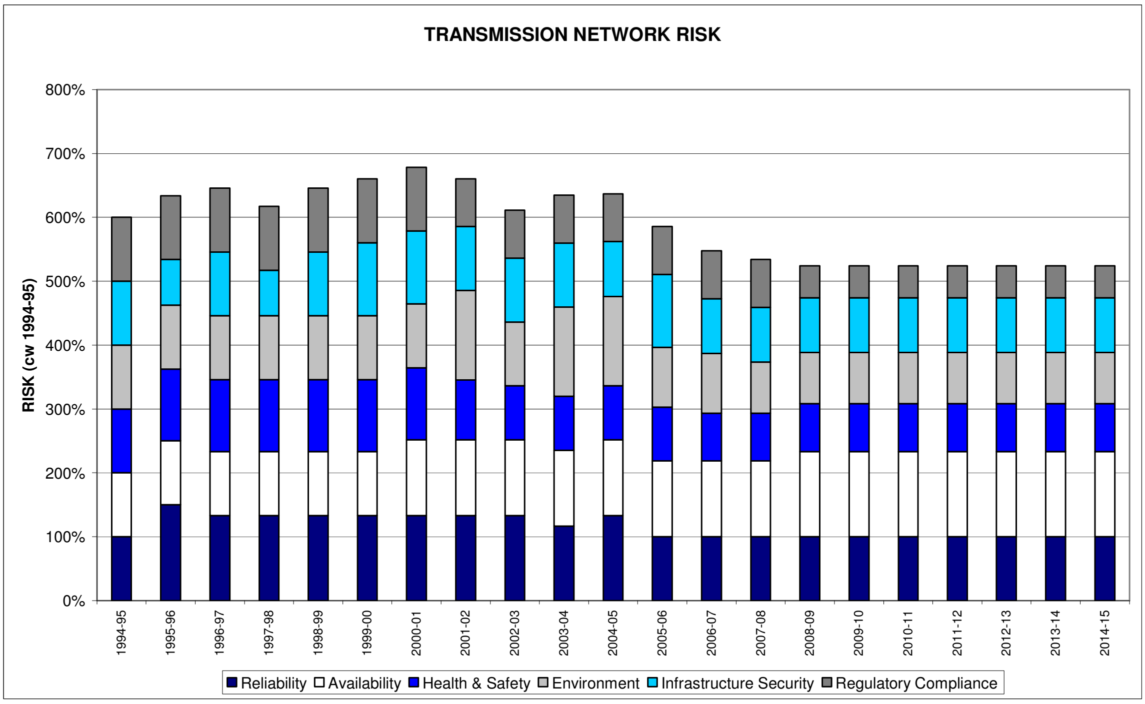


Figure 17 – Network Risk Profile

4.3 Network Augmentation

> "Continuing growth in demand, increasing network fault level restraints and high equipment utilisation levels are increasing network augmentation levels"

4.3.1 Demand

Summer maximum demand is forecast[9] to grow faster than annual electricity consumption at an average growth rate of 2.0% pa over 2006/07 - 2010/11, and then 1.9% pa over the following five years to 2015/16. This change reflects a slower penetration of cooling appliances and the impact of state greenhouse policies. This forecast is illustrated in the following figure (Figure 18).

[9] Electricity Annual Planning Report 2006 - VENCorp

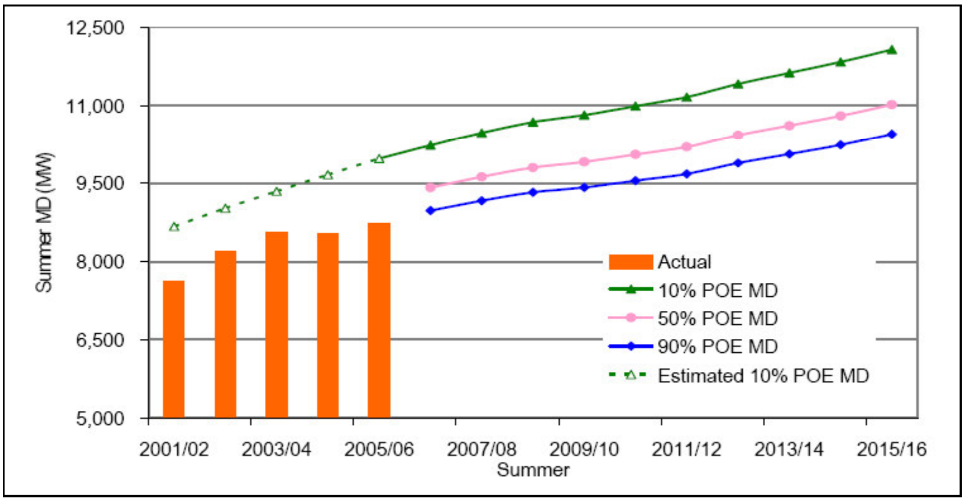


Figure 18 – Summer Maximum Demand

To meet this demand:

- Approximately 2,250 MW of new generation capacity will need to be added by 2015/16 (assuming 1,900 MW import from NSW and 600 MW import from Tasmania)
- Augmentation of the Victoria to Snowy interconnector capability[10] will require investigation
- Fourteen shared-transmission network transformer and line constraints[11] will require resolution
- Thirty-four constraints[12] in the transmission connection networks will need to be addressed

In the longer-term, the VISION 2030[13] identifies 44 shared-transmission network development opportunities for the next 25 years. For further information on continuing demand please refer to Business Environment Assessment.

4.3.2 Network Fault Levels

Annual analysis[14] shows network fault levels are continuing to rise at approximately 1% per annum as illustrated in the following figure (Figure 19).

[10] NEMMCO Statement of Opportunities 2005 - Annual National Transmission Statement
[11] Electricity Annual Planning Report 2006 - VENCorp
[12] Transmission Connection Planning Report – Victorian Electricity Distribution Businesses 2005
[13] 25 Year Vision for Victoria's Energy Transmission Networks OCTOBER 2005 – VENCorp
[14] Transmission Network Short Circuit Levels 2006-2010 Victoria – VENCorp December 2005

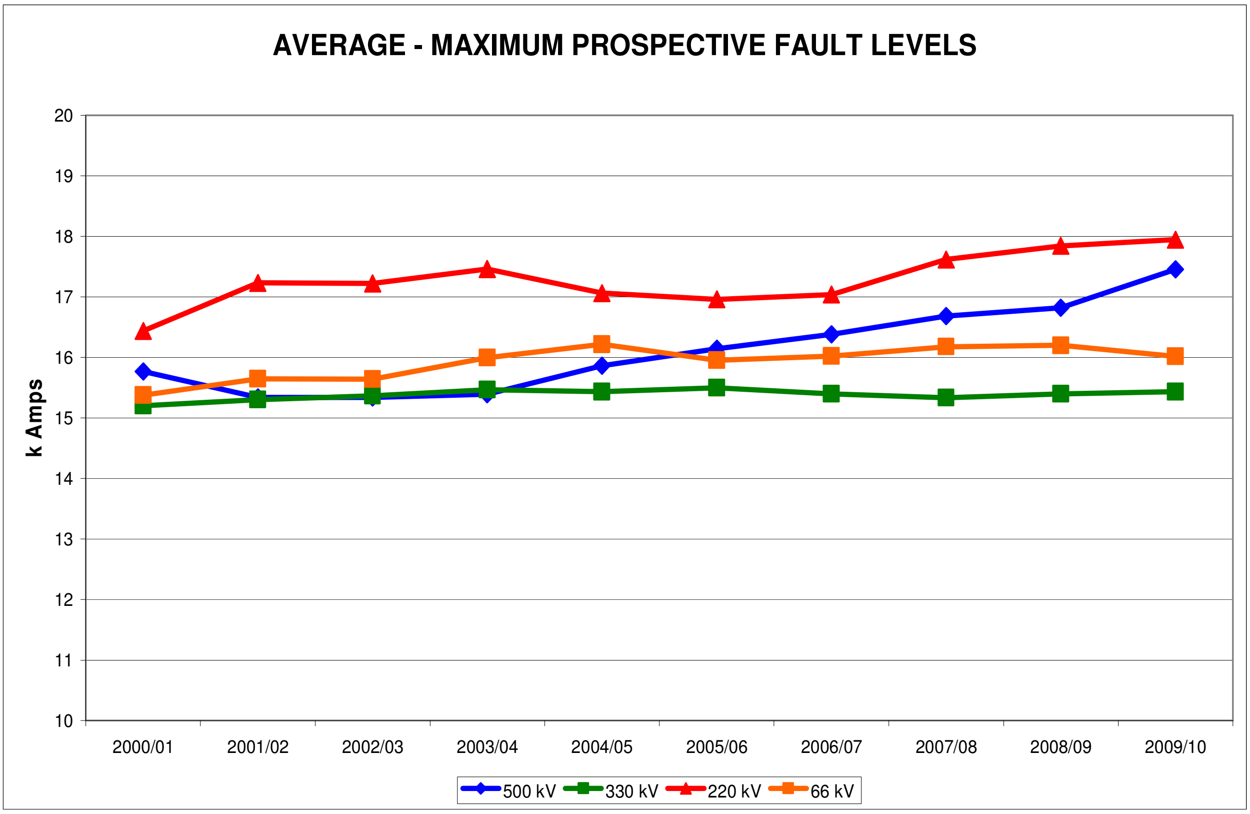


Figure 19 – Average Maximum Prospective Fault Levels

Significant proportions of switchgear are operating at fault levels that are close to their rating. In particular, 45% of 220 kV and 29% of 66 kV circuit breakers are exposed to maximum prospective fault levels, exceeding 90% of the rating assigned when they were manufactured.

Operational switching arrangements have been implemented to maintain fault levels within plant ratings at 39% of terminal stations. The complexity of the operational controls coupled with the inherent reduction in plant redundancy (and hence network reliability), the increased operational costs and associated business risk borne by the network owner/operator make this approach unsustainable.

A significant challenge involves management of the 220 kV fault levels at Hazelwood Power Station and Keilor, Rowville, Thomastown and West Melbourne terminal stations where the bus fault level already exceeds, or is forecast to exceed, the rating of the lowest rated circuit breaker.

VENCorp has initiated the collaboration of generators, DBs and SP AusNet on a strategy for fault level mitigation, considering the impact of network augmentations and VENCorp's VISION 2030 outcomes.

For further information please refer to Business Environment Assessment.

4.3.3 Equipment Utilisation Levels

Maximum load on the transmission network has been growing at almost 3% per year since 1994 and is forecast to continue at 2% p.a. for the next ten-year period[15].

> At present, 35% of transformer banks[16] and 14% of transmission lines[17] are now operating with a redundancy level less than 'N–1' during periods of peak demand.

[15] Electricity Annual Planning Report 2006 – VENCorp.

While increased utilisation is generally desirable because it lowers the unit cost of transporting power, it increases losses and places additional demands on asset reliability and availability as:

- Assets are deteriorating at faster rates than has been the case historically, increasing the need for sophisticated condition assessment programs and accelerating asset replacement programs
- Diminishing plant redundancy imposes limits on when equipment can be accessed for maintenance, repair, modification or replacement, which necessitate increases in on-site project labour and out-of-business hours workloads
- Contingency plans and higher levels of strategic spares are necessary to avoid the situation where failure of one piece of equipment places customer load at risk for long periods
- Reliability of protection and control systems must increase

To manage the risks associated with high utilisation levels, SP AusNet has implemented:

- Sophisticated condition monitoring of in-service equipment with specialised equipment, data acquisition and analysis
- Sophisticated outage planning with emphasis on efficient manning levels, availability of specialised maintenance and test equipment, temporary network configurations and task sequencing to reduce contingency risks and to limit availability penalties
- Increased strategic spares holdings, including major plant holdings
- Accelerated plant and equipment replacement programs

For further information please refer to Business Environment Assessment.

4.4 Compliance and Performance Improvements

> "Code compliance and health and safety, environment and infrastructure security performance improvements"

Unplanned events and new regulatory obligations have focussed SP AusNet on securing major performance improvements in code compliance, health and safety, environment and infrastructure security.

4.4.1 Code Compliance

After a significant increase in regulatory obligations associated with the re-structuring of the Victorian electricity industry and the emergence of a National Electricity Market, recent years have seen a steady improvement in code compliance as these regimes mature.

Improving compliance to the National Electricity Rules in the areas of EHV protection operating speeds and redundancy is a specific focus of SP AusNet's protection and communication investments. Further investments are required in communication systems to enable full compliance with the technical requirements of the National Electricity Rules.

[16] SP AusNet monitoring
[17] Electricity Annual Planning report 2006 - VENCorp

4.4.2 Health and Safety

Victoria's Occupational Health and Safety (Asbestos) Regulations 2003 imposed more rigorous restrictions on the control of asbestos materials to prevent contamination of the work environment with asbestos dust. The major issue is the progressive removal of asbestos from terminal station buildings, generally in the form of wall, roof, eave and ceiling cladding and/or panels supporting electrical relays.

Compliance with the Occupational Health and Safety (Prevention of Falls) regulations require more rigorous job safety assessments and the increased use of ladders, motion control screens, fall restraint systems, mobile plant, scaffolds, handrails and walkways and to ensure the safe performance of work at heights greater than 2 m.

Pending recommendations from ARPANZA on electro-magnetic fields are expected to require additional control measures to ensure safe working conditions near energised, extra-high voltage electrical equipment. Further improvement in SP AusNet's health and safety performance will be largely driven by:

- Removal of asbestos containing materials as part of terminal station redevelopment projects
- Progress on the installation of ladders, screens and fall restraint on transmission line towers and in terminal stations

For further information on health and safety please refer to Health and Safety Management.

4.4.3 Environment

Greenhouse gas emission legislation is expected to mandate additional obligations in the management of SF_6 gas insulated switchgear. Risk management processes driven by the SP AusNet Environmental Management System[18] have identified the following environmental obligations:

- Oil discharge - comply with EPA Victoria's 'Bunding Guideline Publication 347', AS1940 and standards on water quality discharges
- Noise - comply with the State Environment Protection Policy (Control of Noise From Commerce, Industry and Trade)"
- Electro-magnetic fields – responding to the federal Telecommunications Act and community health concerns about long-term exposure to Electro-magnetic fields
- Greenhouse gas emissions - SF_6 usage and gas insulated switchgear leakage rates are the most significant elements of emission reductions
- Poly chlorinated biphenyls (PCBs) – outworking an Environment Improvement Plan submitted to the Victorian EPA
- Vegetation - minimise fire hazards and risks to supply security
- Visual intrusion – improving the appearance of existing installations and amending the design of new installations to secure community support

A major improvement in environmental performance is expected through the next decade; when the reduction in the volume of oil-insulated equipment in service, delivered by the power transformer, current transformer and circuit breaker replacement programs, is coupled with progressive completion of oil spill containment and site water treatment plants at terminal stations.

For further information on remedial programs please refer to Environmental Management

[18] ENV01 Environmental Policy & Guide

4.4.4 Infrastructure Security

The Victorian Terrorism (Community Protection) Act 2003 requires electricity and gas providers to develop and monitor risk management plans, including all appropriate, preventative security and emergency restoration measures. In addition, critical comment from a 2003 NSW Coroner's investigation into several fatalities was the impetus for the Electricity Supply Association of Australia (ESAA) to release new guidelines for the prevention of unauthorised access to various electrical installations.

Security risks have been quantified using a purpose built Infrastructure Security Risk Assessment Tool (ISRAT), which integrates the principles of AS/NZS 4360, National Guidelines for the Prevention of Unauthorised Access to Electricity Infrastructure[19] within REALM[20], an objective risk assessment methodology.

The Terminal Station & Communication Site Physical Security Policy[21] provides the context and rationale supporting the progressive introduction, improvement and integration of security measures including, fencing, electronic access controls, intrusion detectors, closed circuit television cameras, security lighting, building exterior hardening and remote alarm monitoring by the Network Operations Centre. Improvements include event investigation and reporting, control measure audits and contingency plans.

For further information please refer to Infrastructure Security.

4.5 Efficiency

> "Continuing efficiency demands are elevating asset management practice"

4.5.1 Asset Management Planning

In 2002, The Office of Gas and Electricity Markets (Ofgem), the UK market Regulator conducted an asset risk management survey of the large electricity and gas network operators "to explore the medium/long term asset risk management practices".

Recently, Jervis Consulting conducted this survey (using the Ofgem information), to analyse SP AusNet's current "asset risk management performance and where to target improvements"[22].

It was found:

> "SP AusNet is undertaking its asset risk management activities in a structured and sound manner and is at, or better than, most best practices identified in the UK Ofgem study".

[19] National Guidelines for Prevention of Unauthorised Access to Electricity Infrastructure – ENA DOC 015-2006
[20] 30-2650 Risk Assessment Methodology
[21] Terminal Station & Communication Site Physical Security Policy – SP AusNet 2006
[22] Report on Asset Risk Management Survey conducted for SP AusNet – Jervis Consulting August 2006.

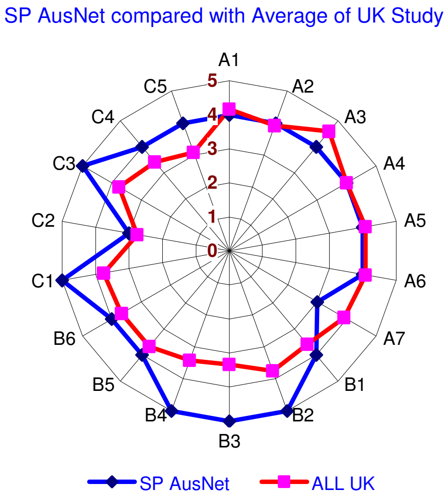


Figure 20 – Comparison with UK Average

The preceding figure (Figure 20) shows SP AusNet performs well against the average of the 12 UK companies:

- In Section A, Business Strategy and Direction, performance is generally equal to the average
- In Section B, Asset and Network Strategy, SP AusNet outpoints the average in all categories.
- In Section C, Asset Life Cycle Management, SP AusNet again shows superior performance in all segments.

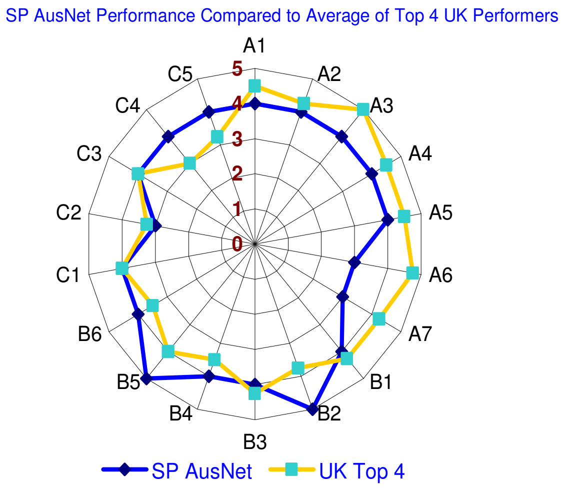


Figure 21 – Comparison with UK Best Practice

The preceding figure (Figure 21) shows SP AusNet will benefit from establishing relationships with the best performers to improve in Section A, *Business Strategy and Direction*.

SP AusNet had been monitoring the maturity of the British Standards Industry's publicly available *Specification for the optimised management of physical infrastructure assets* (PAS 55) for some time.

The findings of the Jervis review[23] have focussed SP AusNet's asset management improvements on achieving accreditation to this recognised international standard. SP AusNet is now seeking partners to facilitate preparation, and ultimately accreditation to BSI PAS 55 by 2008.

4.5.2 Asset Management Delivery

The 2005 International Transmission Operations and Maintenance Study (ITOMS) confirmed SP AusNet's continuing 'top quartile' performance in transmission line related maintenance and terminal station related maintenance amongst international Transmission Network Service Providers (TNSPs). As in previous years, the 2005 study[24] compared TNSPs from Asia, Australia, New Zealand, Europe, Middle East, North America and South Africa on 12 detailed measures and two high-level composite measures of line and station maintenance.

The 2005 results again illustrated significant variations in the 'study-to-study' performance of participants due to differing interpretations of the data definitions, improving asset and financial data capture and re-balancing of individual maintenance priorities to meet short-term needs. This makes detailed spot comparisons between companies unwise, but broader comparisons of performance with peer and region averages over several studies are sufficiently accurate to determine SP AusNet's continuing 'top quartile' productivity and efficiency.

Figure 22 – ITOMS 2005 Line Maintenance Benchmark

The preceding figure (Figure 22) compares SP AusNet's performance with the averages for international and Asia Pacific peers in the composite category of line related maintenance. The following figure (Figure 23), compares performance in the composite category of Station related maintenance.

[23] Report on Asset Risk Management Survey conducted for SP AusNet – Jervis Consulting August 2006.

[24] International Transmission Operations and Maintenance Study 2005 Report

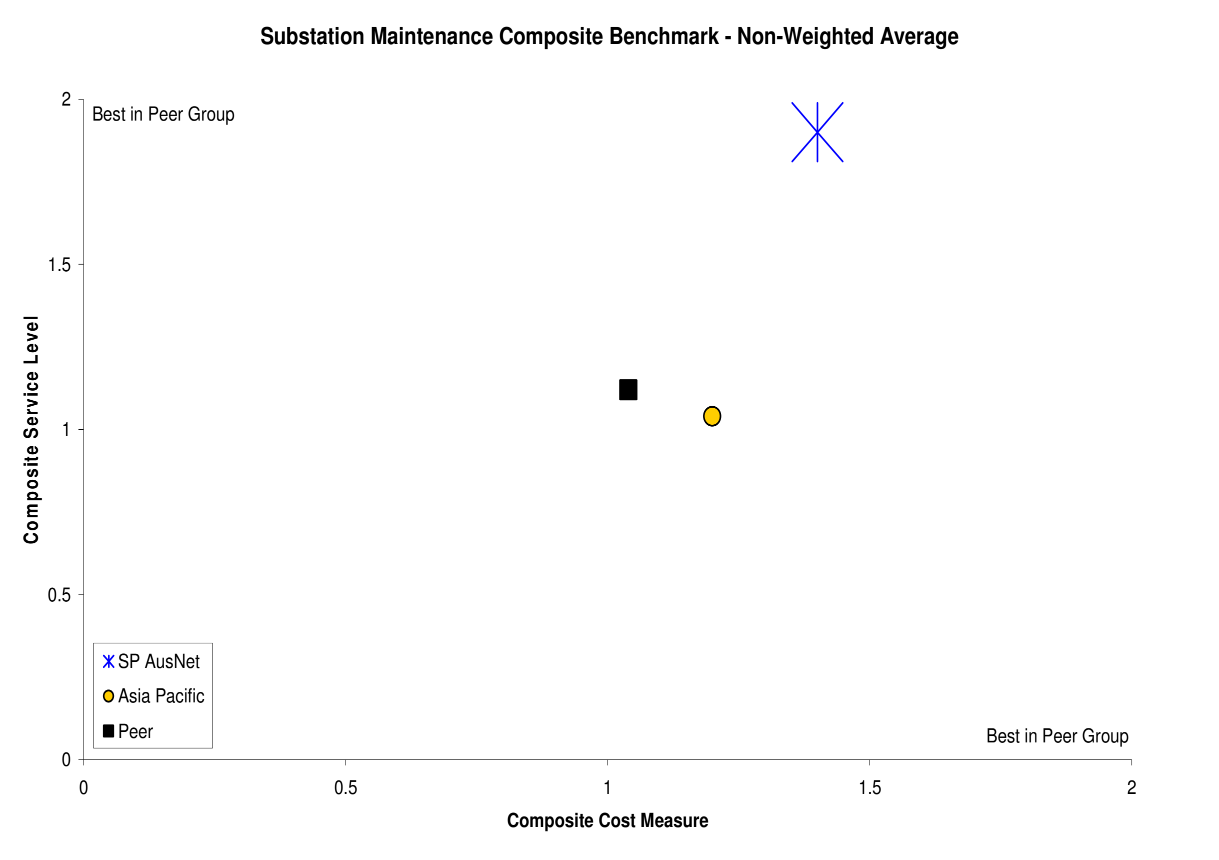


Figure 23 – ITOMS 2005 Station Maintenance Benchmark

The following table (Figure 24) demonstrates SP AusNet's 2005 service and cost was independently assessed by ITOMS as '"superior" to that of international or Asia - Pacific peers on 70% of detailed comparisons and was "competitive" on a further 15% of detailed comparisons.

SP AusNet Performance Compared with 2005 ITOMS Averages				
	Service		Cost	
Maintenance Category	International Peers	Australian Service Providers	International Peers	Australian Service Providers
Overhead Line	Superior	Superior	Superior	Superior
Overhead Line Inspection and Patrol	Superior	Superior	Superior	Superior
Right of Way	Superior	Competitive	Competitive	Inferior
Relay SCADA and Communications	Superior	Superior	Superior	Superior
Transmission Circuit Breaker	Competitive	Superior	Superior	Competitive
Transformer	Superior	Superior	Superior	Superior
Compensation Equipment	Superior	Superior	Superior	Superior
Disconnector and Earth Switch	Superior	Superior	Superior	Competitive
Instrument Transformer and Circuit End Equipment	Inferior	Inferior	Superior	Superior
Substation Site and Auxiliary Equipment	Superior	Superior	Inferior	Inferior
Field Switching Operations	Inferior	Inferior	Superior	Superior
Support Services Expenditure	NA	NA	Competitive	Competitive

Figure 24 – ITOMS 2005 Comparative Performance Benchmarks

4.6 Technology

> "Emerging viability of new technologies"

4.6.1 Vision 2030

VENCorp's Vision 2030[25] outlines a 25-year vision for Victoria's core energy transmission infrastructure. It details the potential requirement for a $1 to $2 billion investment in new transmission capacity to meet the state's growing needs, including key findings on:

> "The overall topology of intra-state networks is likely to remain largely unchanged but each class of elements within that topology may require substantial augmentation"
>
> "Long-haul, bulk energy transmission may be required to bring more remote gas to Victoria or to support major, bulk exchange of electricity with other states"

Vision 2030 also highlighted a number of issues that are likely to require special attention in the next 25 years:

- Need for an audit of existing electricity and gas transmission easements to identify potential, additional capacity and actions to protect future access to easements and nominated sites
- Joint planning studies are required between distributors and planning authorities to define long-term options for bulk energy supply to inner Melbourne and Geelong
- Definition and communication of transmission project requirements so that market participants are fully informed of the need for early investment signals
- A technical investigation is warranted to define a long-term for the management of electricity transmission network fault levels, especially in Melbourne and the Latrobe Valley
- A detailed review of operational constraints on the network caused by high utilisation levels, and a discussion of available options to accommodate them
- A study to identify the effects of increasing wind-power generation on the electricity transmission network
- An in-depth assessment of skills availability and the surety of market place provision, especially in electricity transmission engineering
- A review of the suitability of current regulatory approaches to network planning and investment justification

4.6.2 25 Year Transmission Network Vision

Guided by the NOUS group, SP AusNet developed its own long term thinking on the future for electricity transmission, through a 25-year Vision[26] – primarily to increase strategic awareness and

[25] 25 Year Vision for Victoria's Energy Transmission Networks OCTOBER 2005 – VENCorp

[26] SP AusNet Transmission Vision 2030 –"*A 25 year Vision for the electricity transmission business",* July 2006 – The NOUS Group.

flexible thinking among managers and staff but also to influence planning organizations and to inform shareholders.

4.6.2.1. Critical Business Capabilities

A scenario planning approach was used to explore the boundaries of the possible 25-year future and clarify three critical business capabilities:

- Capability for strategic network development
- Capability to deliver modular relocatable plant designs
- Capability to deploy digital systems

4.6.2.2. Implications for SP AusNet

Network Planning - SP AusNet's relatively passive role in network planning may not continue unaltered, especially in intra-state transmission planning. Potential drivers for change include moves towards a national planner and possibly increased contestability, e.g. of connection assets. Any moves to make infrastructure owners more accountable for overall reliability and security will also necessarily increase their involvement in network planning.

New Technology Adoption - Scenarios underline the importance of SP AusNet maintaining core expertise on a range of transmission technology developments. The continuing need for cost efficiency and performance improvements will drive comprehension and the adoption of:

- HVDC lines and converters
- EHV cable technology
- High temperature conductors
- Super conducting plant
- Cheap modular station builds
- Modular embedded generation units
- Relocatable transmission plant
- FACTS devices and power electronics
- High capacity fibre telecoms networks
- Integrated secondary systems
- IP based communications networks
- Risk management/trading models
- Network planning tools.

Workforce Capability - Scenarios illustrate that a strong asset base and access to new technology will not by themselves ensure business success – the capabilities of SP workforce will be critical. In particular, balanced commercial/technical acuity and flexible strategic thinking must be present throughout the organization at all levels. It is more likely that regulatory and market developments will drive change, rather than technology. SP AusNet will need a workforce that understands these developments and is capable of harnessing new technology in strategic responses that ensure business success.

For further information please refer to Business Environment Assessment.

4.7 Skills and Resources

"Potential workforce skilling demands"

An important business driver is the increasing age of the SP AusNet technical workforce.

The average age of the transmission engineering workforce is 49 years, of whom 44 % exceed the potential retirement age of 55 years as illustrated in the figure below (Figure 25).

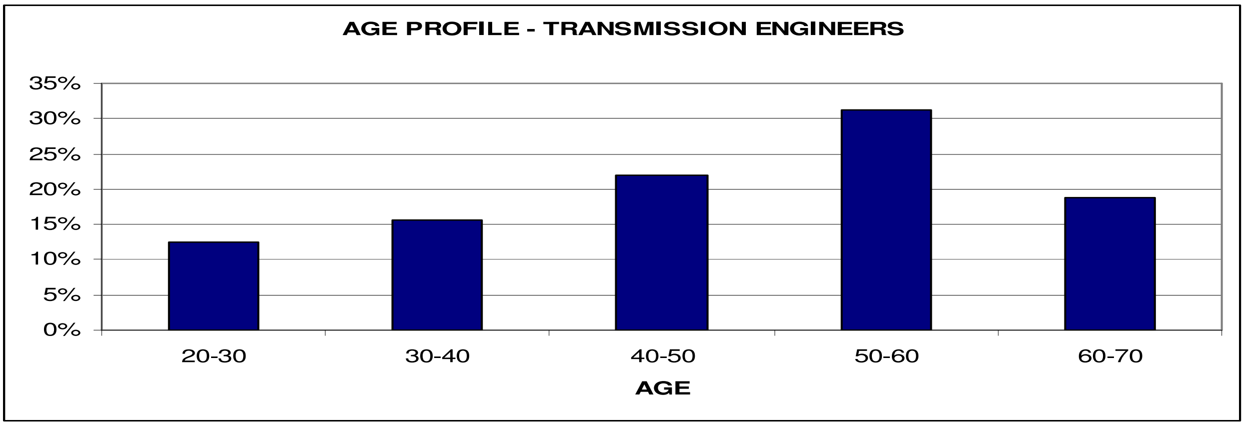


Figure 25 – Age Profile Transmission Engineers

In the field, 59% of transmission power technicians are over the age of 45 and 31% have reached a potential retirement age as illustrated in the figure below (Figure 26).

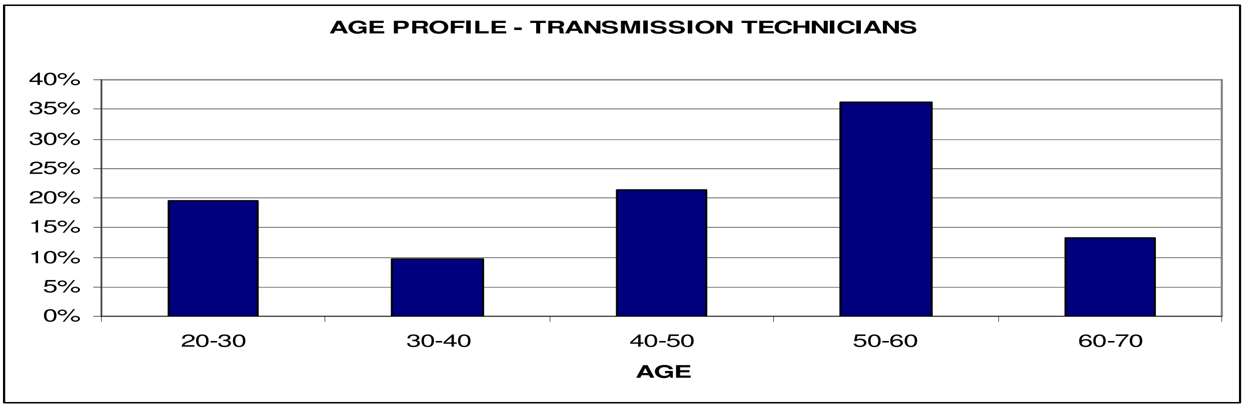


Figure 26 – Age Profile Transmission Power technicians

The Queensland Electricity Review[27], acknowledged a growing shortage of skilled resources in the electricity industry, particularly in planning, protection engineering and line workers. The increased capital programs that are taking place in Queensland, NSW and SA together with the projected requirements in Victoria will place a significant strain on the already limited resources.

This finding was confirmed by a 2004 KPMG study that noted, there are "two key developments affecting the supply of skilled labour in the Victorian electricity industry, specifically the aging workforce and an emerging skills shortage"[28].

The Industry Skills Report[29] confirmed that utility skill shortages are widespread and likely to be sustained in a number of allied industries, as illustrated by the following extracts:

[27] Report of the Independent Panel on Electricity Distribution and Service delivery for the 21st Century, Queensland, July 2004
[28] Draft - Trends in Labour Rates and CPI-X Regulations – October 2004 KPMG
[29] Industry Skills Report – Electro Comms & Energy Utilities Industries Skills Council October 2004

> "The electricity and gas industries have higher proportions of their workforces aged 40 to 54 years, compared with the average across all industries. It remains to be seen whether these workers will continue on until the attainment of retirement age."
>
> "Skill shortages are widespread across the industry with many enterprises experiencing difficulty in locating suitable candidates to fill available positions."
>
> "Employment in electricity supply industry, which directly employs 45,000 people, is forecast to decline over the period 2011-12"

This potential reduction in skilled labour is a significant business risk.

SP AusNet has commenced the progressive renewal of its workforce and Workforce Planning to establish and secure its medium to long-term skilled resource requirements.

In addition to expected staff turnover, recruitment of up to six graduate electrical engineers and up to 30 power technicians is planned for the period 2006 – 2011 to underpin transmission network engineering and technical capability for the longer term.

Further analysis and detailed remedial strategies can be found in Skills and Competencies.

5 Performance

The Performance Outcomes section of the AMS is a high-level summary of the forecast capabilities, performance and resource requirements of the Victorian electricity transmission network for the period 2005–2020. Further information can be found in Business Environment Assessment.

5.1 Energy

The annual electricity consumption[30] is projected to grow at an average rate of 0.5% over the next five years to 2010/11, and then at 1.3% pa to 2015/16 as illustrated in the following figure (Figure 27).

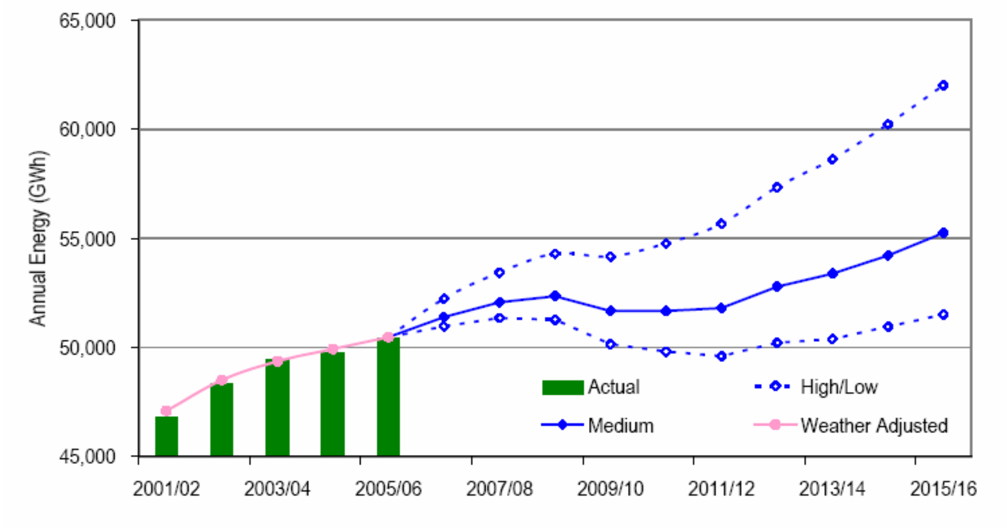


Figure 27 – Electricity Consumption

[30] Electricity Annual Planning Report 2006 - VENCorp

5.2 Demand

Summer maximum demand is forecast[31] to grow faster than annual electricity consumption at an average growth rate of 2.0% pa over 2006/07 - 2010/11, and then 1.9% pa over the following five years to 2015/16 reflecting a slower penetration of cooling appliances and the impact of state greenhouse policies as illustrated in the following figure (Figure 28).

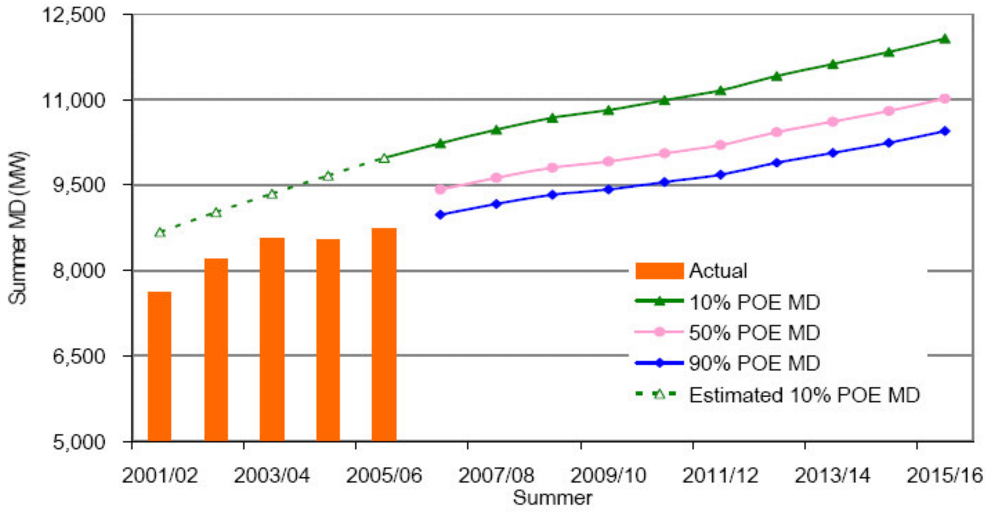


Figure 28 – Summer Maximum Demand

The 10% POE winter maximum demands are forecast to grow from 7,795 MW in 2005 to 8,222 MW in 2010 and 8,875 MW in 2015. The projected average growth rate for the first five years to 2010 is 1.1% pa. Stronger average growth of 1.5% pa is projected for the following five years to 2014, reflecting stronger economic growth and increased penetration of reverse cycle conditioners as shown in the figure below (Figure 29).

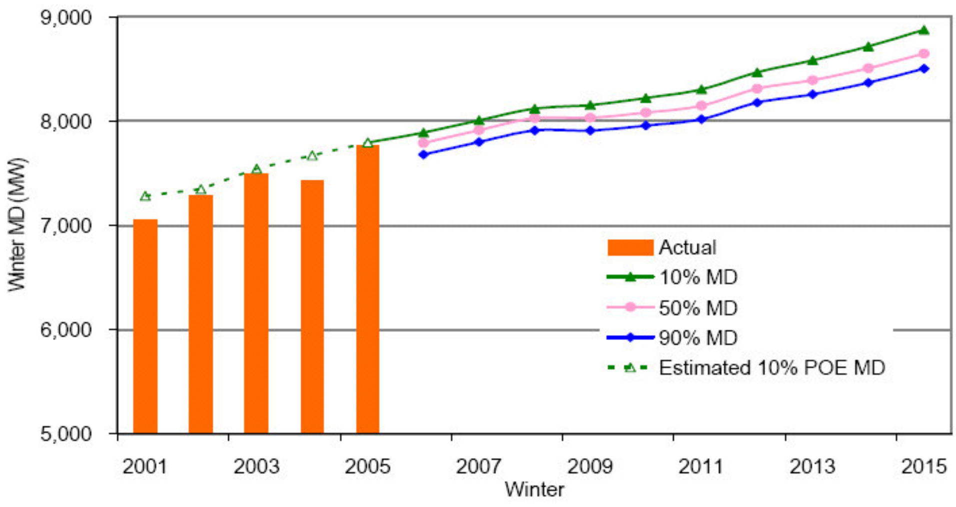


Figure 29 – Winter Maximum Demand

[31] Electricity Annual Planning Report 2006 - VENCorp

5.3 Utilisation

Maximum load on the transmission network has been growing at a compound rate of around 3% per year since 1994. As illustrated in the following figures (Figure 30) and (Figure 31), 35% of transformer banks[32] and 14% of transmission lines[33] are now operating with a redundancy levels less than 'N–1' during periods of peak demand.

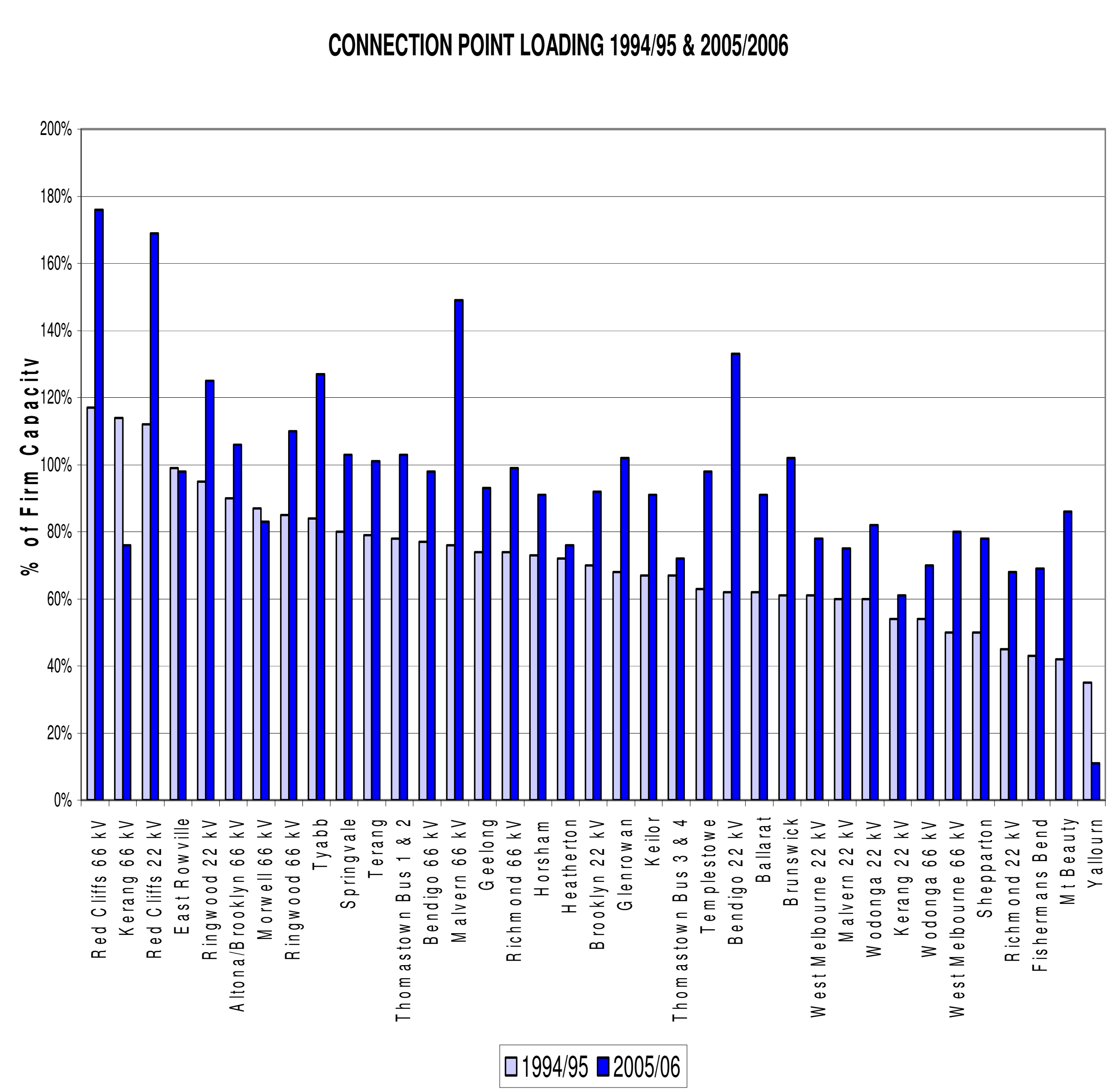


Figure 30 – Electricity Connection Network Loadings

32 SP AusNet monitoring.
33 Electricity Annual Planning Report 2006 – VENCorp

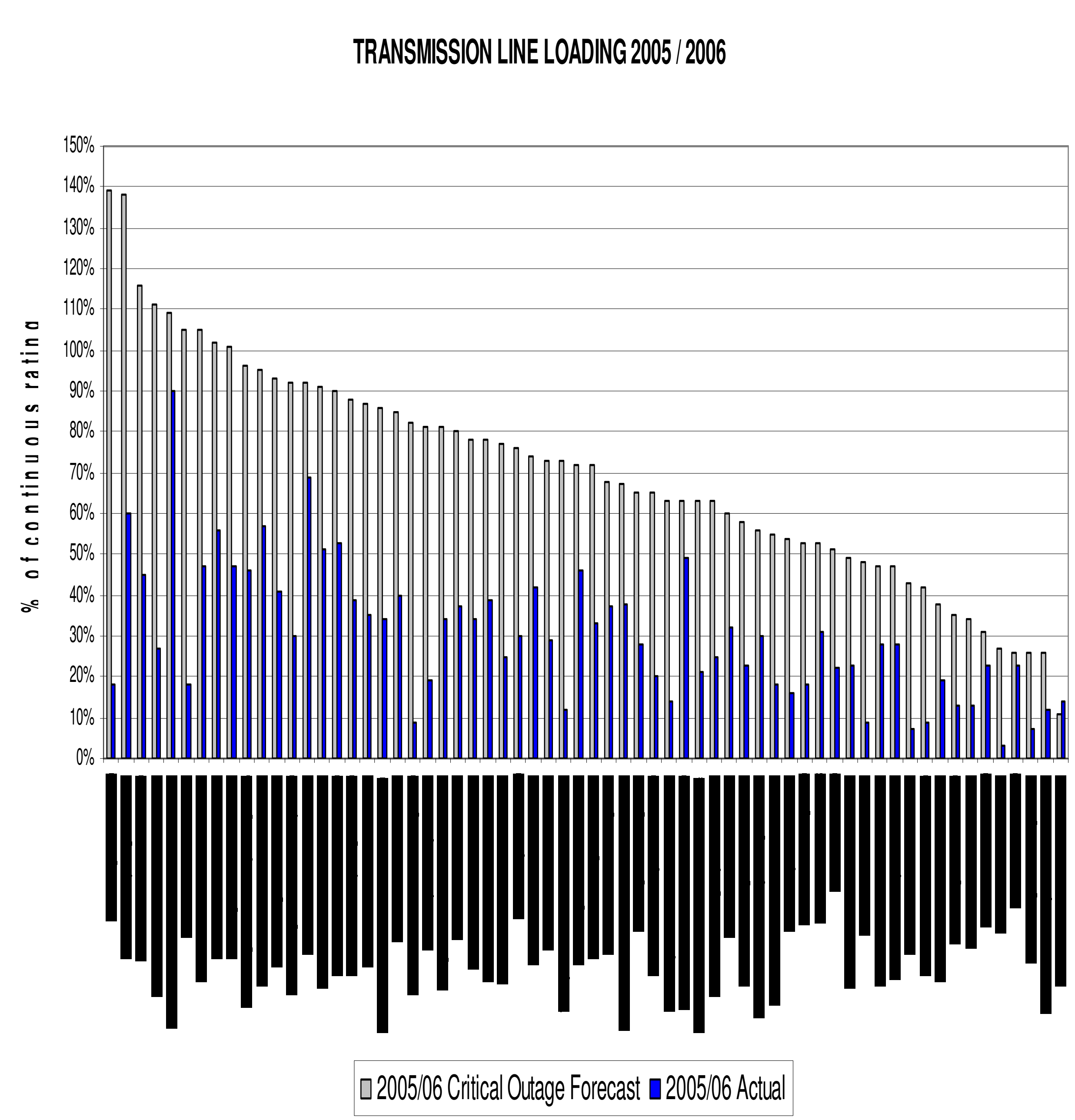


Figure 31 – Electricity Transmission Line Loadings

5.4 Fault Levels

Analysis[34] of the transmission network has shown that fault levels at 275 kV, 330 kV and 500 kV buses are well within the existing switchgear ratings, and it is unlikely that fault levels will be a constraint on development at these voltages within the foreseeable future. However, at 220 kV, 66 kV and 22 kV buses, fault levels are approaching, and over the next five years are forecast to exceed, the rated fault capability of switchgear at a number of Terminal Stations.

Network fault levels are continuing to rise at approximately 1% per annum. The following figure (Figure 32) illustrates the growth in the average of maximum prospective fault levels for the period 2000/01 through 2009/10.

[34] Transmission Network Short Circuit Levels 2006-2010 Victoria – VENCorp December 2005

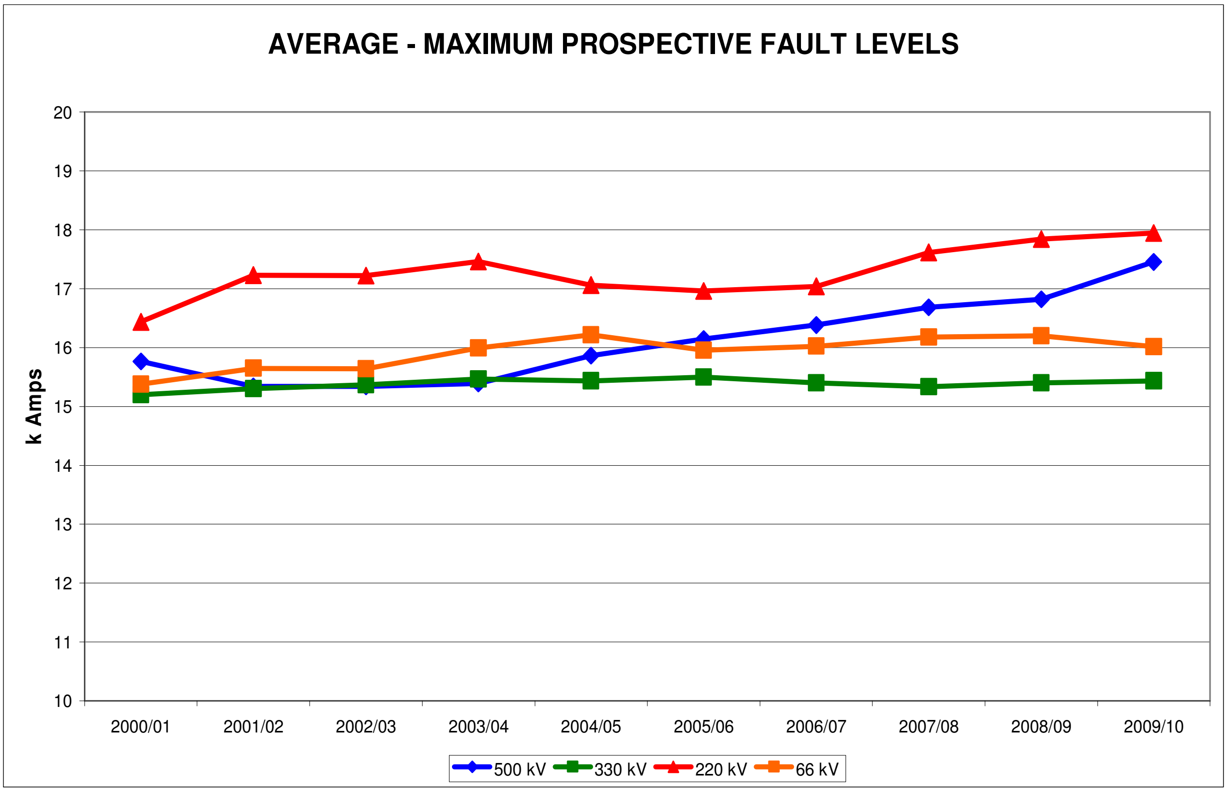


Figure 32 – Average maximum prospective fault levels

Figures 33 and 34 below illustrate that 45% of 220 kV and 29% of 66 kV circuit breakers are exposed to maximum prospective fault levels exceeding 90% of the maximum rating assigned when they were manufactured.

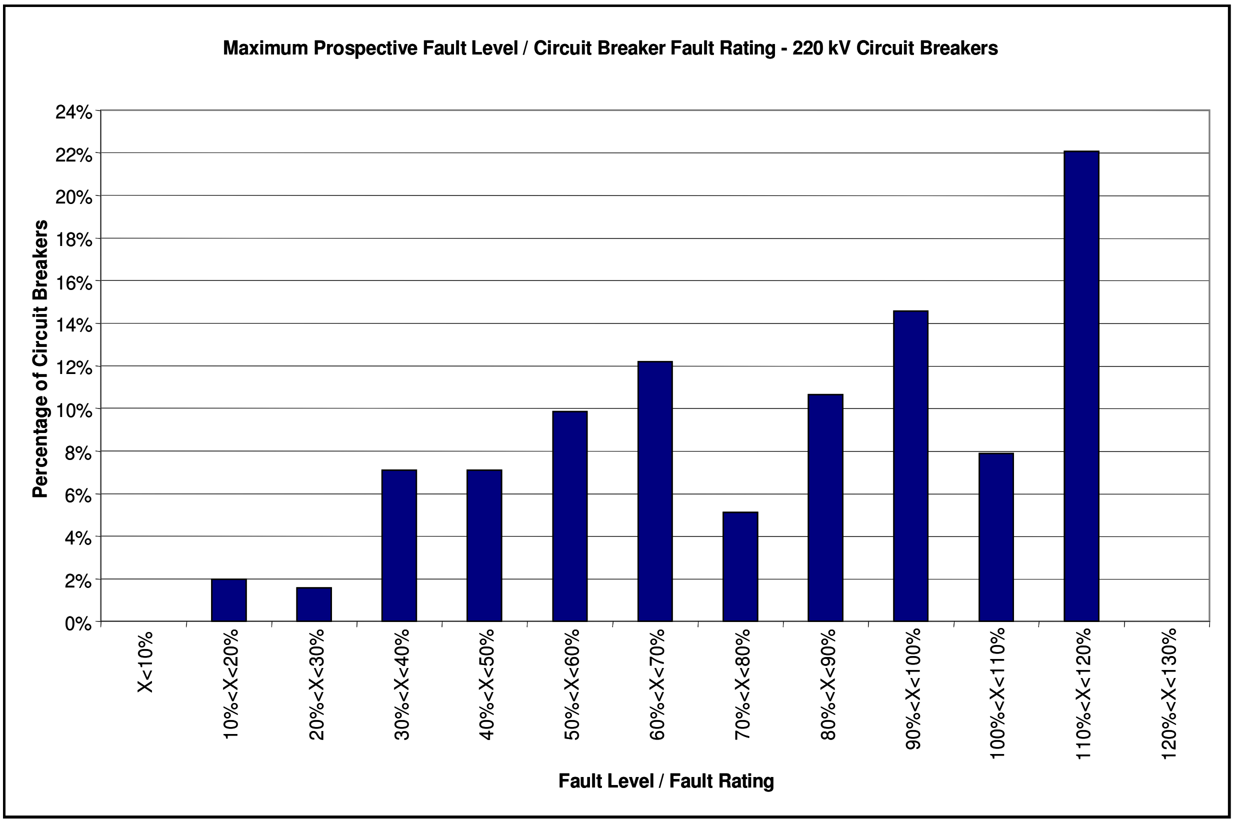


Figure 33 – 220 kV CBs X Fault Levels 2005

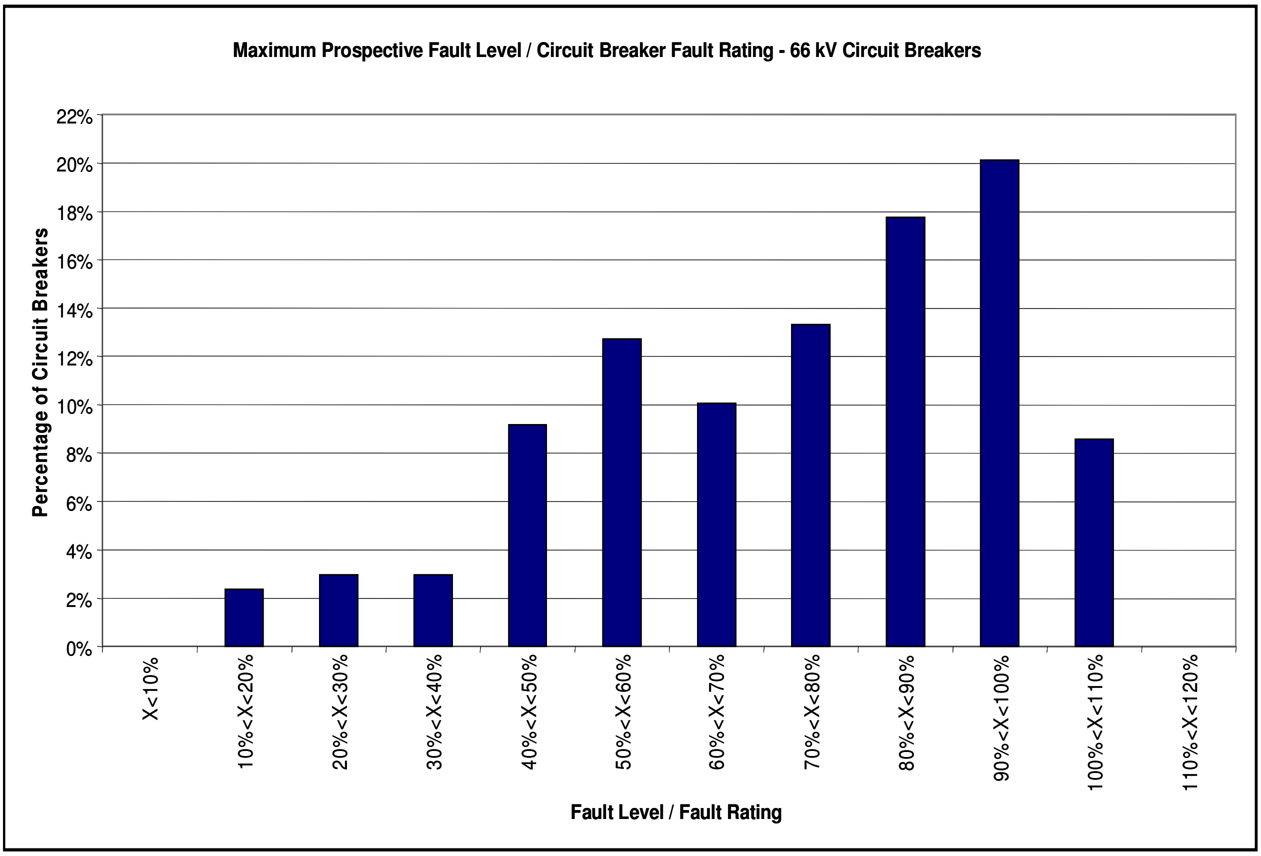


Figure 34 – 66 kV CBs X Fault Levels 2005

For many years, operational switching arrangements have been implemented to maintain fault levels within plant ratings at critical locations. This is illustrated in Appendix - Transmission Network Short Circuit Levels, which summarises the “headroom” available based on the summer 2005/06-fault level review undertaken by VENCorp.

However, the number of locations (now 39% of terminal stations) and the complexity of the operational controls coupled with the inherent reduction in plant redundancy (and hence network reliability), the increased operational costs and associated business risk borne by the network owner/operator make this approach unsustainable.

Consideration of fault levels over the last few years has highlighted the challenges involved in maintaining 220 kV fault levels at Hazelwood Power Station and Keilor, Rowville, Thomastown and West Melbourne terminal stations where the bus fault level already exceeds or is forecast to exceed the rating of the lowest rated circuit breaker at the terminal station.

5.5 Reliability

Principally initiated by equipment failure, the consequences and frequency of reliability events are predetermined by network configuration, equipment utilisation levels and asset condition (age).

5.5.1 Incentive Targets

In 2005 performance targets, set in the Network Service Agreement[35] between VENCorp and SP AusNet, were achieved for the following measures[36]:

- Forced outage frequency for transmission lines
- Mean outage duration for transmission lines
- Forced outage frequency for main and connection transformers
- Mean outage duration for main and connection transformers

However, the Network Service Agreement performance targets for successful auto-reclose rates for transmission lines were not achieved.

In 2005 performance targets, set by the AER (ACCC) as part of the current revenue cap decision[37], were achieved for the following measures[38]:

- Loss of supply event frequency
- Average outage duration

5.5.2 Benchmarking

The Victorian electricity transmission network has consistently proven more reliable[39] than that of other Transmission Network Service Providers (TNSPs). Reliability has varied widely around a 10-year average of 0.5 system minutes not supplied, as illustrated in the following figure (Figure 35).

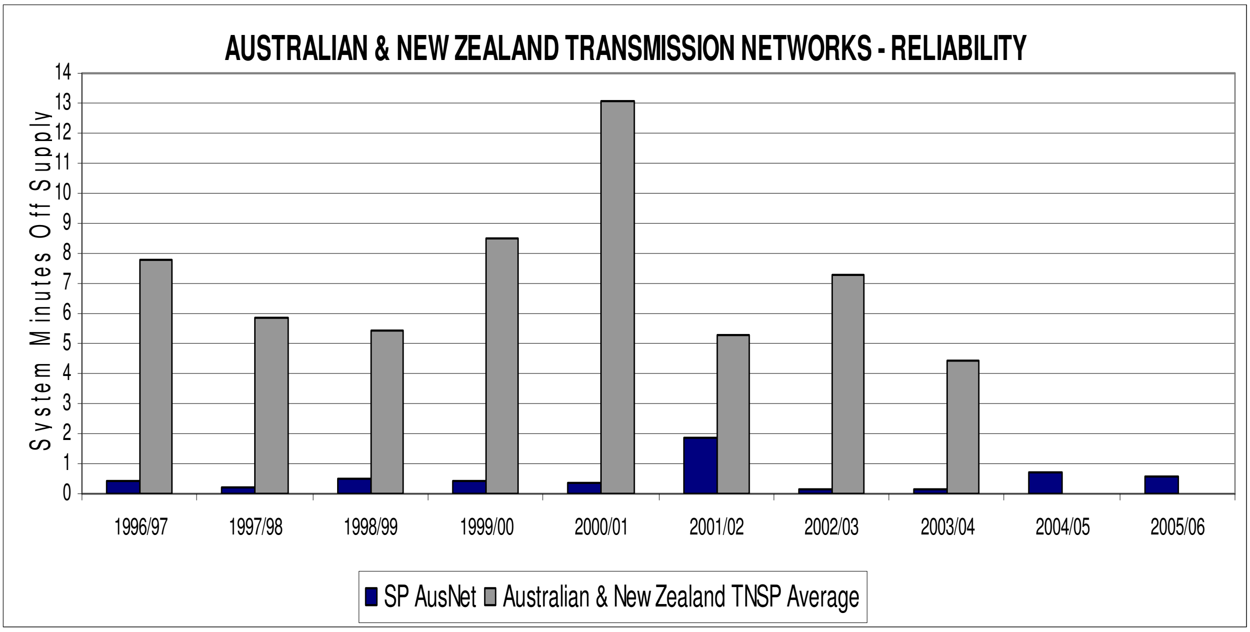


Figure 35 – System Minutes off Supply

[35] Network Service Agreement
[36] Appendix 1 - Network Services Agreement Performance Measures
[37] Victorian Transmission Network Revenue Cap Decision - ACCC December 2002
[38] Appendix 2 – ACCC Service guidelines - performance measures
[39] Electricity Australia 2004 – Electricity Supply Association of Australia

Retail interruptions to supply[40] have also varied widely around a 10-year average of 4 p.a. with an unfavourable performance trend possibly emerging in the latter years of the figure below (Figure 36).

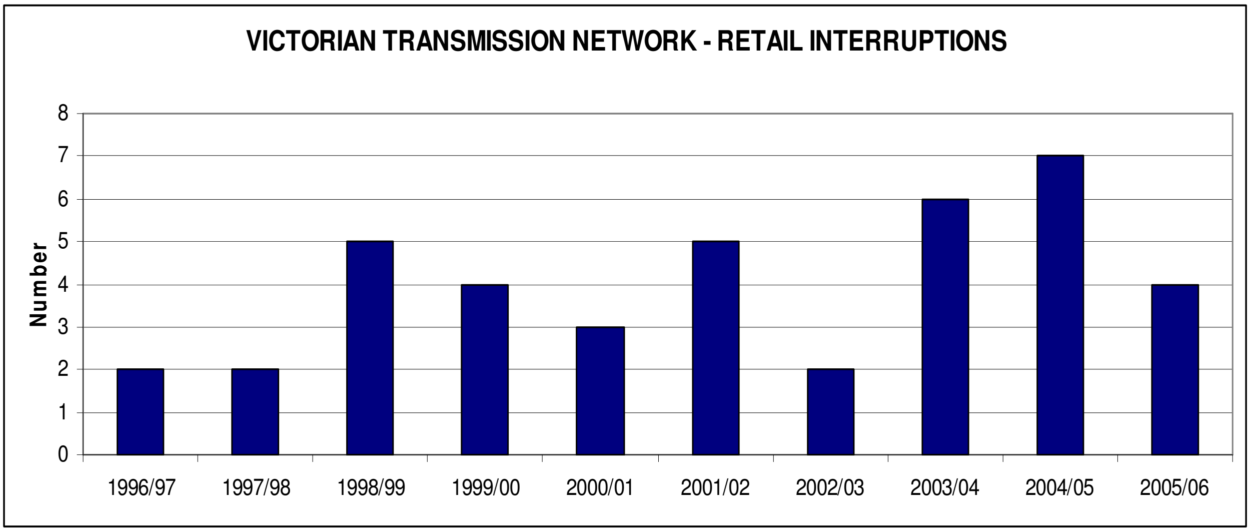


Figure 36 – Retail Interruptions to Supply

5.5.3 Lines

In 2005/06, forced outages of transmission lines, due to equipment failure, bettered the Network Services Agreement target for the first time since 2001/02. By contrast, the mean duration of forced outages has met its target since 2001/02. The wide variance in year-to-year performance over the last decade provides indications of low levels of control over transmission line reliability.

5.5.4 Transformers

Forced outages of main and connection transformers have met the Network Services Agreement targets since 2001/02 and the mean duration of forced outages has met the respective target since 2002/03. However, the wide variations over the last decade suggest that further efforts are necessary to stabilise transformer reliability at target levels.

5.6 Availability

5.6.1 Peak Loading Periods

In 2005, availability performance targets set by the AER (ACCC) as part of the current revenue cap decision[41], were achieved by SP AusNet for both critical and non-critical circuits during peak network loading periods as illustrated in the following figures (Figure 37 and Figure 38).

[40] SP AusNet monitoring
[41] Victorian Transmission Network Revenue Cap Decision - ACCC December 2002

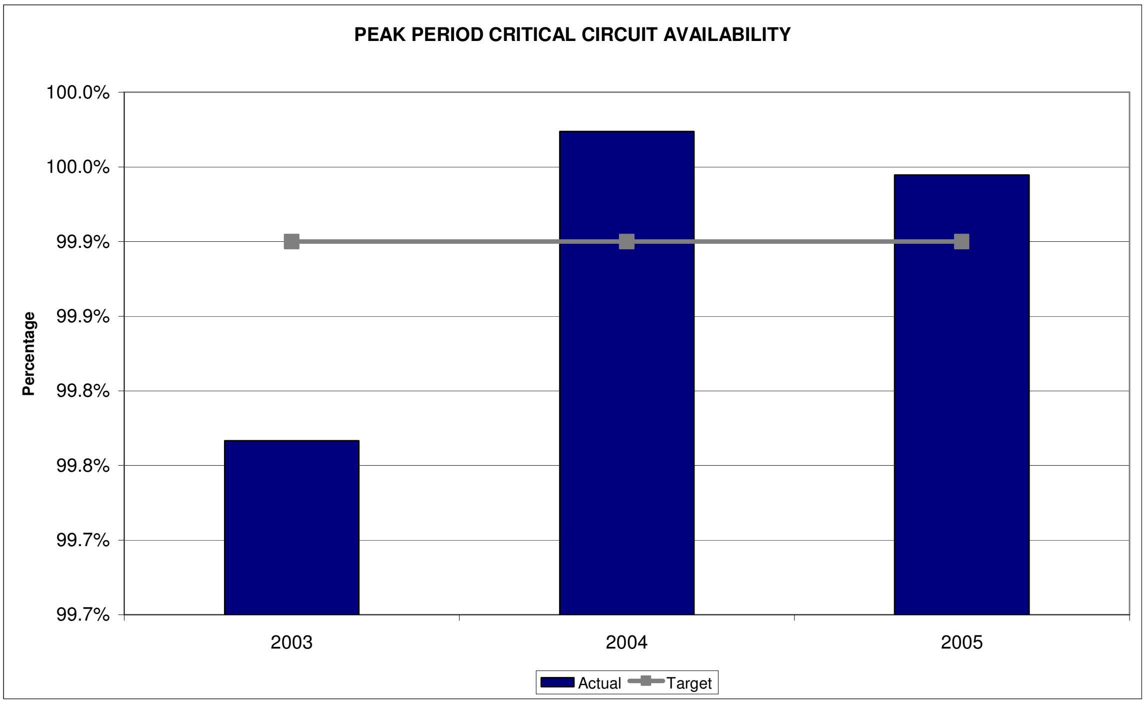


Figure 37 – Availability Peak Period Critical Circuits

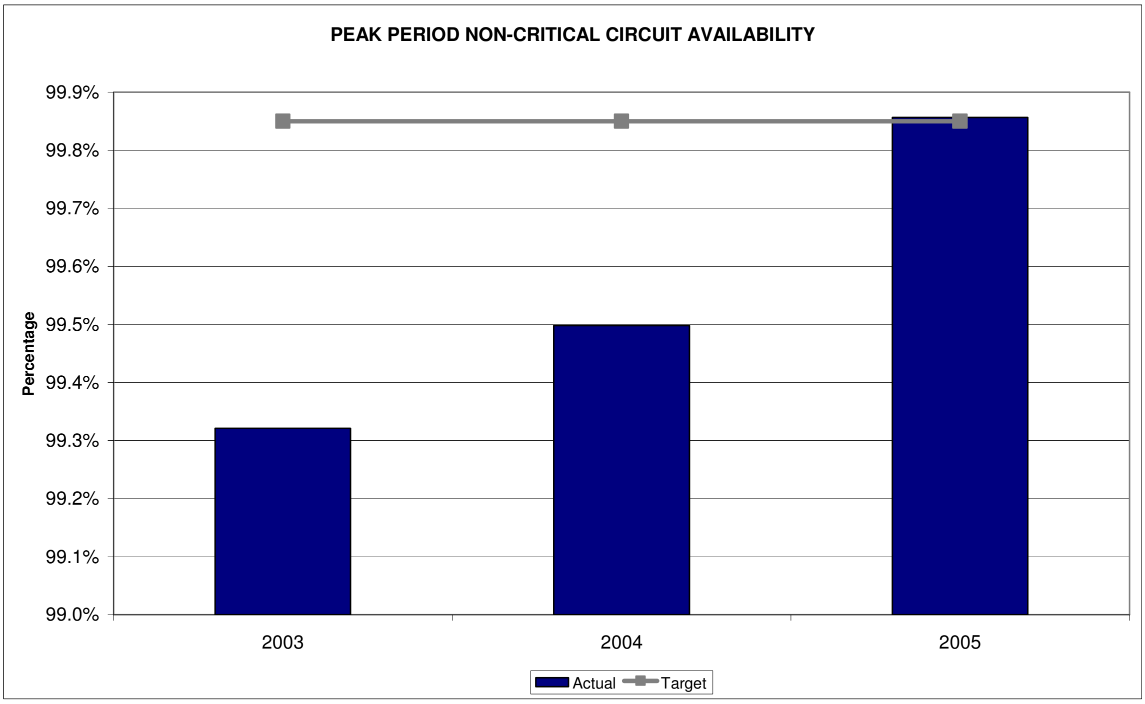


Figure 38 – Availability Peak Period Non-critical Circuits

5.6.2 Intermediate Loading Periods

However, due to the volume of maintenance, refurbishment and replacement works the availability performance targets for intermediate network loading periods have not been met in the last 3 years as illustrated in the following figures (Figure 39 and Figure 40)

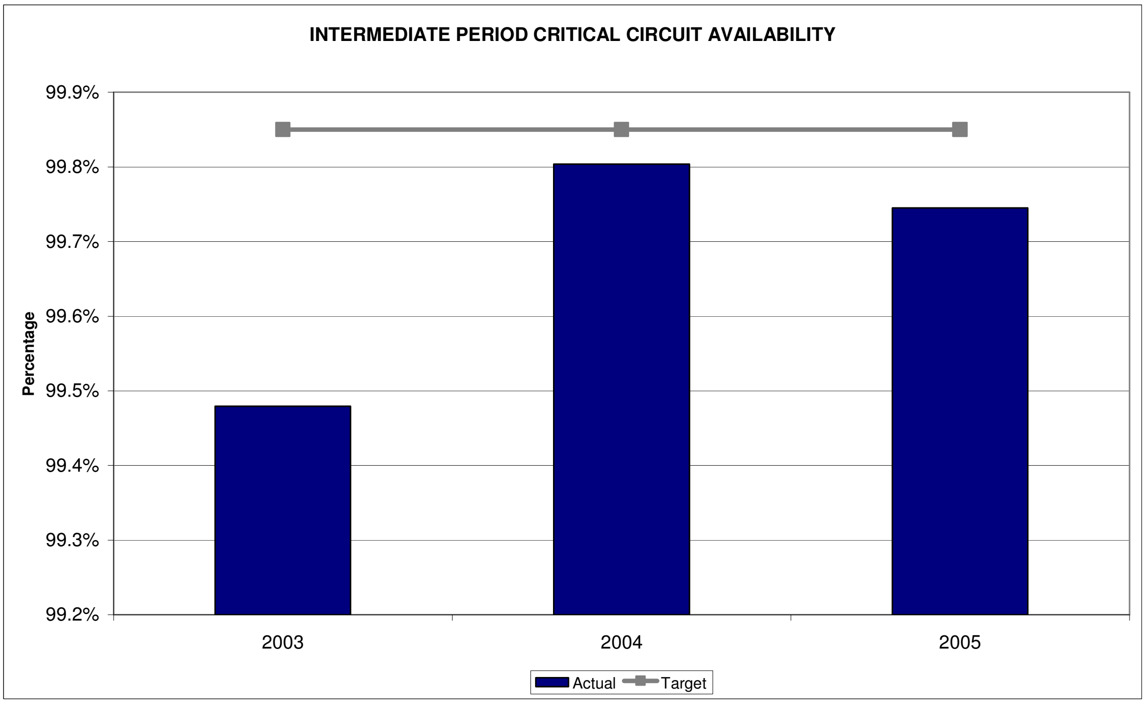


Figure 39 – Availability Intermediate Period Critical CCTS

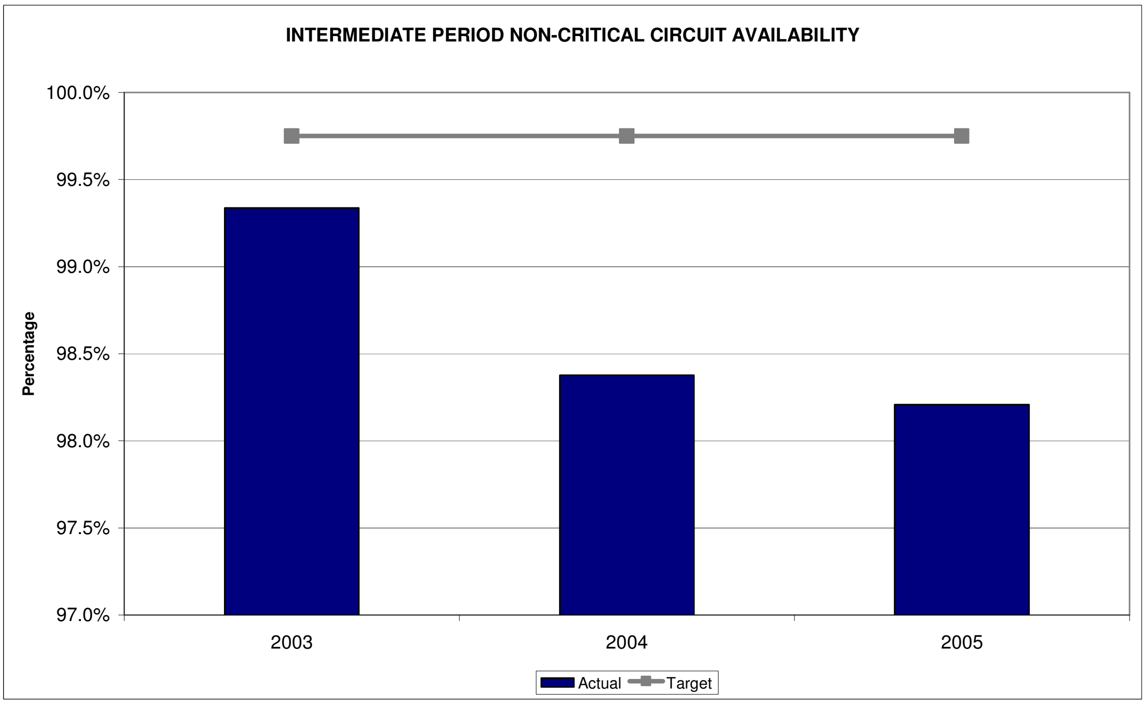


Figure 40 – Availability Intermediate Period Non-critical CCTS

5.6.3 Lines

Victorian electricity transmission lines have exhibited near "best-practice"[42] availability over the last decade with levels exceeding the Network Services Agreement target of 99.5% in all but 2004/05 as illustrated in the figure below (Figure 41).

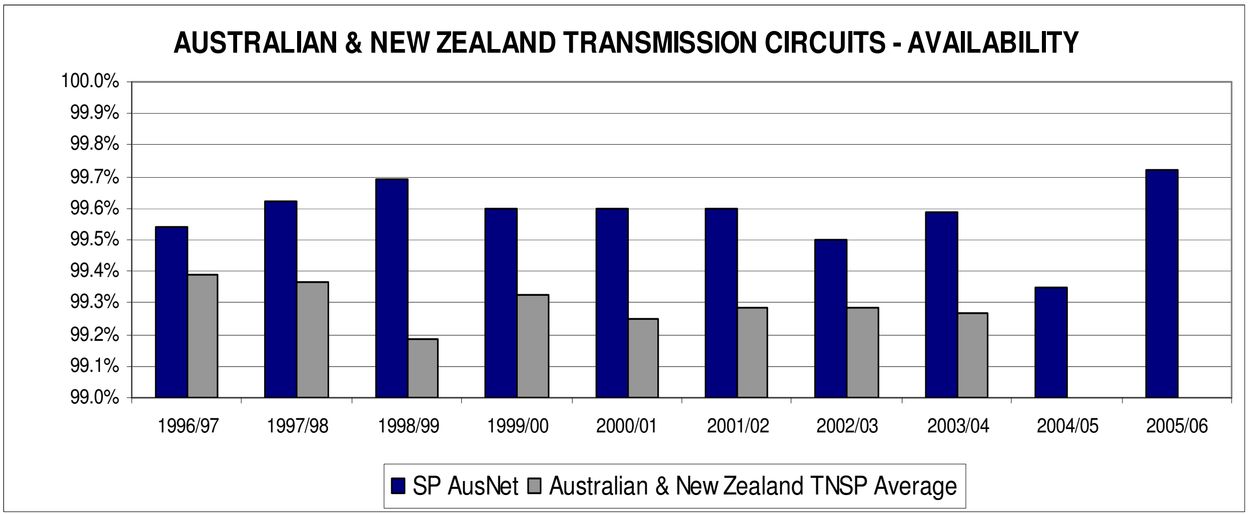


Figure 41 – Transmission line availability

Risk-modelling suggests increasing proportions of line hardware will require replacement over the next 15 years to sustain conductor-drop risks within an acceptable range. Additionally, Vision 2030[43] indicates new circuits and significant uprating and re-conductoring of existing circuits will be necessary in the period to 2015. Thus SP AusNet faces a significant challenge in maintaining transmission line availability near historic levels in the period after 2010.

5.6.4 Transformers

Main and connection power transformer availability has varied over the last decade. On three occasions the Network Services Agreement target of 99.7% was met but in other years performance was below expectations, as shown in the following figure (Figure 42)

[42] Electricity Australia 2004 – Electricity Supply Association of Australia
[43] 25 Year Vision for Victoria's Energy Transmission Networks October 2005 – VENCorp.

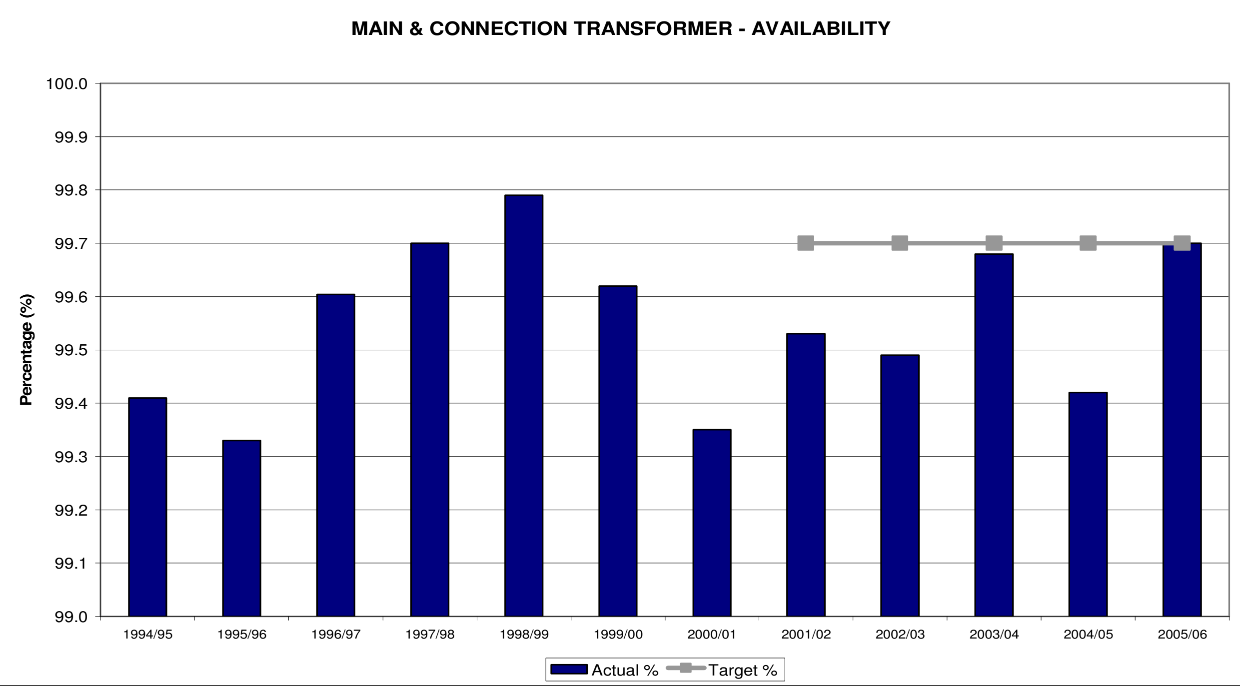


Figure 42 – Main and Connection Transformer Availability

In recent years, transformer availability has been determined by outages arising from failures and the increased testing, maintenance, refurbishment and replacement to manage the reliability risks of a fleet with an average age of 36 years and older units in excess of 52 years.

Framed around a stable risk position, the 2008 to 2013 work program includes continuation of the condition testing program and an increase in replacement activity. It is unlikely that the current availability targets will be met in the next decade. Targets may need to be re-negotiated in order to establish more meaningful incentives to balance current and future transformer availability risks.

5.6.4.1. Capacitor Banks

Capacitor bank availability has varied around the target level of 99.3% for most of the last decade. Only when an intensive capacitor-can testing program coincided with high levels of new plant installation and augmentation, during 2000 – 2002, has availability fallen significantly below target.

VENCorp[44] forecasts ongoing installation of new plant and augmentation of existing capacitor banks to meet reactive demand over the next 15 years. Capacitor bank availability should average 99% over the next 5 years rising to 99.5% as identified issues associated with heavily utilised, older and 1995 specification banks are resolved.

5.6.4.2. Static VAR Compensators

The small population of static compensators has infrequently achieved the target levels of availability in recent years, due predominantly to issues with inadequate thyristor cooling capacity and unreliable control systems no-longer supported by manufacturers.

SP AusNet has commenced a multi-year program of mid-life refurbishment and renewal, which includes replacement of control systems. This is expected to progressively restore availability to the

[44] Electricity Annual Planning Report 2005 - VENCorp

99% target level by 2010. Post 2015, 'end of life' management issues will again begin to limit availability.

5.6.4.3. Synchronous Condensers

The Victorian electricity transmission network includes three synchronous condensers, whose availability has largely met stakeholder expectations of 91% over the last decade. In 2003 availability fell below target levels, when a refurbishment program commenced to ensure that degradation of stator winding sidewall insulation and deterioration of rotor pole insulation do not prematurely restrict service life.

Synchronous condenser availability should return to target levels over the next five years with the progressive completion of refurbishments. Availability is forecast to achieve target until 2015 - 2020 when 'end of life' management issues will impinge on performance.

5.7 Resources

5.7.1 Capital Expenditure

The figure below (Figure 43) summarises the asset replacement, additions and refurbishment CAPEX required to deliver the performance summarised in the preceding pages.

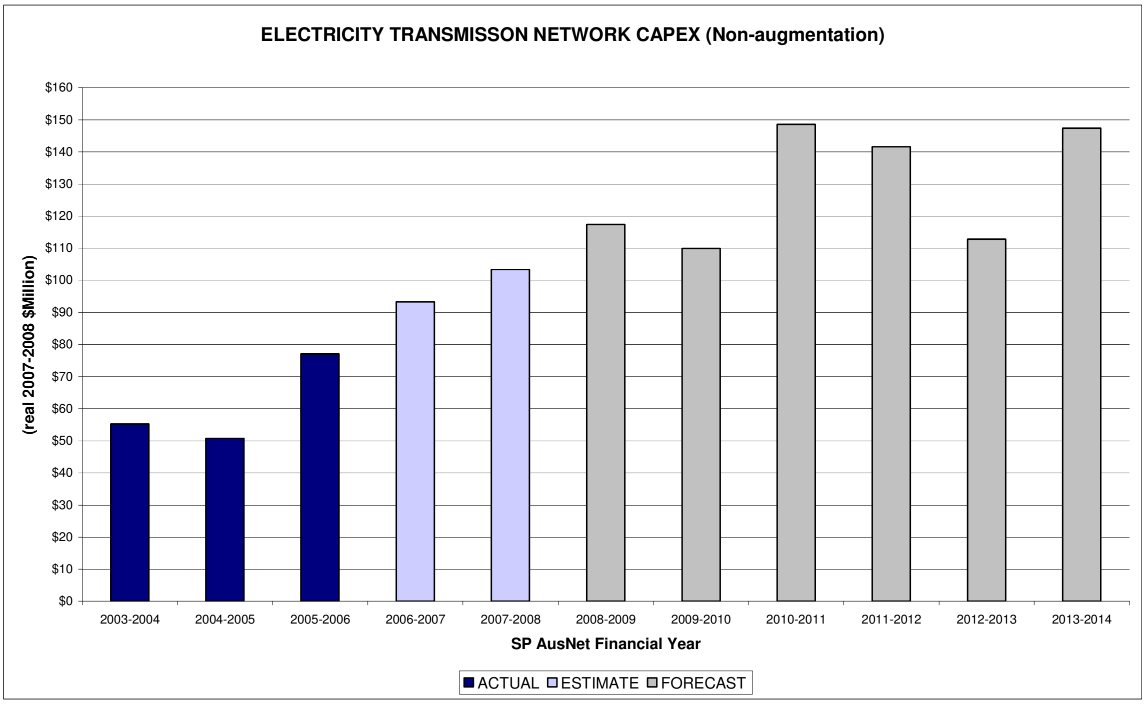


Figure 43 - Network CAPEX

5.7.2 Operating Expenditure

The following figure (Figure 44) summarises the OPEX required to deliver 'system recurrent expenditure' (on regular and ongoing activities such as routine plant maintenance) and 'system non-recurrent expenditure' (one-off programs to respond to specific problems such as tower corrosion mitigation) and underwrite the network performance summarised above.

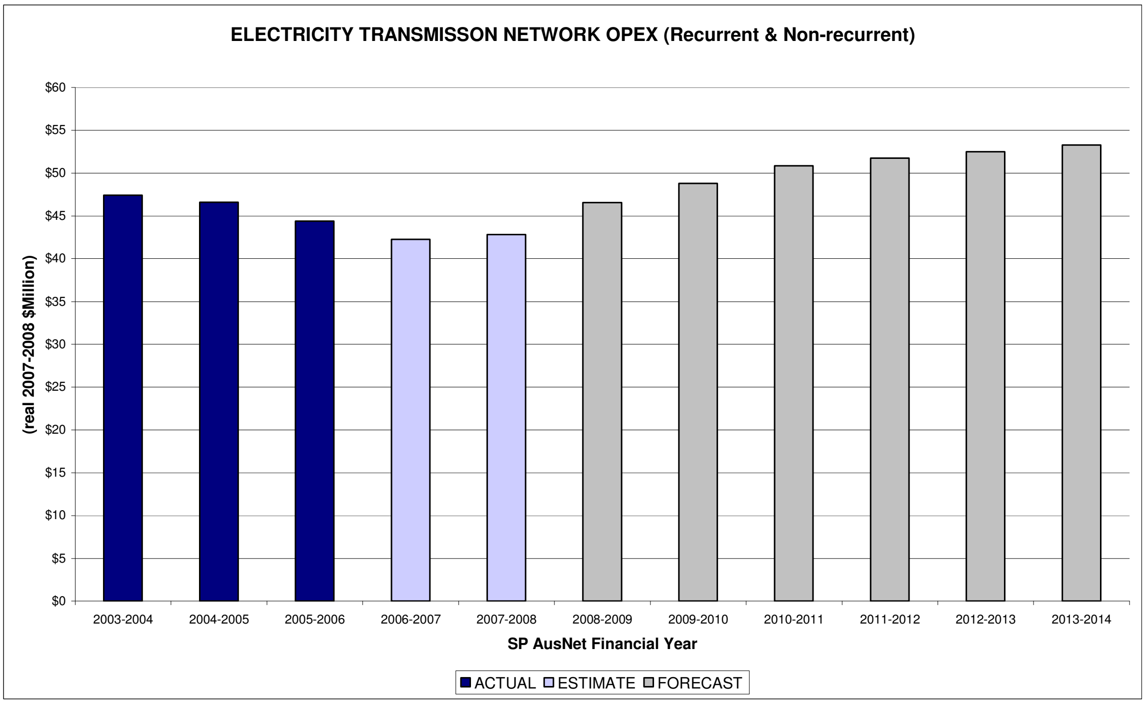


Figure 44 – Network OPEX

6 Process and System Strategy Summary

This section of the AMS provides a summary of issues relating to SP AusNet's processes and systems for the management of transmission assets. These issues are documented in full in the foundation level of resource documents. Each of the following sub-sections details an issue and provides a summary of the key strategies for its management.

6.1 Risk Management

SP AusNet is committed to understanding and effectively managing risk to provide greater certainty for our shareholders, employees, customers, suppliers and the community.

A systematic and consistent approach to risk management and alignment of corporate philosophies and objectives are key principles. The Risk Management Policy defines the governance of risk and the Risk Management Framework sets out the overarching philosophy, principles, requirements and responsibilities for a sound approach. The Group Risk Committee aligns the business objectives with the approved risk appetite and risk management strategy.

Within the above framework, SP AusNet uses a sophisticated suite of models to assess, monitor and mitigate asset failure risks and reliability, availability, health, safety, environment, infrastructure security and code compliance program risks.

Asset risk models guide decisions on the volume and timing of efficient refurbishment and replacement projects necessary to deliver a selected risk position. Program risk models combine asset risk and management improvement programs to guide decisions on the capability of the Victorian electricity transmission network to sustain selected performance levels.

Key Strategies:

- Use asset risk models to guide the volume and timing of asset refurbishment and replacement programs.
- Use program risk models to guide the decisions on sustainable performance levels.
- Further develop contingency plans (to guide recovery from major incidents) for specific critical stations, assets or programs in support of the overarching System Contingency Plan.
- Influence the transmission network-planning process to minimise network outage risks.
- Use risk management as a key driver in project selection, design, procurement, and maintenance of transmission assets.

For further information please refer to Risk Management.

6.2 Health and Safety Management

SP AusNet is committed to providing a safe and healthy workplace for employees and contractors, through the commitment and contribution of every employee. Occupational Health and Safety Management System (OHSMS) for transmission assets is certified against the AS/NZ 4801 standard and compliance is checked by regular internal and external audits.

Key Strategies:

- Continue regular worksite audits to confirm compliance with electrical safety procedures and the Blue Book.
- Continue the implementation of the tower safe-access program.
- Conduct risk assessments for identified working at height tasks and implement recommended actions.
- Implement recommended actions to improve fall restraint on new and existing line towers (in consultation with Victorian WorkSafe Authority).
- Design and operate assets prudently to reduce exposure to Electro-Magnetic Fields.
- Continue to monitor EMF levels associated with transmission assets.
- Progressively remove asbestos containing materials as recommended in the Asbestos Management Strategy.
- Complete the implementation of immediate recommendations of the Human Error Incidents review.
- Minimise exposure of employees and contractors to new and decomposed SF_6 gas.
- Continue the ongoing program of testing the insulating fluid in plant items for PCB and replace the fluid as required.
- Conduct awareness training for relevant personnel on the operation of the INERGEN fire suppression systems.
- Complete the delivery of radio frequency awareness-training courses for people required to access structures near antennae.

For further information please refer to Health and Safety Management.

6.3 Environmental Management

SP AusNet maintains an International Organization of Standards (ISO 14001) certified Environmental Management System (EMS) for its transmission assets. Through the auspices of the EMS, policies, procedures and objectives pertinent to vegetation management, bushfire mitigation and environmental management are integrated and linked to the SP AusNet Environmental Policy and Environmental Objectives.

The EMS is regularly audited internally and externally to assess compliance with the ISO 14001 standard, regulatory requirements and good environmental practice.

Key Strategies:

- Increase community awareness of vegetation management policy and procedures.
- Regularly review environmental policy and procedures in consultation with relevant groups.
- Risks assess line easement access tracks that are publicly accessible and mitigate risks.
- Audit all line easement access bridges to ensure that they are fit for the purpose.
- Complete the program of oil containment, treatment and drainage improvement works.
- Ensure any contaminated soil is disposed of appropriately and affected sites are remediated.
- Remove the lead based paint from three towers on the 220 kV transmission line from the Fisherman’s Bend Terminal Station to West Melbourne Terminal Station.
- Continue to monitor noise levels at terminal station sites and address any noise complaints.
- Minimise the visual impact of existing and new transmission assets.
- Continue to monitor SF_6 leaks from equipment and repair identified leaks.
- Complete the repair of significant SF_6 gas leaks and weather sealing on the Gas Insulated Switchgear at South Morang Terminal Station in 2008.
- Continue to support revegetation of transmission line easements with sustainable vegetation.

For further information please refer to Environmental Management.

6.4 Condition Monitoring

SP AusNet has embarked on the development of a knowledge-based asset management system that utilises both online and off-line condition monitoring data to maintain acceptable levels of network reliability and availability.

New condition monitoring techniques are continuously being developed as the knowledge and understanding of equipment performance expands, aided by the increasing computing capability and high-speed digital communication.

To supplement assessments undertaken during maintenance and analysis of system incidents and equipment defects, SP AusNet has installed a number of online condition monitoring devices and is implementing a number of SCADA based condition monitoring programs including CVT voltage balance and plant current balance systems. As the Asset Data Gathering Network comes into service, the existing condition monitoring devices are connected to allow remote data access and logging. These systems are providing robust data and informing better asset management decisions.

Key Strategies:

- Purchase new assets and retrofit critical existing assets with on-line condition monitoring sensors and install fibre optic cabling within terminal stations to connect to LAN/WAN.
- Integrate diverse condition data and information (from maintenance reports, test reports, failure reports, on-line condition monitoring sensors, Intelligent Electronic Devices, and SCADA) in MAXIMO.
- Automate the analysis of condition assessments and risk ranking of major assets such as transformers, current transformers and circuit breakers.
- Validate models for failure risk, remaining life and maintenance scheduling
- Use simple centralised administration, WAN access and web-based browser technology for remote and wireless access of asset condition reports and failure warnings.
- Migrate to real-time performance management.

For further information please refer to Condition Monitoring.

6.5 Plant and Equipment Maintenance

The overarching strategy for the maintenance of SP AusNet's transmission assets is:

"…the application of safe, efficient and cost effective work practices to optimise the security, reliability and operational capability of the transmission system under normal and abnormal conditions. Further, to preserve the good condition and functional capability of the plant and equipment in order to maximise its service life".

Plant and equipment maintenance includes both recurrent and non-recurrent works.

Recurrent works are activities of a regular and ongoing nature and include scheduled, unscheduled, and breakdown maintenance.

Scheduled maintenance programs are derived from SP AusNet's asset management information system (Maximo) database. A maintenance plan, which lists all of the scheduled maintenance (OMS) tasks for the following 12 months, is produced as a part of the budget process leading up to the new financial year. Forecasts of scheduled maintenance for future years are obtained by generation of virtual work orders in Maximo.

Forecasts for unscheduled and breakdown maintenance are based on historical actual levels.

Non-recurrent works are those that cannot be capitalised and have scopes that are too large or specialised to be included in the maintenance plan (for recurrent works). They are not time or operation based and are generally non-repetitive one-off programs put in place to address specific problems. Examples are tower-corrosion mitigation works and condition assessment programs.

Key Strategies:

- Progressively increase the safe use of live maintenance work on transmission lines where there are work efficiencies and cost savings to be achieved.
- Carry out further investigations into the possibility of performing live maintenance work on selected items of primary plant in terminal stations where such work can be performed safely and there are work efficiencies and cost savings to be achieved.
- Increase the use of reliability and risk assessments to determine the need for scheduled maintenance or refurbishment or replacement.
- Give greater consideration to the criticality of system elements in prioritising the maintenance or refurbishment or replacement effort.
- On the basis of the technical and economic evaluation of proposals, selectively refurbish or replace plant and equipment that is maintenance intensive.
- Continue to participate in industry benchmarking studies relating to the maintenance and operation of transmission plant and equipment and progressively implement appropriate, identified, best practice approaches.
- Selectively increase the use of condition monitoring and diagnostic testing methods to predict the need for and extent of maintenance.
- Ensure that, as much as possible, new assets have built-in condition monitoring and self-testing facilities.
- Progressively refine the use of the handheld devices to enable field personnel to more easily initiate defect reports in the Defect Management system.
- Review spare equipment and ensure appropriate stocks are held at strategic locations to support both scheduled and unscheduled maintenance.
- Review Plant Outage Management System (POMS) workflows and progressively refine the use of POMS.

For further information please refer to Plant and Equipment Maintenance.

6.6 Asset Management Information Systems

The main asset management information systems are MAXIMO for asset and work management, TRESIS for relay settings, Ratings Database Repository (RADAR) for plant and equipment ratings and Mobile Inspection System (MIS) for recording asset inspections.

The progressive development of asset management information systems is co-ordinated by the Enterprise Asset Management program within the Business Systems Asset Management Strategy.

The principle drivers of improvement in information systems are:

- Improved data quality for informed operation and strategic decision making
- Increasing costs of supporting disparate, customised, non-interfaced systems
- High risks associated with reliance on “local knowledge” of mature-aged workforce
- Repeatable, transparent and auditable processes to assure compliance to regulatory and safety obligations
- Replacement of obsolete legacy systems

Key development strategies include:

- Extend the electronic collection of data via mobile computing devices and automatic links between MAXIMO and SCADA.
- Progressively implement the Enterprise Asset Management program to form a single authoritative asset and inventory register incorporating works management, and logistics management which includes:
  - Consolidation of asset data from disparate systems within MAXIMO
  - De-commission disparate systems
  - As necessary, establish links from MAXIMO to other systems to facilitate automatic updates
- Establish web browser architecture to facilitate remote access by authorised stakeholders to view information and reports.
- Implement a flexible reporting capability that caters for routine and ad hoc requests from stakeholders.
- Ensure that there are appropriate data security and data recovery plans in place.

For further information please refer to Asset Management Information Systems.

6.7 Network Performance Monitoring

The effectiveness of SP AusNet's asset management policies and practices is measured directly by the performance of high-voltage electrical plant and its impact on the availability of the transmission system that it operates within. The development of these policies requires the reliable capture of accurate data, effective decision support tools for trending and analysis, and comparison with externally benchmarked performance standards.

The vision for network performance management is to raise this data collection and analysis process to a level that will maximise our return on investment during the next regulatory period.

Key Strategies:

- Update the spreadsheet used to calculate the System Code Performance Measures, utilising the functionality that is now available through changes to POMS and MAXIMO.
- Enhance the IT system used to calculate the measures for the ACCC Service Standards Performance Incentive Scheme.
- Develop the ability to model outcomes of 'what if' scenarios for forecasts about the impact of ramped-up, Group1 capital works program and asset works refurbishment programs.
- Develop the System Incident Report (SIR) system such that the data it provides can be more readily used to trend asset performance and extracted for benchmarking purposes.
- Build improved functionality into the IT solutions for Network Performance measures made possible by the upgrade of MAXIMO to Version 5.2.
- Build a robust system to capture data required for the various network transmission operations and maintenance benchmarking studies that SP AusNet regularly participates in.
- Develop performance benchmarks for specific plant types and compare them with international rating systems such as used by the International Council for Large Electrical Systems (CIGRE).
- Undertake performance analysis on power transformers and isolators.

For further information please refer to Network Performance Monitoring.

6.8 Operations Management

The operation of the overall system and of individual assets is a key to asset management and to ensuring that system performance targets are achieved. Successful operations management also ensures that the integrity of the assets is not compromised, and safety and environmental requirements are met.

Key Strategies:

- Maximise asset utilisation with the support of control schemes and support systems such as System Overload Control Scheme (SOCS), RADAR and Overload Shedding Scheme for Connection Assets (OSSCA).
- Optimise the timing of planned asset outages with the support of systems such as POMS and MAXIMO.
- Utilise proactive and real-time condition monitoring of assets.
- Provide rapid fault response with the assistance of SCADA and real-time fault analysis.
- Record and analyse fault events using the SIR and Defective Apparatus Report (DAR) processes.
- Audit the short circuit ratings of primary plant in stations that are operating at or close to the designed rating.

For further information please refer to Operations Management.

6.9 Program Delivery

The Program Delivery group provides management and resources to deliver the SP AusNet maintenance (OPEX) and capital works (CAPEX) programs relating to transmission assets.

The resource model includes the use of internal and external resources in the delivery of maintenance and capital works programs. Strategic alliances have been formed with companies that provide design services, installation services and maintenance services. Contract arrangements are performance based with benchmarking of costs and standards to ensure that quality and value is maintained throughout the contract.

Key Strategies:

- Improve the planning and control of projects by:
  - Refining the scope and specification of projects through constructability analysis and scenario modelling
  - Completing the implementation of the Project Change Control process
  - Engaging the project manager early and retain NDD representation through the project
- Complete the review and electronic publication of the project execution manual to guide the authorised delivery processes.
- Maintain the project estimating system with relevant project completion, quotation, and tender and benchmarking data.
- Ensure engineering and quality standards by the pre-qualification of design service providers and provision of comprehensive technical specifications, guidelines and standards via the electronic Station Design Manual (SDM).
- Improve quality control of complex projects through on-site supervisors and formal technical compliance audits
- Improve the Constructability, Operability and Maintainability (COM) review process by contractor involvement, pre-commissioning inspections and promptly outworking action items
- Refine the Post Implementation Review (PIR) process to identify innovation and learning opportunities

For further information please refer to Program Delivery.

6.10 Asset Replacement and Refurbishment

In deciding whether to replace or refurbish assets a range of options for asset management are identified and evaluated, utility practices analysed and supporting arguments developed. Primary requirements for any decision on replacement or refurbishment are a well-defined asset management strategy and sound knowledge of the asset's condition and related factors affecting performance and expected technical life.

Key Strategies:

- Establish relationships with best performing electricity and gas network operators in the United Kingdom to improve the "Business Strategy and Direction" part of SP AusNet's asset renewal practice.
- Seek partners to facilitate preparation and ultimately accreditation of asset management practices to BSI PAS 55 by 2008.
- Broaden and enhance the use of on-line-condition-monitoring tools and techniques to uniformly gather, analyse and rank condition assessment data for major assets including power transformers, transmission lines and circuit breakers.
- Broaden and enhance the use of asset risk models to optimise the volume and timing of asset renewal programs.
- Refine the process used to manage ongoing changes to the selected portfolio to ensure that the business is continually resourcing the most optimal set of capital projects

For further information please refer to Asset Replacement and Refurbishment.

6.11 Capital Expenditure Prioritisation

The prioritisation process directs capital expenditure toward those projects, which are most efficient in delivering stakeholder benefits and the regulatory commitment. The process involves quantifying the benefits and resource requirements of candidate projects and ranking them according to stakeholder and corporate values including:

- Asset condition – performance and reliability
- Health & safety (staff and/or public)
- Environmental impact
- Compliance – statutory, regulatory and code
- System and community impact
- Financial impact, and
- Corporate image

Modelling the quantum and the timing of benefits from each candidate project against target outcomes provides an optimal list of projects, which following ratification, forms the basis of the near term budget and capital works program.

Key Strategies:

- Refine the process used to manage ongoing changes to the selected portfolio i.e. have a rolling selection process to continually resource the optimal set of capital projects.
- Further refine the metrics used to quantify desired outcomes and the benefits of candidate projects.
- Provide earlier quantification of alternate options for significant projects.

For further information please refer to Capital Expenditure Prioritisation.

6.12 Process and Configuration Management

Process and configuration management includes:

- The standardisation of design, hardware and configuration of protection and substation automation systems
- Database management – consolidation of secondary systems data, firmware and configuration in accessible engineering data bases
- Power system protection, control and monitoring - development of protocols for the application of standard designs, the implementation of settings and the testing of secondary devices.

Key Strategies:

- Document the vision for substation automation concept, including the implementation of international substation automation standard IEC 61850
- Complete repeatable configuration templates for two alternative System Control and Information Management Systems (SCIMS)
- Complete the development of standard bay cubicles and interfaces for typical high-voltage circuit bays in terminal stations.
- Reduce the number of communication protocols used between the SCIMS and Intelligent Electronic Devices (IEDs).
- Identify the data and relevant ports of IEDs that are accessed remotely for engineering purposes.
- Implement IEC 61850 in terminal station refurbishment projects.
- Develop a philosophy for Local Area Network (LAN) based engineering access to IED data (possibly using the IEC1850 standard) and implement where available.
- Develop support tools for monitoring and disturbance analysis in order to maximise the benefits of a quick and accurate assessment of system conditions.
- Adapt station configuration to support the introduction of “station to station to control centre” network communication based on international standards.

For further information please refer to Process and Configuration Management.

6.13 Knowledge and Record Management

The establishment of robust knowledge management systems, processes and culture is pivotal to the achievement of network performance targets, optimised life-cycle costs and a sustainable risk profile.

Knowledge and record management includes maintaining accurate records of asset types and locations; condition assessments from periodic inspections, risk based testing programs and automated online condition monitoring systems.

It also includes the real-time acquisition and management of data regarding network operating parameters and event circumstances. This data will facilitate confident, safe and reliable operation of the network, the modelling of future scenarios and the forecasting of performance.

It extends to include the transfer of intellectual property and informal knowledge through training and mentoring programs.

Key Strategies:

- Identify policies and standards that require documentation and prioritise these for implementation.
- Refine the Protection and Control Design Guide document.
- Realise a compendium of supporting, secondary-system databases that is accurate, easy to use, readily manageable and that matches the applied technology.
- Review the requirements of communication system documentation and produce a plan to meet organisational needs.
- Review the requirements of secondary-system documentation and, in conjunction with other organisational IT initiatives, produce a plan to best meet organisational needs.

For further information please refer to Knowledge and Record Management.

6.14 Skills and Competencies

Opportunities to leverage human skills and competencies within SP AusNet have proved somewhat limited due to the common problems of an aging technical workforce and increasing technical workloads. Independent analysis reveals that the wider Victorian and Australian utilities workforces are confronted by the same challenges.

Key Strategies:

- Model business development to quantify the volumes of traditional and emerging skills required to meet projected work programs.
- Develop action plans to close resourcing gaps.
- Retain existing baby boomer skilled resources beyond nominal retirement.
- Retain existing and future generation X & Y employees, by improving the employee value proportion.
- Focus recruitment and development programs on core skills.
- Establish commercial alliances with industry partners to secure access to non-traditional skills and business practices.
- Increase use of consultant and contractor resources for non-core skilled tasks.
- Increase employee and contractor productivity through training and improved access to Information Management Systems (IMS).

For further information please refer to Skills and Competencies.

7 Plant Strategy Summary

7.1 Introduction

To meet network performance targets and maintain a sustainable risk profile, SP AusNet faces a number of major plant management challenges over the next 15 years. This section summarises the issues and the strategies selected to address these challenges and identifies the location of further information on these assets, including their age and condition.

In the first 10-year period covered by the AMS, issues are concentrated on terminal station assets. In the latter part of this 15-year time frame, issues with transmission lines are expected to predominate.

Transformers - The most financially significant asset management issue is the reliability of a large part of the power transformer fleet. With high and increasing utilisation, increasing network fault levels and an old age-profile, power transformers have only met availability expectations in three of the last 10 years. High maintenance and condition monitoring activity has been necessary to manage the increasing risk of major failures. A comprehensive condition assessment, maintenance, refurbishment and replacement program is focussed on addressing known issues, assessing remaining life and replacing uneconomic units over the next 25 years.

Switch Bays - In 2001, the 25-year task of modernising an old and unreliable circuit breaker fleet commenced. With fault levels approaching ratings at 39% of stations and benchmarking showing failure rates above international averages, the progressive replacement of air-blast operation and bulk oil-insulated circuit breakers are key factors in managing availability performance, operating costs and environmental risks such as noise and oil spills.

Targeted condition monitoring and replacement programs are the basis for management of the health and safety and reliability risks associated with deteriorating insulation of particular current and voltage transformers. Replacement of manual operation disconnector switches with remote control units, to improve network control and mitigate health and safety risks, will continue.

Secondary Systems - The progressive replacement of electromagnetic protection relays with integrated digital protection/control/instrumentation relays that feature serial communications facilities is a key step in improving the reliability and accuracy of protection operations, managing maintenance costs and acquiring the information necessary for effective real-time control of an increasingly complex network. Another major element is the systemic movement toward broadband, Optic Fibre Ground Wire (OPGW) based communications between terminal stations and control centres in order to meet NER mandated performance levels.

Civil Infrastructure – The progressive establishment of suitable accommodation for digital protection/control/instrumentation equipment remains a focus in the augmentation of civil infrastructure for the next 10 years. Asbestos removal from building claddings and equipment mounting panels will take prominence following the completion of the PCB removal program. The recent enhancement of site and network data security will remain a high priority for the next five years.

Lines – Insulator and fitting failures and tower footing corrosion are the observable factors associated with the emerging deterioration of transmission lines. Carefully focussed risk assessment followed by remedial maintenance and selected replacement are the first steps in managing the significant health and safety and environmental risks associated with the mechanical failure of a transmission line. SP AusNet's challenge is to manage these escalating risks prior to the major line up-rating and augmentation program forecast by VENCorp to commence within the 15-year time frame of this strategy.

The following sections discuss in more detail the assets, issues and strategies selected to meet future network performance targets and to maintain a sustainable risk profile.

7.2 Transformers

This section summarises the issues and management strategies associated with the 117 main tie and connection power transformers, 19 oil-filled reactors, 1852 current transformers (CTs), 991 inductive and capacitive voltage transformers, and 85 station service transformers.

The average age of power transformers is 36 years, with the oldest unit being 56 years. The allocated technical life ranges from 40 to 60 years depending upon suitability for 'mid-life' refurbishment. The ITOMS 2005 report[45] indicates that SP AusNet power transformers are on average 19 % older than Australian peers and 39 % older than international peers. Notable is the large number of old single-phase transformer banks in service. These units have high losses compared with their three phase equivalents.

[45] ITOMS 2005 Report - International Transmission Operations & Maintenance Study – Revision 6 May 2006

Similar in construction to power transformers, the oil insulated reactors range in capacity from 15 to 121 MVAR, and have operating voltages of 500 kV, 220 kV, 66 kV and 22 kV.

Inductive type VTs predominate up to 66 kV and capacitive type VTs are principally used for voltages of 220 kV and above. The VT fleet has an even age profile but notable is the 47% of units with a service life in excess of 35 years.

In general, the condition of power transformers is good with few incipient faults or major defects. The failure rate (requiring major repair) remains low when compared with CIGRE averages. Principle technical issues are associated with power transformers that are subject to extended periods of high operating temperatures and high numbers of operating cycles include:

- Low dielectric strength of both solid and fluid insulations due to high moisture content, oil degradation and sludge restricted cooling
- Excessive noise and low resistance to electro-mechanical forces of fault currents due to loose windings and deteriorating mechanical strength of solid insulation
- Environmental, explosion and fire risks arising from insulating oil leaks from bushings, main tanks and ancillaries due to deteriorating seals and corroding radiators
- Increasing maintenance requirements of tap changer contacts and drive mechanisms
- Rising Winding Temperature Indicator calibration errors and secondary wiring degradation
- Non-scheduled PCB contamination of insulating oils

The violent failure mode of some instrument transformers presents safety risks to field staff working in the vicinity, risk of collateral damage to nearby equipment and unplanned network outages with attendant availability penalties. The frequency and sophistication of the condition monitoring, testing and analysis regime has been increasing to ensure insulation degradation rates are assessed accurately and units are replaced prior to failure.

Principal power transformer management strategies:

- Replace two 3-phase units at Geelong Terminal Station and 57 single-phase units at Bendigo, Brunswick, Dederang, Glenrowan, Ringwood and Thomastown Terminal Stations and remove the Group 5 units at Yallourn Power Station to provide a stable risk position.
- Utilise the condition assessment/testing and performance/reliability monitoring programs to prioritise units for additional testing, addition of online condition monitoring facilities, refurbishment or replacement.
- Progressively replace inaccurate winding temperature indicators and inadequate cooling controls with digital equipment enabling monitoring and cooling control from NOC.
- Integrate DDF re-testing of identified bushings with the Toshiba 220 kV SRBP and Micanite Oil impregnated paper bushing monitoring programs and ASEA 220 kV SRBP bushing replacement program.
- Insulating oil condition management program shall incorporate OLTC diverter switch tests, shunt reactor PCB tests, oil leak repairs, oil filtering and reclamation, progressive replacement of non-scheduled PCB oils and implementation of oil preservation system for identified transformers.
- Contingency response planning shall include confirmation and implementation of the contingency spare holdings review and progressive installation of fire suppression systems and blast / fire barriers between transformers based on network criticality and terrorism risks.

Principal instrument transformer management strategies include:

- Replace a minimum of 580 single phase oil insulated CTs at Altona, Dederang, Fishermans Bend, Geelong, Moorabool, South Morang, Tyabb, Templestowe and Wodonga terminal stations by 2013 as part of a portfolio of terminal station refurbishment projects, bay replacements and like for like replacements to minimise the risk of catastrophic failure.

- Condition monitoring program will focus on annual Radio Frequency Interference (RFI) scans, CVT output voltage monitoring via CAMS, DGA analysis of nominated CTs and inductive VTs during scheduled maintenance, off line electrical tests (eg DDF where DGA is impractical), SF_6 gas purity and density monitoring on 500 kV SF_6 CTs, comparisons with other utilities and forensic examination of units removed from service.

For further information please refer to the detailed plant strategies: Power Transformers and Oil-filled Reactors and Instrument Transformers.

7.3 Transmission Lines

SP AusNet manages more than 6,500 km of transmission lines, operating at voltages of 500 kV, 330 kV, 275 kV, 220 kV and 66 kV, supported by more than 12,700 towers located on 3,800 km (21,500 ha) of easement. Including conductors, insulators, line hardware, towers, rack structures, access tracks and bridges, transmission lines represent 60% of the Victorian electricity transmission network's total asset value.

Mainly constructed between the early 1950s and late 1980s, 65% of towers now exceed their technical half-life.

The emerging management issues are:

- Legislative change in the areas of worker safety, unauthorised access and electromagnetic radiation limits.
- Mechanical failure of insulators due to bonding cement failure, mechanical wear or corrosion of fittings and electrical failure due to insulator cracking from excessive loading or lightning strike
- Corrosion of tower and rack structure foundations, steel work and fasteners
- Loosening, corrosion, metal fatigue and wear erosion of line hardware, dampers and spacers particularly in coastal and wind incident areas
- Galvanised steel ground wire corrosion and ACSR conductor metal fatigue and mechanical abrasion due to wind initiated vibration
- Soil erosion of access tracks and bushfire damage to bridgeworks

For the most part asset deterioration is progressive with localised exceptions determined by site-specific environments. Reliability events due to failures of insulators, spacers and mid-span conductor joints have occurred in 200 kV circuits with service lives of approximately 50 years.

To date, remedial monitoring and maintenance programs have not had a material impact on circuit availability.

Principal strategies to address the risks outlined above include:

- Maintain a stable risk profile by focussing the 2008-2013 insulator replacement program on approximately 9600 off 16mm pin diameter insulator strings located on 3200 tower-sides on 220 kV lines, 1500 insulator strings located on 500 tower-sides on the Murray Switching Station to Dederang Terminal Station 330 kV lines, and 1500 insulator strings located on 250 tower-sides on the Hazelwood Terminal Station to South Morang Terminal Station and South Morang Terminal Station to Keilor Terminal Station 500 kV lines
- Consolidate asset inspection program and focus criteria, methods and management on quantified risks.
- Risk assessment program to quantify asset condition and adjacent land use to facilitate mitigation programs for conductor drop, vehicle impact, and hazardous land use and EMF compliance.

- Grillage foundation corrosion assessment and sacrificial anode installation at up to 4000 sites over 10 years as required.
- Ground level corrosion monitoring, and as required, re-coating and member replacement.
- Full tower painting and selected steel member and bolt replacement at 15 high atmospheric corrosion sites over the next 15 years.
- Progressive replacement of steel ground wires at terminal stations over the next five years.
- Selective replacement of deteriorated line hardware at high-risk sites, including vibration dampers, conductor spacers and insulators.
- Risk based line pollution monitoring and insulator washing programs.
- Progressive fitting and replacement of circuit identification signs, fall prevention devices, anti-climbing devices and warning signs.
- Continue to work with the Department of Sustainability and Environment (DSE) to ensure the ongoing management of line easement issues.

For further information refer to the detailed plant strategies, Transmission Lines and Line Easements.

7.4 Circuit Breakers - Switches - Surge Diverters

The Victorian electricity transmission network includes more than 980 circuit breakers, 1970 disconnectors, 1250 earth switches, and 1800 surge diverters operating at voltages from 22 kV to 500 kV.

Circuit breaker (CB) types include air-blast (9%), bulk oil (42%), minimum oil (21%) and SF_6 (28%). Vertical break and hookstick operation disconnectors predominate (87%) but the fleet includes SF_6, rotary double-break and semi-pantograph styles. Two-thirds of surge diverters are of zinc oxide construction (age < 20 years) and the remainder are of silicon carbide construction (20 < age < 45 years).

In summary, the principal technical issues are:

- CB fleet is one of the oldest operated by Australian and international TNSPs[46]
- Failure rate of CBs exceeds the average of international TNSPs[47]
- CB full-refurbishment costs are approaching replacement costs
- Shortages of skilled and experienced technicians
- High cost of severely limited technical support from original equipment manufacturers
- Corrosion induced SF_6 gas insulation leakage rates
- Excessive air-blast CB operating noise
- Insulating oil leakage rates and hydraulic operating mechanism leakage rates
- Disconnectors are on average 14 % older than those on Australian networks and 27 % older than those on international networks. A high proportion of the fleet are manually operated, are prone to stiction when idle for extended periods, have lower availability and higher maintenance costs.
- Silicon carbide type surge diverters are prone to seal degradation, moisture ingress and explosive failure. They offer inferior protection when compared with zinc oxide units.

Reliability events due to circuit breaker, disconnector and surge diverter failures have occurred at all voltages. Risk mitigation monitoring and remedial maintenance programs are expensive and have a material impact on future OPEX and circuit availability.

Principal management strategies include:

[46] ITOMS 2005 Report - International Transmission Operations & Maintenance Study – Revision 6 May 2006
[47] G Mazza, R Michaca, "The first International Enquiry on Circuit Breaker Failures and Defects in Service" Electra No. 79 Dec 1981.

- Deliver a 20% improvement in circuit breaker risk through the progressive replacement of 260 off air blast and bulk oil circuit breakers at Brooklyn, Dederang, Geelong, Glenrowan, Hazelwood, Horsham, Kerang, Morwell, Redcliffs, Ringwood, Rowville, Springvale, and Thomastown terminal stations and the Loy Yang and Hazelwood power station switchyards by 2013.
- Replace air blast CBs by 2013 and most bulk oil insulated CBs over the next 15 years.
- Salvage replaced CBs to provide spares for in-service JW420, JW419 and LG4C CBs
- Opportunistic replacement of minimum oil insulated CBs controlling reactive plant.
- Review the performance of older SF_6 CBs and develop refurbishment programs as required.
- Establish a 6-year program for the overhaul of CB hydraulic mechanisms and upgrade of control circuits.
- Increasing use of SF_6 gas insulated CBs with on line condition monitoring.
- Progressive introduction of motorised disconnectors at 220 kV and above.
- Introduction of systemic monitoring of thermal imaging and third harmonic discharge currents to assess surge diverter condition.
- Selective replacement of surge diverters with inadequate pressure relief or known corrosion problems.

For further information refer to the detailed plant strategies, Circuit Breakers, Disconnectors and Earth Switches and Surge Diverters.

7.5 Gas Insulated Switchgear

SP AusNet manages 28 circuit breaker bays of gas-insulated switchgear (GIS) across four stations. In addition, there is one bay that is comprised of bus-only at fifth station.

The 500 kV GIS is located outdoors at South Morang (SMTS), Sydenham (SYTS) and Rowville Terminal Stations (ROTS) and the 220 kV GIS is located indoors at Newport D Power Station (NPSD) and West Melbourne Terminal Station (WMTS). The 66 kV GIS is located indoors at WMTS.

The GIS population falls into two age brackets. The majority is between 23 and 27 years old and include the switchgear installed at SMTS, SYTS, NPSD and ROTS. The GIS at WMTS is under five years old.

The GIS has experienced few failures and has performed well in comparison to international installations. However, the number of major failures on the older outdoor GIS has dramatically increased in recent years.

The main issues are:

- Increasing numbers of major CB interrupter failures, resulting in internal flashovers, at SMTS and SYTS. Many of these failures are due to design and manufacturing problems. Protracted and expensive repairs due to the requirement for significant plant outages, highly skilled manpower resources and specialised tools and clean-room facilities.
- Increasing requirement for effective condition monitoring techniques.
- Leaks in the drive mechanism hydraulic system of the CB's at SMTS and SYTS.
- Availability of spares and manufacturer support.
- Corrosion of flanges, resulting in moisture entry and increasing SF_6 gas leaks, especially evident at SMTS and SYTS.

Key strategies to address the issues outlined above are:

- Install an emergency by pass facility at SMTS to ensure network security during repair of major SF_6 gas leaks and weather sealing on the Gas Insulated Switchgear in 2007/08.
- Install permanent, partial discharge sensors on GIS at SMTS, during SF_6 leak repairs.
- Complete the refurbishment of the CB hydraulic mechanisms at SMTS by 2010/11
- Continue monitoring disconnector and earth switch operation at SMTS and overhaul if required.
- Upgrade the control circuits for 500 kV CB hydraulic mechanisms at SYTS to avoid potential "slow operations"
- Implement GIS repairs and refurbishment at SYTS by 2008/09.
- Monitor bushing corrosion and gas leakage at SYTS and reseal as required.
- As required, complete drying of SF_6 gas, fitting of drying canisters and re-establish external weather sealing at SYTS.
- Implement automatic detection of bus-current imbalance from ESCA data to quickly identify hot joints in GIS.
- Schedule six-monthly, in–service monitoring of partial discharge using UHF sensors on the GIS at SMTS, SYTS and NPSD.

For further information refer to the detailed plant strategy Gas Insulated Switchgear.

7.6 Reactive Plant

Increasing maximum demand on the Victorian electricity transmission network has increased the operating duty of the 90 capacitor banks installed to provide steady-state voltage support, the four Static VAR Compensators (SVCs) and the three synchronous condensers installed to provide dynamic reactive capacity.

In total, there are more than 13,000 capacitor cans operating in the 90 banks at seven voltages ranging from 4.5 kV to 330 kV. The capacitor cans are up to 27 years old with an expected life of 40 years. The SVCs have ratings of +50-25 MVar and +100-60 MVar and are 18 and 22 years old respectively with a technical life of between 40 and 60 years. The synchronous condensers have ratings of +110-64 MVar and +125-75 MVar and are 36 and 40 years old respectively with a technical life of between 40 and 50 years.

Capacitor cans are generally in good condition. However, rising network utilisation requires more frequent and longer operation of reactive plant. This has increased the switching duty on capacitor cans such that increasing failure trends have been observed in cans subjected to high numbers of operational cycles and greater times at elevated operating temperatures.

Recent replacement of thyristor cooling systems to restore capacity, and address corrosion and circulation pump deterioration has overcome the tripping of SVCs at times of high ambient temperature. Thyristor failures, due to control system malfunctions have been exacerbated by the absence of spare parts and diminishing OEM support and this is raising the priority of control system refurbishment and replacement proposals.

Deterioration of rotor pole insulation has led to shorted rotor turns on all synchronous condensers and partial discharge is evident on some stators. Defects in automatic voltage regulation and impulse exciters and other auxiliary systems have increased the frequency and complexity of maintenance activities.

In recent years availability targets for capacitors, synchronous condensers and, in particular SVCs have not been achieved. This is due to half-life refurbishment requirements and augmentation projects in critical stations.

Thermo-vision scanning, coupled with electrical testing of higher-risk capacitors and the preventative replacement of deteriorating cans, is necessary to raise the availability of capacitor banks to target levels.

Close monitoring of the performance of SVC thyristor control systems is necessary to determine the timing of a progressive refurbishment and replacement program that will include air conditioning of thyristor halls to moderate ambient operating temperatures.

Increased condition monitoring in the form of vibration analysis (shorted rotor turns), online partial discharge monitoring (stators), analysis of main exciter brush wear and exciter currents as well as main bearing lubricating oil will determine the timing of rotor and possibly stator refurbishment, necessary for each synchronous condenser to reach its nominal technical life.

Key management strategies include:

- Replace capacitor cans and associated series reactors in selected older banks over the next five years, subject to appropriate economic evaluations.
- Upgrade the control system (including thyristors) on one of the SVCs at Rowville Terminal Station and monitor the performance of the control systems of the other three SVCs to determine the need for future upgrade.
- Refurbish the synchronous condensers at Fishermans Bend and Templestowe terminal stations using the knowledge acquired from re-furbishment of the unit at Brooklyn Terminal Station.

For further information refer to the detailed plant strategies, Capacitor Banks, Static VAR Compensators and Synchronous Condensers.

7.7 Power Cables

SP AusNet owns significant quantities of HV underground power cables arranged in 97 circuits operating at voltages of 220 kV, 66 kV, 22 kV, 11 kV and 6.6 kV. Mass impregnated paper is the main insulation type but there are XLPE and oil filled insulation cables predominantly located within terminal station sites. An 11 km circuit of 220 kV, 3 x single core XLPE insulated cable is located in easements on public property between the Richmond and Brunswick Terminal Stations.

The majority of 220 kV and 66 kV cable terminations are of air insulated, out-door configuration. However, there are also some SF_6 and oil-immersed terminations. Lower voltage terminations are of compound filled, outdoor configuration. Only the Brunswick Terminal Station to Richmond Terminal Station (BTS – RTS) and Eildon Power Station to Thomastown terminal Station (EPS – TTS) 220 kV cables, within the South Morang Terminal Station site, have cable joints.

The 220 kV cables were installed between 1979 and 1992, while the 66kV cables were installed between 1981 and 2001. The lower voltage cables were mostly associated with equipment installation as part of station developments between 1951 and 1998. Underground cables have been allocated a technical life of 60 years.

In general, the condition of power cables is good, however some problems are becoming apparent with the joints in the BTS - RTS 220 kV cable. In the immediate future the main investment drivers will be related to the replacement of further joints and continued investigation of the cause of low sheath insulation resistance and oil leaks from joints in the BTS - RTS 220 kV cable and addressing deficiencies in the management of power cables including availability of:

- Materials (including spares)
- Specialised equipment
- Maintenance expertise, in particular to carry out repairs of EHV cables after failures

Specific strategies include:

- Produce a power cables contingency plan that addresses issues in the management of power cables, in particular repairs after failures.

- Replace original oil filled joints in the BTS - RTS 220 kV cable to address low sheath-insulation resistance, faulty oil pressure sensors, oil leaks and failure risks.

For further information refer to the Power Cables detailed plant strategy.

7.8 Station Auxiliaries

Station auxiliaries include diesel generators, compressed air systems, fire detection and suppression systems, secondary cables, AC and DC power supplies, and earth grids.

7.8.1 Diesel Generators

Seventeen diesel generator sets provide emergency 415 V AC supplies at 15 critical terminal stations and communications sites in the event of the total loss of auxiliary power supplies. Ranging in age from 12 to 35 years, the diesel-fuelled generators are a low cost contingency measure to facilitate rapid restoration of supply during large unplanned outages. Operation is confined to regular test start and run sequences. Although the assets are quite old there are few issues of significance.

For further information refer to the Diesel Generators detailed plant strategy.

7.8.2 Station Air Systems

Station air systems can be duplicated high pressure, high capacity and high quality for air blast circuit breakers and some ‘CB close’ mechanisms or low pressure, low air quality for general purpose, workshop or fire service purposes.

There are 62 air systems containing 81 compressors. The majority were installed between the mid 1950s and mid 1960s and the last was installed in 1970. Air receivers are registered and inspected in accordance with statutory provisions

Galvanised pressure vessels have performed well and have a long life. Safety valves seal well until operated, after which sealing can deteriorate. High-pressure hard drawn copper or stainless steel airlines remain in good condition. However, compressors require a significant level of planned maintenance to ensure inlet and outlet valves remain reliable. After 15 years of operation, compressor breakdowns increase and replacement becomes an economic option.

- Progressively retire station air systems as the CBs they support are retired.
- Rationalise and relocate compressors to minimise purchase of new equipment.
- Review need for workshop and fire service air systems periodically.

For further information refer to the Station Air Systems detailed plant strategy.

7.8.3 Fire Detection and Suppression Systems

Fire detection and suppression systems protect key transformers and protection, control and communication facilities to minimise fire damage and resultant outages, availability restrictions and network constraints. HALON fire suppression systems were removed from terminal stations during the 1990s.

Since 2000, VESDA fire detection systems have been installed in critical locations within terminal stations to supplement less sensitive smoke and heat detectors.

Water-deluge fire suppression systems have protected the 500 kV and 330 kV network transformers since their installation. INERGEN gaseous fire suppression systems have been recently installed to protect communications, protection and control facilities at South Morang, Hazelwood and Rowville Terminal Stations. FM200 suppression systems have been recently installed at the back up Network Operations Centre (NOC) and back-up Data Management Centre (DMC). Installation of fire barriers between power transformers and in cable ducts to protect the protection, control and communications facilities has recently commenced.

The water deluge and gaseous fire suppression systems are in good condition with periodic maintenance, as per the Australian Standards, essential for continued reliable operation.

In recent years environmental and occupational health and safety legislations have driven investment. Increased security and risk management approaches may enhance coverage of existing detection systems and precipitate further installations of suppression and barrier systems.

- Review VESDA installations and functionality with a view to enhancing coverage.
- Review INERGEN installations and functionality prior to progressive installation (on an assessed risk basis) at additional 500 kV and interstate inter-connector stations.
- Where practical, supplement water deluge suppression systems with transformer fire barriers and progressively install transformer fire barriers at additional terminal stations.
- Progressively install cable duct fire barriers and tamper proof fire service facilities at additional terminal stations.

For further information refer to the detailed plant strategy, Fire Detection and Suppression.

7.8.4 Secondary Cabling

More than 43,000 secondary cables totalling more than 6000 km in length interconnect primary plant such as circuit breakers and power transformers with low-voltage AC and DC power supplies, protection relays, control systems and measurement systems located in control and relay buildings. By length, 91% of secondary cables are associated with switch bays, 8% with transformers and 1% are installed in control or relay rooms. Four and eight core construction predominates and there are more than 260,000 individual cores in service.

More than 90% of secondary cables are insulated and sheathed with PVC and have installation dates from the early 1950s to 2005. An estimated 7% (420 km) of secondary cabling is of vulcanised rubber construction. It is now more than 50 years old and can be found in significant quantities in older stations such as Brooklyn, Mount Beauty, Malvern, Morwell, Richmond and West Melbourne terminal Stations and Yallourn Power Station. PVC insulated and sheathed cabling is in good condition with no significant deterioration and only isolated examples of damage where inadequately protected by cable ducts or trenching. PVC insulated and sheathed cables have proven reliable and are expected to remain serviceable for a further 20 to 30 years attaining a service life in excess of 60 years.

However, the vulcanised rubber cabling has deteriorated to the extent that battery earth-faults and short circuits have occurred in older installations (such as Malvern terminal Station) following heavy rainfalls. In some locations it has been necessary to run temporary cabling across switchyard surfaces as all existing cable cores were utilised and cable ducts and trenches were full. The vulcanised rubber cables have reached the end of their reliable life and care is required to ensure they remain undisturbed until their replacement.

The transition from copper secondary cabling to fibre-optic cabling and digital communications within terminal station switchyards is expected to be driven by the standardisation of interfaces on secondary equipment, availability of interfaces on primary equipment and commercial viability of interfacing with existing primary equipment. The use of fibre optic communication circuits is expected to progressively grow from Asset Data Gathering Networks into instrumentation, control systems and finally protection systems.

Principal strategies to address the risks outlined above include:

- Progressively abandon vulcanised rubber secondary cabling and establish replacement PVC cabling in conjunction with network augmentation and plant/equipment replacement projects.

For further information refer to the detailed plant strategy, Secondary Cabling.

7.8.5 Auxiliary Power Supplies

7.8.5.1. AC Systems

Duplicated AC systems supply transformer tap changers and cooling, battery chargers, station lighting, air compressors, air conditioning, computer servers and general-purpose outlets at 415 V.

AC supplies date from the station's inception with progressive augmentation and refurbishment only during major station re-builds. Conceptually sound and generally in reasonable condition, AC supplies and changeover schemes are not remotely monitored. Some failures have occurred and there have been problems related to cable insulation and asbestos in distribution panels.

The AC system supplies to transformer tap changers and cooling is critical to power transformer rating. Inadequate AC supplies can precipitate outages, restrict availability or constrain the network.

AC systems strategies include:

- Review AC system component ratings including auxiliary and station service transformers, cables, fuses and contactors.
- Assess the condition of AC supply changeover schemes with a view to installation of monitoring facilities.
- Progressively replace AC distribution and auto changeover switchboards containing asbestos.

7.8.5.2. DC Systems

Station DC power systems[48] supply protection, SCADA, instrumentation, metering, communications equipment, CB controls and auxiliary power, emergency lighting and alarm systems. Prior to 1995, two 48 V communications batteries, a single 250 V protection and control battery, and a single 48 V control battery were standard.

Since 2000, 27 key, new and refurbished stations have received duplicated 250 V battery chargers and batteries of lead acid, flooded cell construction. 48 V supplies are derived from DC-DC converters. Battery condition is monitored and so too is abnormal voltage and earth faults.

There are 17 DC systems that date from station commissioning, they are generally in good condition, but the age and condition of batteries varies widely. Batteries are subject to regular maintenance and planned replacement of cells after the expected life. Chargers are replaced on failure or as required by station augmentation. Older distribution and monitoring boards contain asbestos.

'On-load' maintenance of batteries forming the sole power source for protection, control or SCADA facilities present risks to the safety of personnel and the security of the network. The older stations have large distribution boards that contain asbestos, and are fitted with exposed, copper knife switches with attendant health and safety risks.

DC systems strategies include:

[48] Batteries, battery chargers and associated wiring and switchgear

- Complete the installation of a second 250 V control battery in the remaining 19 terminal stations by 2012
- Replace the 48 V Control Battery with standard DC-DC converters supplied from duplicate 250 V batteries in 34 stations. Re-use cells, having sufficient life, released by this work in 250 V batteries.
- Develop a DC supply policy that includes capacity requirements for time-off supply, recharge, and boost charging and testing.
- Focus battery condition assessments on cell design lives and replace cells on assessed condition.
- Review modern battery technologies as potential replacements for flooded lead-acid type cells.
- Include battery-sizing review in all major projects and audit battery sizing in a selection of sites where recent incremental upgrades have been completed.
- Develop a battery failure recovery strategy for sites without duplicate batteries.

For further information refer to the detailed plant strategy, Auxiliary Power Supplies.

7.8.6 Earth Grids

Earth grids are installed below ground in all terminal stations and communication sites. Typically, the grids comprise stranded copper conductor welded at connection and crossover points. Vertical copper risers (typically flat-copper conductor) are then welded to the grid and either welded or bolted to the installed plant and equipment items. The switchyard surface material placed over the grid is an integral part of this earth grid system.

Ground wires, connected to the station earth grid via termination hardware and plant structure steelwork, are strung above switchyard plant in all terminal stations to provide protection from direct lightning strikes. These ground wires are ‘slack strung’ compared with transmission line ground-wires.

Transmission line towers (including those inside terminal station boundary fences) do not normally have an installed earth grid but rely on the tower foundations. In the few cases where this footing resistance is not adequate, the tower foundations have counterpoise (earth conductors) installed. Ground wires are strung between the tops of towers above the line conductors. This ground wire is connected to the steelwork of each tower and also to the rack structure steelwork at the line termination point in terminal stations.

Earth grids were installed when the terminal station switchyards and communication sites were originally established. They have been progressively augmented as additional plant was installed. The ground wires above transmission lines were installed at the time the lines were constructed.

The condition of the belowground earth grids can generally be regarded as good. This is due to comparatively neutral Ph soils, low salinity water tables, and the use of long-life materials with high-reliability welded joints. Some of the station ground wires are showing deterioration due to surface corrosion, but testing has shown acceptable tensile strengths.

Corrosion problems have been identified in the footings of towers with grillage-type foundations, located close to terminal stations. This is caused by currents circulating between the line ground wire and the station earth grid. The installation of insulators to prevent circulating currents also helps the calibration of station earth grid current-injection tests in that the station earth grid and ground wire may then be separated from the line ground wire. A recent failure of a ground wire (installed between a tower inside a station and the station rack structure) due to overheating from circulating currents has led to the implementation of a program bridging the termination hardware to make a solid connection between the ground wire and tower steelwork in such situations.

SP AusNet employs portable earthing devices in order to earth plant items to the station earth grid or tower steel work to ensure safe access for personnel. These devices usually comprise a flexible copper conductor with plug or clamp fittings and are applied to electrically isolated plant using insulated switch-sticks in most cases.

In 2001 a review was conducted on the requirements of these portable earthing devices. This was due to the increasing fault levels in terminal stations. The recommendations of this review are presently being re-assessed and will be updated as required.

The main investment driver is the requirement to ensure the ongoing integrity of existing earth grids from both an electrical safety and plant operation limit viewpoint. This is achieved by a program of station earth grid current injection tests, establishing the best switchyard surface material and checking the condition of foundations for some at-risk transmission line towers.

Strategies to manage the integrity of earth grids include:

- Undertake current injection testing of station earth grids every seven years and of selected transmission line towers located near to significant residential developments.
- Excavate a sample of existing earth grid copper joints in terminal stations during refurbishment to confirm condition.
- Investigate switchyard surface materials to satisfy both electrical safety and surface stability issues.
- Develop a program, to install insulators between the transmission line ground wire and terminal station rack structures to prevent circulating currents corroding the grillage type foundations of towers near terminal stations,.
- Complete the program of the installation of bridge connections across the termination hardware for line ground wires located at power station switchyards and on 500 kV line ends.
- Replace deteriorated terminal station ground wires as the opportunity arises, such as during refurbishment projects.
- Complete the re-assessment and update of the 2001 review of the requirements of portable earthing devices.
- Carry out a study on the future system fault requirements and station earth grid performance to identify stations that will require augmentation of their earth grids.

For further information please refer to the detailed plant strategy, Earth Grids.

7.9 Protection Systems

The ITOMS 2005 Report[49] indicates that SP AusNet’s relays are on average 25 % older than relays protecting other Australian networks and 38 % older than relays protecting international transmission networks.

7.9.1 EHV Lines

There are 456 main protection relays that are supplemented by 1000 trip relays, interposing relays and remote trip receive relays providing duplicate protection for 122 EHV lines (220 kV and above). There are 23 different types of main relays including electro-mechanical pilot wire relays, electro-mechanical, electronic and microprocessor type distance protection relays, and microprocessor based current differential relays.

The oldest electro-mechanical relays have delivered 40 years service and 26% of electro-mechanical relays and electronic relays are older than 20 years.

[49] ITOMS 2005 Report - International Transmission Operations & Maintenance Study – Revision 6 May 2006

7.9.2 Transformers

A total of 277 biased differential relays, differential relays, overcurrent relays and high impedance zone protection relays provide duplicated protection for the 105 transformer banks. Buchholtz, trip and auxiliary relays totalling more than 1000 additional items complete these protection schemes. Main protection relay technologies include electro-mechanical (57%), electronic 14% and microprocessor types 29%.

A total of 48% of main protection relays are electro-mechanical types over 30 years old. Electronic relays ranges from 10 to 30 years in age and microprocessor relays are less than 10 years old.

7.9.3 HV Feeders

There are 457 schemes with a total of 555 main relays that provide duplicated protection for 227 off 66 kV feeders. Auxiliary relays including trip relays, interposing relays and remote trip receive relays add 2000 items to these schemes.

A recorded 42 different types of main relays include electro-mechanical pilot wire protection, electro-mechanical, electronic and digital microprocessor type distance protection, electro-mechanical and microprocessor types, over-current protection, and microprocessor based digital current differential protection. Further, 53% of relays are electro-mechanical, 6% are electronic and 41% are digital.

Electro-mechanical relay age is up to 40 years. It is calculated that 46% of electro-mechanical and electronic relays have provided more than 20 years service.

7.9.4 Bus-Zone Protection

Seventy-seven percent of the 354 bus-zone protection systems are electro-mechanical high-impedance differential schemes with the balance being mainly differential over-current or low/medium impedance differential schemes. A few installations are also protected by busbar overload schemes.

Most of the high impedance schemes are in good condition and do not require attention.

Some low impedance differential and overcurrent schemes however have electro-mechanical relays with rotating induction discs and these are in need of replacement due to component wear, stiction, and large operating and maintenance costs as they are no-longer supported by the manufacturers. From a system security and protection dependability perspectives, the 'unstabilised' and single scheme installations need to be replaced/upgraded as this presents a system operational risk.

7.9.5 Reactive Plant Protection

Reactive plant protection systems (with the exception of the old synchronous condensers) are mainly of electronic design. These relays are generally in good condition and most relay types are still supported or have compatible replacement products. The electro-mechanical relays that make up the balance of the installed assets are also sound with the exception of capacitor bank current balance relays, which are exhibiting non-operation and measurement error. The D21SE relays protecting reactors at Horsham and Redcliffs terminal stations are prone to inrush tripping. Protection on the synchronous condensers at Fishermans bend, Templestowe and Brooklyn terminal stations would benefit from the installation of relays with recording facilities to assist in the analysis of network transients.

7.9.6 Principal Issues

Principal issues associated with protection systems include:

- Bearing wear, stiction, corrosion, loss of magnetism and insulation breakdown in electro-mechanical relays
- Component failure caused by thermal stress and auxiliary voltage variation in electronic relays
- Slow operation of the Duo Bias relays
- Inrush tripping on the D21, D202 and D203 relays
- High number of relay types and unique relays protecting major transformers
- Lack of fault logging information
- Software and firmware management of the microprocessor based relays

7.9.7 Main Investment Drivers

The main drivers of investment in protection systems include:

- Network reliability - replace schemes prone to failure and mal-operation
- Lower Opex costs - replace schemes requiring intensive maintenance
- Increased functionality - monitoring and disturbance-recording capabilities
- Functional integration – standardised integrated protection, controls, instrumentation and serial communication systems reduce accommodation, installation and maintenance costs

7.9.8 Main Strategies

Key management strategies include:

- In conjunction with the replacement of high-risk primary equipment or as identified below replace up to 433 relays to provide a 7 % improvement in relay functionality risk by 2013.
- Comply with the network agreement requirement for duplicated high-speed protection on Moorabool to Terang, Terang to Ballarat, Ballarat to Horsham, Horsham to Redcliffs, Redcliffs to Kerang and Kerang to Bendigo lines.
- Progressively remove electro-mechanical relays within 10 years commencing with older Type H electro-mechanical relays on the Geelong Terminal Station to Keilor Terminal Station line in 2009, and the Ballarat Terminal Station line and Redcliffs Terminal Station line at Horsham Terminal Station in 2010. Progress to replacement of one older DS5 and DSF7 pilot wire relays on each line with a digital current differential relay in 2011.
- Replace the remaining four DT2 and DTA2 transformer protection relays at West Melbourne and Wodonga Terminal Stations.
- Replace unique relays and slow operating Duo Bias relays protecting the eleven 500 kV and 330 kV transformers at Hazelwood, Keilor, Moorabool and South Morang Terminal Stations to achieve faster operation and fault recording.
- Replace the remaining fifteen D21, D202 and D203 relays to reduce false transformer tripping at six stations.
- Where slow operating Duo Bias relays provide both X and Y scheme transformer protection replace one Duo Bias relay to achieve fault recording, faster operation and limit transformer damage
- Progressive replacement of electromechanical feeder protection relays based on condition and risk of failure with microprocessor relays integrating protection, control and instrumentation functions with serial communication to SCIMS.

- Research the application of digital information busses and digital control signalling using fibre-optic cabling to facilitate protection schemes.
- Monitor the performance of reactive plant protection systems.
- Replace main protection relays on synchronous condensers to improve reliability and transient fault recording.
- Replace protection on one SVC at Rowville Terminal Station in conjunction with replacement of control system.
- Where appropriate, install new reactive plant protection systems, which incorporate primary plant condition monitoring capabilities.

For further information refer to the detailed plant strategy, Protection Systems.

7.10 Control and Monitoring Systems

Control and monitoring systems refer to the control and monitoring of station plant (particularly circuit breakers) both locally and remotely from the NOC. This includes instrumentation (Volts, Amps, Frequency, Watts and VARs) and CB status and station alarm reporting. Local control is by hard-wired switches and analogue indicating instruments in Remote Terminal Unit (RTU) stations, and via a Human Machine Interface (HMI) in SCIMS stations. Remote control from NOC is either by hard-wired RTU or by a SCIMS.

More than 100 RTUs dating from 1974 are located at 53 sites. SCIMS equipment dating from 2002 has been installed at 15 locations. General controls (re-close relays, potential selectors, instruments) range in age up to 40 years. RTU and SCIMS systems are operating satisfactorily. However, repair of faulted cards is becoming increasingly difficult due to technical obsolescence and the need to match new components with existing.

Some failures have occurred in older general controls where mechanical relays (timers) in re-close circuits can run fast or slow and cause non-operation. Similarly, electronic relays may have component failures, be inoperative, and only found on a six-year maintenance interval or by not re-closing after a fault. The remaining electro-mechanical voltage regulating relays are suffering bearing wear and are no longer repairable.

RTU equipment has undergone huge technological change over the past 30 years and the older RTUs are now completely outmoded, and no longer supported by the makers.

The SCIMS concept is a developing technology and migrating station controls from the old configurations to the new in a coherent and cost effective way is a major challenge.

Management of the software programs and supporting documentation of PLC based control schemes is a major issue. For the Emergency Control Scheme (ECS) information is very poor and the PLCs that are the main components (Toshiba EX500) are obsolete and are no longer produced or supported.

The overall functionality and inter-relationship of some schemes and the network is not well documented. This presents a problem to the network controllers, engineering and maintenance leading to delays, and at worst mal-operation or failure to operate.

Principal strategies for control and monitoring systems include:

- Replace RTU models for which spares have been consumed.
- Install SCIMS control systems in new terminal stations and when undertaking major station refurbishment or replacement projects.
- Remove Station Mimic Controls and transducer instrumentation through incorporation of their functions into IEDs and SCIMS.
- Research the use of digital information busses and digital control signalling within terminal stations using fibre optic cabling.

- Provide a comprehensive database of design principles, operation and software for control schemes.
- Replace SCV controls.
- Research the potential for Network Control and Information Management (NCIMS) to provide functions such as load management and contingency switching.

For further information refer to the detailed plant strategy, Control and Monitoring - SCADA and Control and Monitoring - General.

7.11 Revenue Metering

There are approximately 410 revenue and 50 check meters installed at connection points with distribution customers. There are approximately 20 meters at connection points with generator customers and 10 meters at bulk supply and interstate connections to monitor energy flows, to calculate losses and facilitate invoicing amongst NEM participants.

Approximately 460 EDMI MK1 energy meters were installed in 1993 and 1994 to facilitate the disaggregation of the State Electricity Commission of Victoria (SECV). During the period 2001 to 2004, 67% of these meters were replaced with EDMI MK3 energy meters to provide a more secure, reliable, centralised metering installation compliant with the requirements of the National Electricity Code (NEC). Replacement of the remaining 33% is scheduled for completion in 2007.

The MK3 energy metering installation is modular with one meter module housing up to two energy meters including associated test switches, and the voltage selection module housing up to four voltage selection relays. The EDMI MK 3 energy meter has a typical life expectancy of 15 years and it is expected that 67% of the energy meter population will require replacement before 2020.

The design, installation and maintenance requirements associated with these metering installations are defined within Chapter seven of the NEC. The main drivers for investment would be changes to the NEC or new technologies providing superior outcomes at reduced cost.

Beyond the replacement of the remaining MK1 installations there are no specific asset management strategies relating to revenue and check metering.

Principal strategies for revenue metering include:

- Complete the progressive replacement of non-compliant MK1 energy meters with MK3 energy meters in 2007.
- Provide a more secure, reliable, centralised metering installation as part of the upgrade from the MK1 to the MK3 energy meters.
- Monitor the functional reliability of energy meter installation.
- Research the potential for future NEC compliant metering functions to be provided from Station Control and Information Management System (SCIMs) with information security provided by encryption.

For further information refer to the detailed plant strategy, Revenue Metering.

7.12 Communication Systems

Communications equipment is installed at more than 100 SP AusNet sites to provide:

- Electrical protection signalling between generating stations and terminal stations

- Electrical protection signalling between terminal stations
- Monitoring and control signalling between the Network Operations Centre (NOC), generators, terminal stations, and the National Electricity Market Management Company (NEMMCO), and
- Operational voice and business communication between NOC, offices, depots, terminal stations, generating stations, distribution zone substations, and VENCorp.

The communication system includes more than 200 links/nodes formed from optical fibre cables, radio, power line carrier and copper supervisory cables as well as operational and corporate telephone networks. At an average age of 25 years, SP AusNet communication assets are 25 % older than their Australian peers and 38 % older than international peers.

Optical Fibre in Ground Wire (OPGW) and underground fibre optic cables are now less than 20 years old. In good condition, with few incipient issues and a technical life of 40 to 45 years, little replacement is expected in the next 20 years. All Dielectric Self Supported (ADSS) fibre optic cables are predominantly installed on distribution company poles in metropolitan Melbourne. Most ADSS is now more than 10 years old and has suffered relatively high accidental damage rates. Carrying high priority EHV line protection and terminal station SCADA traffic and with a predicted life of 20 years, significant replacements of ADSS are forecast.

A majority of the electronic components forming the digital microwave-radio communications system were installed less than 10 years ago. However, with a short life expectancy of seven to 15 years, significant replacement rates are expected over the next 20 years. Most radio towers are less than 30 years old and associated antennas are less than 10 years old. Having expected lives of 40 to 70 years, few replacements are expected in the planning period.

Some of the Power Line Carrier (PLC) equipment, carrying protection signals for the 275 kV, 330 kV and 500 kV lines, does not meet the redundancy requirements of the National Electricity Code (NEC). Most of this equipment has been in service over 30 years. Manufacturers no longer provide support and there are few or no spares available for critical components. Recent failures have resulted in prolonged equipment outages while re-design and assembly workarounds were implemented. Performance tests also indicate that operating times are slower than Code specifications.

Like ADSS, aerial copper supervisory cables in metropolitan Melbourne are predominantly located on poles managed by others. Carrying system frequency and voltage control signals, industry operational traffic and 66 kV protection signals, most has been in service for 25 years. With a predicted life of only 30 years significant replacements are forecast. In the Latrobe Valley, SP AusNet owns the aerial copper supervisory cables carrying generator operational traffic and pilot wire protection signals. Most of the supervisory cable is more than 30 years old and in acceptable condition but failures are rising due to the ingress of water and broken cores.

The Operational Telephone Network (OTN) is being progressively replaced as failure rates increased on 20-year-old exchanges that were unsupported by manufacturers and limited spares were available through second hand distributors.

Voice Frequency (VF) tele-protection systems, comprising discrete analogue electronic components have been protecting generator connections for more than 30 years. Failure rates are rising and no manufacturer support is available. A seven-stage replacement program is under way.

7.12.1 Investment Drivers

The following is a list of investment drivers for plant:

- Higher standards of moisture, dust and temperature control are required for digital microprocessor based communication equipment. At several locations accommodation including cable trays and ducts is fully utilised with insufficient room for new equipment or maintenance. Security of remote location radio sites is compromised by past access key management practices.

- The progressive replacement of tele-protection and PLC systems by microwave radio links, and optical fibre bearers ensure compliance with NEC mandated performance.
- The progressive replacement of ADSS optical fibre cables and copper supervisory cables with OPGW or underground optical fibre cables to maintain network reliability and plant availability.
- Compliance with communications availability standards specified in the NEC 'Standard for Power Systems Data Communications.'
- Provision of fall restraint devices and safe working procedures for radio antenna support structures and associated training to comply with occupational health and safety legislation. Refer to the Health and Safety Management process and system strategy.
- Increasing demands for digital bandwidth and digital multiplexed signalling to efficiently integrate protection, SCADA and conditioning monitoring communications needs, refer to the Asset Data Gathering Networks document for further information.

7.12.2 Strategies

In consideration of the investment drivers mentioned above, long-term, stringent availability requirements and functionality under system black-conditions of the NEC and network agreement will prove challenging.

Key strategies include:

- Audit communications equipment rooms, cable trays and ducts and plan removal of out-of-service items
- List future requirements and where necessary plan extensions to communications rooms.
- Audit the communications network that carries protection signals to ascertain compliance with the requirements of the National Electricity Code and develop plans to rectify any no-compliances.
- Examine the practices of carrying protection signals for multiple EHV lines on a single communications bearer, and also of carrying current differential signals on switched communications networks.
- Monitor the performance of the SCADA network to ensure compliance with the NEMMCO Standard for Power Systems Data Communications.
- Outwork the seven-stage VF tele-protection replacement program.
- Replace traditional PLC equipment functions with fast digital tele-protection, SCADA and operational voice systems utilising OPGW or microwave radio bearers.
- Consider modern PLC technology as a back up to microwave radio and/or OPGW bearers where there is a concentration of operational risk (e.g. in main power corridors).
- Secure the use of existing microwave radio frequency bands to avoid stranding antennae and transmitter assets.
- Extend the installation of microwave radio and OPGW in the metropolitan area by 2009 to reduce dependence on circuits mounted on distributor's poles.
- Progressively migrate from PDH to SDH technology where link capacity is constraining traffic.
- Integrate OPGW installations with ground wire replacement plans.
- Develop methods to harden OPGW joint boxes and cable against bush fire damage.
- Progressively extend the Wide Area Network to each terminal station where wide bandwidth digital communications are available to create an asset-based' operational information system with WAN/LAN connectivity.
- Undertake a pilot application of Dense Wave Division Multiplex (DWDM) and/or Course Wavelength Division Multiplex (CWDW)
- Develop a plan to remove SP AusNet traffic from the Gippsland copper supervisory network by 2009 and transfer ownership to distributors or generators.

For further information refer to the detailed plant strategy, Communication Systems.

7.13 Asset Data Gathering Networks

Various online monitoring devices now available are capable of being periodically polled to get a snapshot of equipment's condition over time. The devices can either be retrofitted to existing equipment or integrated with new equipment.

Asset data gathering equipment falls into three distinct categories, communications equipment, IT equipment and engineering devices:

- The main communications equipment assets are the optic fibre links and associated equipment that provide network connectivity to most sites
- Associated with the optic fibre links are the switches and routers used to construct the WAN
- The third and most broad category of devices is engineering devices. These range from simple weather monitors to online transformer or circuit breaker monitors that also provide certain control functions (for example, fan control in the case of a transformer). Other prominent devices include Closed Circuit TV cameras (CCTV), building security devices, system disturbance recorders and protection relays

There are currently 46 condition-monitoring connections to equipment located in terminal stations. This number is increasing rapidly with a conservative forecast of 160 connections by 2008/2009. With the increase in devices, network infrastructure must evolve to accommodate the bandwidth, protocols, connection and other system requirements that these devices demand. Much of the data collected requires some sort of processing and storage for historical analysis. Historically, devices for asset data gathering have not been present on the power system. As such, many existing documentation, cataloguing and equipment spares systems have not been set-up to accommodate these devices.

The data from engineering devices allows maintenance and replacement strategies to be optimised, equipment availability to be maximised and equipment failures to be minimised.

For further information refer to the detailed plant strategy, Condition Monitoring.

A high-bandwidth digital network allows rollout of advanced security measures including CCTV cameras and intelligent intrusion detection devices, refer to Infrastructure Security for further information.

Network upgrades are required to support increased bandwidth needs from devices, refer to Communication Systems for further information.

Key strategies for Asset Data Gathering Networks are focussed on the following:

- Establish more detailed policies regarding procurement, spares and documentation of asset data gathering devices.
- Establish a processing and storage facility for collected engineering data – by 2008/9.
- Review performance and operation of serial interfacing equipment with the view to replace the equipment – starting 2009/10.
- Rollout high-bandwidth options across the WAN, allowing 1 GB/s operation to most nodes – commencing in 2006/7 and concluding by 2009/10.
- Introduce 1 GB/s network operation within most terminal stations – commencing 2008/9.
- Explore options for 10 GB/s operational WAN – commencing by 2012/13. Commence installation of selected option in 2013.

7.14 Civil Infrastructure

Assets within the classification of civil infrastructure include buildings, roads, surfaced areas, foundations, support structures, cable ducting, drains, fences, and water and sewerage pipes. These generally date from the time of original construction of the terminal station, depot or communication site.

About 56 km of security fencing encloses more than 532 ha of land at more than 100 individual sites. One hundred and thirty three hectares has been graded, drained and surfaced for the installation, operation and maintenance of electrical equipment in all weather conditions. Approximately 13 km of reinforced roads provide transport for heavy equipment and 29 km provide all weather access to electrical equipment. Two hundred and sixteen buildings provide all weather housing for control equipment, protection relays, communication facilities, batteries, rotating machinery, generators, compressors, switchgear, stores, workshops, laboratories, warehouses, worker amenities and office equipment.

Security fencing made from chain-wire mesh and topped with barbed wire varies from 'serviceable' to 'new' condition. However, increasing security standards and neighbouring land usage changes frequently mean that security fencing becomes inadequate before reaching its nominal service life.

The return to average rainfall after a prolonged drought and the increasing volume of augmentation works has placed greater construction traffic in switchyards with a negative impact on switchyard and access road condition. Large investments over the last five years have maintained switchyards and access roads in serviceable condition, but forecasts of increasing augmentation works over the next decade suggest continuing investment will be required.

Heavy vehicle transport roads were infrequently used at their load bearing capacity in the last decade. However, with utilisation now nearing 100% and transformer age and condition suggesting increasing refurbishment works, the next decade will involve more frequent movement of heavy equipment with consequent road augmentation and repairs necessary.

Approximately 15% of the buildings are in discrete communication sites constructed within the last 45 years. These brick walled and steel roofed buildings are in good condition with little maintenance or augmentation needs. However, the remaining buildings (mainly located in terminal stations and depots) vary widely in age, construction materials and condition. These buildings range from multi-storied brick and masonry construction to single storied timber and asbestos cement sheet construction. Many are in need of augmentation, refurbishment or replacement to provide adequate ambient temperature, dust and humidity control for an increasing volume of digital protection, control and communications equipment.

The main issues associated with civil infrastructure can be summarised by:

- Compliance with environmental legislation such as oil spill control, site water run-off and noise
- Compliance with occupational health and safety legislation such as working at heights, confined spaces and asbestos
- Extended periods of non-availability of key plant (inefficient maintenance and refurbishment, due to complex operational risk mitigation processes)
- Infrastructure security – to reduce risks of unauthorised persons in close proximity to electrical equipment, terrorist acts, theft and damage to equipment
- Provision of adequate environmental housing for the increasing volume of digital equipment that requires the superior control of dust, humidity and ambient temperature

The principle management strategies are:

- Develop annual asset works budget/program for major civil infrastructure maintenance from the annual inspection of assets and the prioritisation of identified work.
- Carry out civil infrastructure maintenance work in an ongoing manner to minimise costly replacement work.

- Consider the use of relocatable buildings when constructing new or re-furbishing existing terminal stations.
-
- Ascertain the best switchyard surface material to be used to satisfy both electrical safety and 'traffic' requirements.
- Progressively introduce secondary cable pulling pits rather than extending and replacing existing cable trenching.
- Upgrade security fencing commensurate with the degree of assessed security risk.

Please refer to the following documents for further information:

- Environmental Management
- Health and Safety Management
- Civil Infrastructure
- Infrastructure Security

7.15 Infrastructure Security

The state and federal governments have designated selected electricity transmission sites as 'Critical Infrastructure'.

The SP AusNet Integrated Response and Contingency System (SPIRACS) contains the framework for preventative and responsive measures to infrastructure security threats. It has classified credible threats as:

- Safety – untrained persons in the vicinity of energy containing equipment
- Malicious – motivated by revenge, fame, association or challenge
- Criminal – profit driven, includes theft, fraud, sabotage or extortion
- Terrorism – use or threat of force or violence to influence government or public through fear or intimidation

The main drivers of investment in security controls at more than 100 terminal stations, remote communication installations, depots and offices are to:

- Ensure that only authorised and trained people have access to key assets
- Identify, respond and minimise the impact of security events
- Prevent loss of assets or functionality for the community and customers

Security risks have been quantified using a purpose built Infrastructure Security Risk Assessment Tool (ISRAT), which integrates the principles of AS/NZS 4360, National Guidelines for the Prevention of Unauthorised Access to Electricity Infrastructure[50] within REALM[51], an objective risk assessment methodology.

The Terminal Station & Communication Site Physical Security Policy[52] provides the context and rationale supporting the progressive improvement, introduction and integration of security measures

[50] National Guidelines for Prevention of Unauthorised Access to Electricity Infrastructure – ENA DOC 015-2006
[51] 30-2650 Risk Assessment Methodology
[52] Terminal Station & Communication Site Physical Security Policy – SP AusNet 2006

including, fencing, electronic access controls, intrusion detectors, closed circuit television cameras, security lighting, building exterior hardening and remote alarm monitoring in the Network Operations Centre. Improvements include security event investigation and reporting, control measure audits and network and site-specific contingency plans.

Management strategies are centred on:

- Commensurate with the assessed risk of unauthorised access, upgrade existing security control measures and introduce new controls to deter, delay, detect, respond and mitigate unauthorised access intrusions.
- Facilitate remote alarm verification and response by NOC and external security resources.
- Integrate security controls using WAN communications and CARDAX management system.

For further information refer to the detailed plant strategy, Infrastructure Security.

8 Appendix – Foundation Documents

The following list of documents details the support material for the AMS. Each title listed is a hyperlink to the relevant Foundation document.

8.1 Business Environment Assessment

Business Environment Assessment

8.2 Process and System Strategies

Asset Management Information Systems
Asset Replacement and Refurbishment
Capital Expenditure Prioritisation
Condition Monitoring
Environmental Management
Health and Safety Management
Knowledge and Record Management
Network Performance Monitoring
Operations Management
Plant and Equipment Maintenance
Process and Configuration Management
Program Delivery
Risk Management
Skills and Competencies

8.3 Plant Strategies

Asset Data Gathering Networks
Auxiliary Power Supplies
Capacitor Banks
Circuit Breakers
Civil Infrastructure
Communications Systems
Control and Monitoring - SCADA

Control and Monitoring - General
Diesel Generators
Disconnectors and Earth Switches
Earth Grids
Fire Detection and Suppression
Gas Insulated Switch Gear
Infrastructure Security
Instrument Transformers
Line Easements
Power Cables
Power Transformers and Oil-filled Reactors
Protection Systems
Revenue Metering
Secondary Cabling
Static VAR Compensators
Station Air Systems
Surge Diverters
Synchronous Condensers
Transmission Lines

Electricity Transmission Regulatory Reset

2008/09 – 2013/14

Appendix F

BIS Schrapnel Report

SP AusNet
A member of Singapore Power Group

Outlook for Wages to 2012/13:
Electricity, Gas and Water Sector
Australia and Victoria

Prepared by BIS Shrapnel for
ENVESTRA, SP – AUSNET AND MULTINET GAS

MARCH 2007

BIS Shrapnel
BUSINESS RESEARCH AND FORECASTING

BIS Shrapnel welcomes any feedback concerning the forecasts or methodology used in this report as well as any suggestions for future improvement.

Job No: E4620/RR/AG

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Contents

Table 1.1
Summary of Nominal and Real Wages Growth
Electricity, Gas & Water Sector, Australia

Year Ended June	Nominal Wages Growth		Real Wages Growth (3)		Headline CPI Inflation %CH
	Average Weekly Ord Time Earnings (1) %CH	Labour Price Index (2) %CH	Average Weekly Ord Time Earnings (1) %CH	Labour Price Index (2) %CH	
1989	5.2		-2.1		7.3
1990	9.1		1.1		8.0
1991	4.6		-0.7		5.3
1992	6.3		4.4		1.9
1993	2.4		1.4		1.0
1994	3.2		1.4		1.8
1995	3.1		-0.1		3.2
1996	7.0		2.7		4.2
1997	6.9		5.5		1.3
1998	8.2		8.2		0.0
1999	4.0	3.1	2.7	1.8	1.3
2000	7.2	3.9	4.8	1.5	2.4
2001	7.1	3.9	1.1	-2.1	6.0
2002	7.8	4.3	4.9	1.4	2.9
2003	3.3	4.3	0.2	1.2	3.1
2004	7.4	4.4	5.0	2.0	2.4
2005	3.9	4.3	1.5	1.9	2.4
2006	1.5	5.5	-1.7	2.3	3.2
2007e	4.4	5.8	1.3	2.7	3.1
Forecasts					
2008	6.2	5.8	3.2	2.8	3.0
2009	5.4	4.8	2.5	1.9	2.9
2010	5.1	4.2	2.8	1.9	2.3
2011	6.1	4.6	3.2	1.7	2.9
2012	5.9	5.1	2.7	1.9	3.2
2013	5.8	4.8	2.7	1.7	3.2
Long Term Averages					
1990-00	5.3		3.0		2.2
2001-07	5.0	4.6	1.7	1.4	3.3
2008-13	5.7	4.9	2.8	2.0	2.9

e : estimate
(1) Earnings of males only are used in order to obtain the most consistent time series. Data is year end May.
(2) Ordinary time hours excluding bonuses.
(3) Nominal wages growth deflated by headline CPI inflation.

1. SUMMARY

- BIS Shrapnel was engaged by Envestra (on behalf of Investra, SP-AusNet and Multinet Gas) to provide an expert opinion regarding the level of wages growth that the three distribution businesses should incorporate into its forecasts of costs over a period that extends to 2012/13. For the purposes of estimating wage cost changes in Envestra's operating expenses, BIS Shrapnel recommends that movements in average weekly ordinary time earnings (AWOTE) for the electricity, gas and water sector should be used.
- Having considered the available data, it is BIS Shrapnel's opinion that wages growth in the electricity, gas, water sector will, on average, continue to outpace national wages growth over the next six years to 2012/13 — with utilities wages growth expressed in average weekly ordinary time earnings forecast to average 5.7 per cent per annum (compared to the national average of 5.2 per cent p.a.) and growth in the labour price index forecast to average 4.9 per cent p.a. (national average 4.2 per cent). The faster wages growth expected in the electricity, gas and water sector over the next six years is in line with historical movements over the past 15 years.
- Real wages growth is forecast to average 2.8 per cent per annum. This is based on forecast headline CPI inflation of 2.9 per cent a year on average and forecast wages growth (AWOTE) in the electricity, gas & water sector of 5.7 per cent a year on average.
- The Australian economy carries good momentum at present, and growth is set to strengthen in 2007. Consumer demand, investment, public expenditure and employment growth are expected to maintain solid growth over 2007 and into 2008. Headline GDP growth will also pick-up as resources export capacity comes onstream. The main weak spots are housing construction, the drought and a high A$ impacting on manufacturing and tourism.
- But capacity constraints and labour shortages will persist and mean even moderate growth will be hard to sustain without generating inflationary pressures. The tight labour market means wages growth will continue to rise over the short term, with wages growth expected rise above 5 per cent in 2007, pushing price inflation over the Reserve Bank's 3 per cent ceiling.
- The current economic cycle is forecast to peak in 2007 with higher interest rates, downswings in key investment cycles and a slowdown in world growth driving a downturn from 2008. Consequently, a stalling over employment growth in 2008/09 will impact on wages growth, collectively shaving around one percentage point off growth over 2008/09 and 2009/10. We anticipate a rebound in demand to drive renewed employment growth from 2009/10, with stronger employment growth over 2010/11 and 2011/12 again leading to a tightening of the labour market and another upsurge in wage inflation.
- Skills shortages have been evident in the electricity, gas and water sector for the past three years, which is demonstrated in the sharp increase in job vacancies during this period. The latest 'skills in demand' lists released by the Department for Employment and Workplace Relations show that all states are experiencing skills shortages in the engineering trades, while Queensland, South Australia, Western Australia and Tasmania all report shortages of gas fitters. Shortages in the electrical trades are also widespread.
- The electricity, gas and water sector is having to compete against the mining, construction and manufacturing sectors for skilled labour with similar skills (i.e. engineers, engineering trades, gas-fitters, electricians, etc). Mining is well into an extraordinary boom which has at least two more years to run, while construction will stay strong due to non-dwelling building and infrastructure activity and, later this decade, a recovery in residential construction. This points to the need to offer high wages to keep skilled labour in the electricity, gas and water sector.

Table 2.1
Australia – Key Economic Indicators
Financial Years

Year Ended June								Forecasts			
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
EXPENDITURE ON GDP (at average 2002/03 prices)											
Consumption											
– Private	3.4	5.3	4.3	2.6	3.3	3.1	2.7	3.9	4.5	4.0	2.7
– Government	3.2	3.9	3.9	3.4	4.9	3.8	2.5	2.0	3.3	3.6	4.2
Private Investment											
– Dwellings	15.0	4.1	-1.5	-3.8	0.7	-2.9	6.6	10.9	7.1	3.0	-3.8
– Real Estate Transfer Exp.	5.0	-2.0	-16.6	1.5	-5.0	-0.1	16.0	10.5	0.0	-10.0	-0.5
– New Non-Dwelling Construction (+)	27.6	8.5	8.8	21.0	7.6	-0.7	-13.1	-5.5	2.2	3.4	5.8
– New Equipment (+)	17.2	14.5	15.4	14.5	3.6	1.8	-3.6	7.2	16.6	13.5	1.0
– Livestock	-47.1	125.6	3.6	1.9	-1.9	4.0	1.0	8.0	0.0	3.0	-3.0
– Intangible Fixed Assets	11.8	4.9	7.8	8.7	14.7	6.2	2.8	5.0	11.0	13.5	2.0
– New Business Investment (+)	18.5	12.7	12.0	16.0	5.9	1.3	-6.4	2.7	11.2	10.4	2.3
Total New Private Investment (+)	**15.8**	**8.4**	**5.1**	**9.0**	**3.8**	**0.1**	**-1.8**	**5.5**	**9.2**	**6.9**	**0.5**
New Public Investment (+)	6.1	2.4	9.2	8.3	5.6	-1.0	-4.1	-6.0	1.5	10.6	4.8
Domestic Demand	**5.9**	**5.8**	**4.6**	**4.3**	**3.8**	**2.4**	**1.4**	**3.6**	**5.2**	**4.8**	**2.5**
Stock Contribution (*)	0.1	0.6	-0.1	-0.3	-0.2	0.1	-0.1	0.4	0.2	0.1	-0.4
Gross National Expenditure (GNE)	**6.0**	**6.3**	**4.5**	**4.0**	**3.6**	**2.5**	**1.4**	**3.9**	**5.4**	**4.9**	**2.1**
Exports	**-0.4**	**2.1**	**3.1**	**2.2**	**6.4**	**8.2**	**6.8**	**7.1**	**6.3**	**5.0**	**3.5**
Imports	**13.1**	**13.0**	**12.1**	**7.3**	**6.6**	**3.1**	**0.2**	**6.6**	**13.3**	**10.7**	**2.0**
External Contribution (*)	-2.9	-2.3	-1.8	-1.0	-0.1	0.9	1.4	0.1	-1.6	-1.4	0.3
Statistical Discrepancy (*)	0.0	0.0	0.0	-0.1	0.0	-0.1	0.0	0.1	0.1	0.0	0.0
GDP	**3.2**	**4.1**	**2.7**	**2.9**	**3.5**	**3.3**	**2.8**	**4.1**	**3.9**	**3.5**	**2.4**
Inflation											
CPI (Yr Avg)	3.1	2.4	2.4	3.2	3.1	3.0	2.9	2.3	2.9	3.2	3.2
CPI (Jun on Jun)	2.7	2.5	2.5	4.0	2.2	3.2	2.7	2.4	2.9	3.3	3.0
Baseline (Jun on Jun)	2.7	1.9	2.3	2.4	3.0	3.2	3.0	2.6	3.0	3.3	3.0
Labour Price Index (Jun on Jun)	3.6	3.5	4.1	4.2	4.6	4.2	3.6	3.9	4.5	4.6	4.2
Average Weekly Earnings (Jun on Jun)	6.5	2.8	5.9	3.5	5.5	5.3	4.7	4.7	5.7	5.5	5.2
Average Weekly Earnings (Yr Avg)	5.2	4.7	4.5	4.9	4.4	5.6	4.9	4.5	5.3	5.6	5.4
Employment											
– Employment Growth (Yr Avg)	2.5	1.8	2.9	2.3	2.7	1.8	0.2	1.6	3.0	2.6	1.5
– Employment Growth (May on May) (%)	2.5	2.0	3.4	1.7	2.8	1.0	0.4	2.3	3.0	2.4	1.2
– Unemployment Rate (May) (%)	6.2	5.5	5.2	4.9	4.6	5.3	6.0	5.5	4.8	4.3	4.5
Labour Productivity Growth	1.8	1.4	-0.2	0.6	1.4	1.1	2.5	2.3	1.1	0.7	0.9
Interest Rates (30 June)											
– Cash Rate	4.8	5.3	5.5	5.8	6.5	6.5	6.0	6.0	6.5	7.0	5.8
– 90–day Bank Bill	4.7	5.5	5.7	6.0	6.7	6.4	6.0	6.2	6.7	7.2	5.8
– 10–year Govt. Bonds	5.0	5.9	5.1	5.8	6.0	5.6	5.5	6.3	6.5	6.4	5.6
– Prime Overdraft (upper rate)	8.4	8.9	9.1	9.4	10.1	10.1	9.6	9.6	10.1	10.6	9.3
– Housing (variable)	6.6	7.1	7.3	7.6	8.3	8.3	7.8	7.8	8.3	8.8	7.6
Balance of Payments ($bn)											
– Goods & Services	-15.9	-21.5	-22.6	-14.5	-4.6	-5.7	-11.9	-18.8	-17.6	nf	nf
– Net Income & Transfers	-22.4	-24.4	-32.8	-38.9	-47.7	-52.8	-53.9	-54.9	-56.8	nf	nf
– Current Account	-38.4	-45.9	-55.5	-53.4	-52.3	-58.5	-65.8	-73.7	-74.5	nf	nf
– as a % of GDP	-4.9	-5.5	-6.2	-5.5	-5.0	-5.3	-5.7	-6.1	-5.7	nf	nf
Net Foreign Debt											
$ billion	357.0	390.6	431.9	499.4	534.7	607.5	648.8	665.0	693.2	nf	nf
% GDP	45.7	46.5	48.2	51.7	50.9	54.8	56.6	54.9	53.1	nf	nf
Exchange Rates											
– US$ per A$ (Yr Avg)	0.58	0.71	0.75	0.75	0.77	0.70	0.62	0.64	0.73	0.76	0.73
– US$ per A$ (30 June)	0.67	0.69	0.76	0.74	0.76	0.66	0.62	0.69	0.75	nf	nf
– SDRs per A$ (30 June)	0.48	0.47	0.52	0.51	0.51	0.44	0.42	0.48	0.53	nf	nf
– Trade Weighted Index of A$: 1970 = 1000 (30 June)	59.4	59.1	64.5	62.2	62.0	55.3	53.8	58.5	63.2	nf	nf

e: estimate ; nf: not forecast Source: BIS Shrapnel 'Long Term Forecasts:2006-2021', ABS Data, RBA

+Expenditure on new assets (or construction work done). Excludes sales (or purchases) of second hand assets.
*Contribution to growth in GDP

2. MACROECONOMIC OVERVIEW — AUSTRALIA

- The Australian economy continues to move through a long upswing cycle. The short term outlook remains positive, with solid business investment to continue driving good growth. But performances are diverging widely across different parts of the economy and capacity constraints mean even moderate growth will be hard to sustain from here, and will add to inflation pressures. With a further interest rate rise (or rises) to come in 2007, and downswings in key investment cycles, a marked domestic downturn looms from 2008. At this stage, the economy looks likely to avoid a recession, with a housing construction led recovery gaining traction in 2009, but there is a major risk of a bigger boom-bust cycle.

- Headline GDP growth slowed in 2006, but the data belies the strength of the economy. Domestic demand and employment growth were still strong, but the economy was hampered by skills shortages, capacity constraints and temporary price effects.

- Stronger growth should come through in 2007. The economy has entered 2007 carrying good momentum from the last quarter of 2006. Employment growth is strong, consumer confidence has bounced back after the three interest rate rises in 2006 and consumer spending has accelerated. Furthermore, a sharp rise in the value of imports in the December quarter suggests that equipment investment and non-farm stocks have also recovered from the temporary weakness of the June and September quarters last year. With governments still spending up big for (recent and) upcoming elections and to catch up on infrastructure investment, the only weak spot continues to be new dwelling construction. While most housing markets are not oversupplied, they will remain hostage to affordability problems and interest rate moves, with under-building leading to a major stock deficiency by 2008.

- Moreover, growth will be more broad-based through 2007. Consumer demand is expected to firm as the effects of the temporary spikes in petrol and food prices, that came through in 2006, unwind. Meanwhile, healthy finances will underpin another year of strong public sector expenditure. Easing capacity constraints will boost metals and minerals exports, but the external sector will remain weak as the drought will constrain rural production and as a high A$ continues to cause problems for the manufacturing and tourism sectors. And while conditions remain broadly favourable there is scope for more generalised and non-residential building investment to come through and support overall activity.

- The investment boom, which has been a key driver of growth over the past four years, is starting to lose momentum. The boom has been sustained because the major cycles came through in succession. We are now reaching a point where the present drivers are peaking, but no other cycle is ready to take up the slack. However, we expect that there is still enough momentum to drive a further, modest rise in activity in 2007:

  - Engineering construction — after an exceptionally strong period, growth in mining investment is slowing, and although public sector infrastructure activity is still rising strongly, the contribution to growth from mining activity has been so significant that total growth for the engineering construction sector is also now slowing.

  - Non-residential building — this was the last investment cycle to display a significant pick up in total activity and carries the most momentum. Further strong growth is expected through 2007 as an upswing in office construction gathers pace and broadens to include the Sydney and Melbourne markets. Other growth sectors include hotels and warehouses.

- Machinery & equipment investment — this category is nearing the tail end of its cycle after four years of very strong growth. Replacement demand and capacity building investment have been largely satisfied, but demand for generalised business investment will remain at a high level while conditions remain broadly favourable.
- Residential construction — the weakness of Sydney has continued to drag down overall activity, despite exceptionally strong activity in Perth and patchy growth in other markets. Although there is now strong underlying demand in the Sydney and Brisbane markets, we will not see a significant increase in activity while interest rates are still rising.

- However, growth is becoming harder to sustain. The economy continues to be constrained by skills shortages and limited productive capacity, which have effectively put a speed limit on the growth rate which can be achieved without a significant escalation in inflation. We have yet to see a blow-out in costs and prices, but this has been as much the result of good luck as good economic management — compared to other periods of strong economic activity, higher wage and consumer price inflation has taken considerably longer to come through.
- But we have finally seen a marked pick up in baseline inflation, which ended 2006 close to the top end of the Reserve Bank's 2 to 3 per cent target range. Previously, falling prices for tradeable goods and services (those which are exposed to foreign competition) had been offsetting rising non-tradeables inflation, but with world inflation on the rise and the dampening effect of a rising $A largely over, tradeables inflation is now on an upward track.
- Weak productivity growth, higher wage bills, capacity constraints in key domestic industries and rising prices for raw materials (particularly commodities) are pushing up unit production costs and hurting company profitability. As firms were able to build up profit margins during the period of weak inflation and a rising $A, they were willing to accept a slight erosion in margins when stronger inflation first emerged in order to protect their market share. However, margins are now being squeezed and firms are increasingly having to pass on rising costs in the form of higher prices. With prices on the rise, we expect to see stronger wage inflation come through over the coming year as employees move to protect real wages and as employers bid up wages to attract scarce skilled labour.
- Consequently, we expect that the Reserve Bank will be forced to raise rates again in 2007. How growth pans out will depend very much on how quickly and strongly inflation comes through and how consumers respond to a further tightening in monetary policy. Although consumers have been fairly resilient to date, we expect that — given the high levels of household debt — it would only take one or two more rate rises to reach the point where the burden of repayments is sufficient to trigger a significant weakening in consumer demand.
- We expect that the slowdown in consumer spending, along with the start of a demand-driven downturn in key investment cycles and an easing in world growth, will be sufficient to turn momentum in the economy more generally over 2008, with businesses responding to the slackening in demand by delaying hiring and investment decisions. Although we are not expecting a pronounced downturn in any single growth driver, the combined effect of a broad-based easing in activity will be a marked slowdown in domestic demand through 2008.
- The commodity price boom and the sharp appreciation of the $A since 2003 have been closely linked. As demand and supply realign through 2008, we expect to see sharp falls in commodity prices, which together with the weaker outlook for investment and interest rates will see speculators abandon the $A. It is likely that the high level of speculative activity will see the currency undershoot on the way down before returning to a more 'fair' exchange rate.

- Despite the slowdown in domestic demand, headline GDP growth is expected to hold up reasonably well in 2008, supported by a strong positive external sector contribution. Weaker investment, higher levels of productive capacity, and a subdued household sector will constrain demand for imports. Meanwhile, resource exports will continue growing strongly as capacity ramps up (including port expansions), while the depreciation in the $A will increase the competitiveness of local manufacturers who had been unable to compete during the period of the high $A.

- However, the downturn will not be protracted. Investment will run out of steam and consumers will be temporarily cash constrained, but markets will not be generally oversupplied and the rise in unemployment will be modest. As inflationary pressures ease, allowing interest rates to be lowered, demand will regain momentum led by dwelling construction and consumer spending, with a broader upturn in investment and employment expected by early next decade. Even though investment has been strong, most industry sectors and markets will not be facing much in the way of oversupply or excess capacity once the cycle turns down.

- Generally speaking, the current round of investment has been a badly needed catch-up after years of under-investment rather than a speculative cycle. Indeed, during the current investment cycle, we don't expect investment to go 'over the top', i.e. speculative activity leading to a build up of excess supply. In particular, office construction activity only started to pick up significantly in 2006 and is unlikely to have time to reach boom levels before domestic demand and employment growth turns down. Consequently, it will not take long for any excess supply to be absorbed and for markets to tighten sufficiently to warrant a new round of investment.

- As investment strengthens we will see the return of stronger employment growth. But because we will not have seen a substantial rise in unemployment, it will not be long before the problems of labour shortages return. And with not much in the way of excess productive capacity the economy will quickly return to the point where it is nudging its growth speed limit and a build up of inflation once again threatens.

- GDP growth is forecast to re-accelerate from 2.9 per cent in 2005/06 to 3.5 per cent over 2006/07, slowing to 3.3 per cent in 2007/08 and further to 2.8 per cent in 2008/09 (growth bottoms out at 2.2 per cent in calendar 2008), before picking up to around 4 per cent again over in 2009/10 and 2010/11, before again easing over the following two years. However, the cycle may prove to be more volatile, depending on the timing and magnitude of key investment cycles, and the rise in inflation and interest rates.

- Depending on the build up of inflation and households' sensitivity to further rate rises, the timing and shape of the cycle could change. If consumer demand continues to display resilience the cycle could be extended. This would give more time for investment to come through leading to a bigger build up in inflation, requiring a more aggressive tightening in rates and resulting in a sharper downturn and longer recovery period.

- Despite a remarkable run, Australia has not solved its economic problems. The economy has been more stable since the early 1990s, but remains prone to major cycles in activity. Capacity constraints and labour shortages will be a recurring problem, limiting growth over the medium to longer term and resulting in persistent higher wage and price inflation relative to the past decade.

Table 3 .1
Wages and Prices — Australia
Year Average Growth

Year Ended June	Average Weekly Ordinary Time Earnings[1] $	%CH	Wage Cost Index 2002/03=100	Official/ Headline Inflation CPI 89/90=100	%CH	BIS Shrapnel Baseline CPI (2) %CH
1989	515.7	7.2		92.6	7.3	5.7
1990	552.2	7.1		100.0	8.0	4.8
1991	588.3	6.5		105.3	5.3	5.4
1992	615.4	4.6		107.3	1.9	4.6
1993	627.2	1.9		108.4	1.0	3.4
1994	646.0	3.0		110.4	1.8	3.1
1995	673.0	4.2		113.9	3.2	1.7
1996	705.1	4.8		118.8	4.2	2.8
1997	731.4	3.7		120.3	1.3	3.2
1998	763.6	4.4		120.3	0.0	3.2
1999	790.0	3.5	3.2	121.9	1.3	1.5
2000	816.0	3.3	2.9	124.8	2.4	1.9
2001	857.5	5.1	3.5	132.2	6.0	2.6
2002	903.7	5.4	3.3	136.0	2.9	3.5
2003	950.7	5.2	3.5	140.2	3.1	2.9
2004	995.3	4.7	3.6	143.5	2.4	2.3
2005	1 040.2	4.5	3.8	147.0	2.4	2.1
2006	1 091.6	4.9	4.1	151.7	3.2	2.3
2007e	1 139.7	4.4	4.2	156.4	3.1	2.8
Forecasts						
2008	1 203.8	5.6	4.5	161.2	3.0	3.3
2009	1 263.2	4.9	3.8	165.9	2.9	3.1
2010	1 320.0	4.5	3.7	169.7	2.3	2.6
2011	1 390.4	5.3	4.2	174.6	2.9	2.9
2012	1 468.4	5.6	4.5	180.1	3.2	3.2
2013	1 546.9	5.4	4.4	185.8	3.2	3.2
Long Term Averages						
1990-00	4.0			2.2		3.1
2001-07	4.9		3.7	3.3		2.6
2008-13	5.2		4.2	2.9		3.0

e : estimate Source: BIS Shrapnel, ABS Data
(1) Earnings of males only are used in order to obtain the most consistent time series.
(2) Baseline CPI excludes GST effects, mortgage interest charges, fuel and fruit and vegetables

3. WAGES OUTLOOK— AUSTRALIA

The key determinants of nominal wages growth are consumer price inflation productivity and the relative tightness of the labour market (i.e. the demand for labour compared to the supply of labour). Price inflation, in turn, is primarily determined by unit labour costs, i.e. wage increases adjusted for productivity increases. Other factors which also influence price inflation include the exchange rate, the stage of the business cycle and the level of competition in markets generally.

3.1 A note on different wage measures

Several different measures of wages growth are referred to in this report, each differing slightly both in terms of their construction and appropriateness for measuring different aspects of labour costs. The following provides a brief summary of the main measures, what they are used for and why.

The main wage measures are:

- Average Weekly Earnings — average weekly total gross before tax earnings per employee. The measure includes both earnings from standard hours and from overtime, bonuses, etc. It is derived by dividing weekly total earnings by an estimate of the number of employees.
- Average Weekly Ordinary Time Earnings (AWOTE) — earnings gained from working the standard number of hours per week. It includes agreed base rates of pay, over-award payments, penalty rates and other allowances, commissions and retainers; bonuses and incentive payments (including profit share schemes), leave pay and salary payments made to directors. AWOTE excludes overtime payments, termination payments and other payments not related to the reference period. AWOTE for males is used for long-term series of wage inflation as it excludes the compositional effects of shifts between males and females and the equal pay legislation of the 1970s.
- The Labour Price Index (LPI) — a CPI-style measure of changes in wage and salary costs based on a weighted combination of a surveyed 'basket' of jobs. The LPI used in this report excludes bonuses. The LPI also excludes the effect of changes in the quality or quantity of work performed and most importantly, the compositional effects of shifts within the labour market, such as shifts between sectors and within firms.

Each measure provides a slightly different gauge of labour costs. However, the main distinction between average earnings measures and the labour price index relate to the influence of compositional shifts in employment. A large fall in the number of lower paid employees, or in employment in an industry with lower average wages, will increase average weekly earnings (all else being equal). While this is a true reflection of the average cost of labour to businesses, it is not necessarily the best measure of ongoing wage inflation (i.e. trends in wage-setting behaviour in the labour market).

The labour price index was specifically designed to get around this problem. It uses a weighted average of wage inflation across a range of closely specified jobs. However, like the CPI (Consumer Price Index), the weights are fixed in a base year, so that the further away from that base and the more the composition of the labour market changes over time, the more 'out of date' the measure becomes.

The labour price index is also likely to understate true wage inflationary pressures as it does not capture situations where promotions are given in order to achieve a higher salary for a given individual, often to retain them in a tight labour market. Average weekly earnings would be boosted by employers promoting employees (with an associated wage increase), but promoting employees to a higher occupation category would not necessarily show up in the labour price index. However, the employer's total wages bill (and unit labour costs) would be higher.

For this reason, BIS Shrapnel prefers using AWOTE as the measure that best reflects the increase in wage cost changes (or unit labour costs, net of productivity increases) for business and the public sector across the economy. On the other hand, labour price index can be used as a measure of *underlying* wage inflation in the economy.

3.2 Wage formation changed in the 1990s

The nature of wage formation in Australia changed dramatically over the 1990s. Once the labour market effects of the deep early 1990s recession eventually wore off, it became increasingly apparent that both wages growth and price inflation had made a permanent down-shift. A range of factors have helped keep both lower since then, but the most important was a shift to decentralised wage-setting ushered in by the Federal Industrial Relations and Workplace Relations Acts in 1996, which created a tougher bargaining environment, tipping the wage bargaining system in favour of enterprise agreements and individual contracts. The new Act also indirectly accelerated the decline in unionisation with the shift to non-union agreements, while the continued strong growth in non-unionised industry sectors also contributed to lower unionisation rates.

As well as changing the balance of power between employers and employees, the shift has altered the relationship between economic activity, employment and wages. In particular, wages growth is not only lower but has become more stable as a result.

Over time, the operation of the Act also produced a lengthening in the average duration of wage contracts — average enterprise agreements now run for two years, although many include 'escalation' clauses that provide higher wages if inflation runs higher than expected. The longer duration of wage contracts means wage pressures are now slower to respond to changing economic conditions. Businesses also have more flexibility when it comes to meeting changes in demand, and are more readily able to change the number of hours worked rather than employment levels or wages in response to a slowdown in activity.

However, the shift to a decentralised system of wage determination has not altered the fundamental supply and demand drivers of wages. The new system has reduced the threat of a 'union-driven' rise in wages growth but it does not preclude a 'market-driven' rise, i.e. one driven by strong demand and supply shortages. Indeed, a more market-oriented system may make wages *more* prone to strong rises, especially when skilled labour is in short supply.

A market-driven acceleration in wages would be driven primarily by the section of the workforce who are on individual contracts or other salary arrangements. The evolution of wage determination over the past two decades has seen the workforce effectively split into three segments, with wages set by different mechanisms and with wage outcomes showing large divergences over the past decade:

- Those dependent on awards, i.e. increases now to be set by the Fair Pay Commission (formerly by the Australian Industrial Relations Commission), covering around 20 per cent of all employees.
- Those on registered collective agreements negotiated under enterprise bargaining, who now account for over 40 per cent of all employees.

- The remaining 39 per cent of employees on individual contracts or other salary arrangements, which includes a high proportion of more highly skilled workers.

The 'wages growth by workforce segment' table (table 3.2) show a large divergence in earnings growth in the 1990s, which we expect to continue. Key factors influencing wage outcomes in the individual contract segment include supply and demand fundamentals, particularly for skilled labour, and overall profit growth. Average weekly ordinary time earnings include bonuses and incentives, which in turn are primarily driven by profit.

Table 3.2
Wages Growth by Workforce Segment
Moving Annual Totals, Percent Change

	Year Average Percent Change													
								Forecast						
Year Ended June	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Proportion of Workforce														
Awards Only	24%	23%	21%	21%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Collective Agreements	36%	36%	37%	37%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%
Individual Contracts, Other	40%	41%	42%	42%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
AWOTE														
Awards Only	1.4	1.8	1.8	2.0	1.9	1.9	1.6	1.0	2.3	1.6	1.5	1.9	2.1	1.9
Collective Agreements	3.7	3.8	4.0	4.1	4.1	4.2	4.3	4.3	4.5	4.2	4.0	4.3	4.4	4.4
Individual Contracts, Other	4.2	8.1	8.5	7.7	6.7	6.2	7.3	6.3	8.4	7.3	6.6	8.0	8.7	8.0
AWOTE (Males)	**3.3**	**5.1**	**5.4**	**5.2**	**4.7**	**4.5**	**4.9**	**4.4**	**5.6**	**4.9**	**4.5**	**5.3**	**5.6**	**5.3**
Labour Price Index														
Awards Only	1.4	1.8	1.8	2.0	1.9	1.9	1.6	1.0	2.3	1.6	1.6	1.9	2.1	1.9
Collective Agreements	3.7	3.8	4.0	4.1	4.1	4.2	4.3	4.3	4.5	4.2	4.1	4.3	4.4	4.4
Individual Contracts, Other	3.2	4.2	3.5	3.8	3.9	4.4	5.2	5.7	5.6	4.4	4.3	5.3	5.8	5.6
Labour Price Index	**2.9**	**3.5**	**3.3**	**3.5**	**3.6**	**3.8**	**4.1**	**4.2**	**4.5**	**3.8**	**3.7**	**4.2**	**4.5**	**4.4**
Compositional Effects + Bonuses,etc	0.4	1.6	2.1	1.7	1.1	0.7	0.8	0.2	1.1	1.1	0.8	1.1	1.1	0.9

Source: BIS Shrapnel, ACCIRT, ABS, DEWR

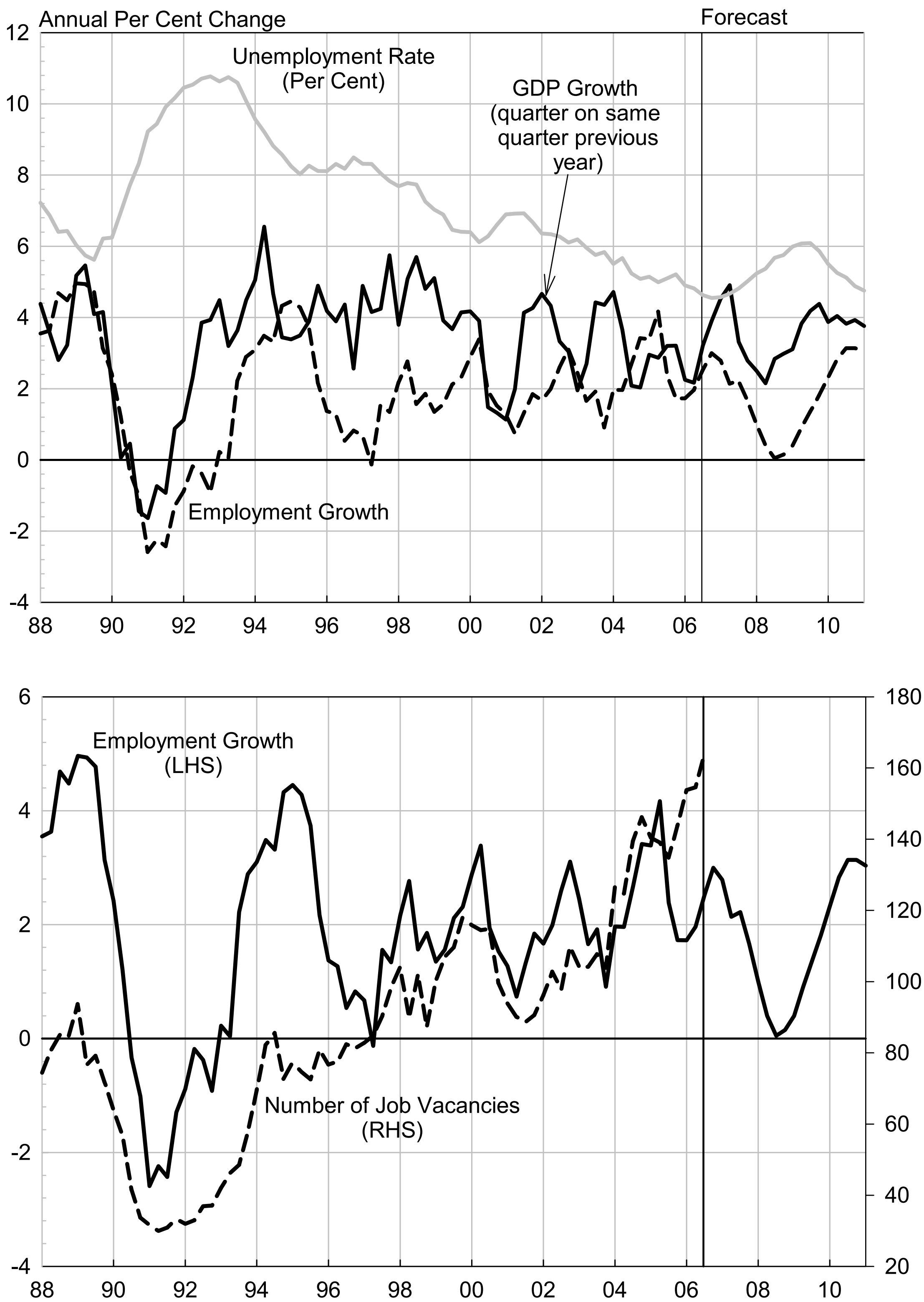
3.3 Wages growth has been higher since 2000

The last six years has seen a significant rise in wages growth. Whereas annual growth in average weekly earnings averaged 3.9 per cent in the five years to June 2000, it has averaged 4.9 per cent over the first half of the 2000s. The pick-up is also apparent in the wage cost index, which has seen a steady rise in wages growth since 2001/02 with the tempo increasingly significantly since mid-2004.

Although the rise in wages growth since 1999/2000 has been sustained for several years now, it has been driven by different factors along the way:

- The initial rise came during the 'dot-com' boom — with a shortage of skilled workers (IT professionals in particular) combined with strong economic growth and rising profits.
- The 2000/01 slowdown would normally have led to a significant slowdown in wages growth but had a fairly minor effect due to the longer duration of wage contracts and to businesses reducing hours worked instead of wages.
- Wage pressures started to resurface as the domestic economic recovery strengthened in 2002, but wages were again relatively slow to respond to the shift as the initial recovery in hiring was patchy with confidence undermined by weak external conditions and a series of negative shocks (terrorist attacks, war, drought, sharp stockmarket declines etc).

Chart 3.1
Employment and Unemployment



As at June Source: BIS Shrapnel, ABS data

- Composition factors appear to have added to overall growth in AWOTE over 2000/01 to 2002/03, with employment growth in higher paid occupations outpacing employment growth in the lower paid occupations. Surging profits also contributed to increased bonuses, incentives and commissions. These compositional effects and bonuses, etc are apparent in the difference between the growth in the LPI compared to AWOTE (see table 3.2), where these effects added between 1.6 to 2.1 per cent over those three years, while the LPI only grew by 3.3 to 3.5 per cent.
- Since 2004, underlying wages growth — as measured by the LPI — has accelerated from around 3.5 per cent to over 4 per cent — a historically high level since the index's inception in September 1997. Meanwhile, the compositional effects have now narrowed the gap between AWOTE and the LPI. Skills shortages have slowed in growth in the higher paid occupations, while the strong growth in employment in 2004/05 and again in calendar 2006 appears to have largely been in lower paid (i.e. less skilled) occupations.

We believe the latest rise in underlying wage pressures marks a significant change.

Labour markets are now unambiguously tight with the unemployment rate running consistently under 5 per cent, down from 7 per cent in 2001. Labour markets have tightened considerably since late 2004, coinciding with employment growth accelerating to over 4 per cent in the 12 months to August 2005, the strongest increase since the mid-90s. More importantly, job vacancies have also surged pushing well over 20% (and recently over 30%) of total unemployed since mid 2004. This is well above historical levels — the average since 1979 has been just 12 per cent, only pushing near 20 per cent for the first time at the height of the 'dot-com' boom. In other words, labour demand has started to outstrip supply at an unprecedented rate.

3.4 Current state of play — Labour Market is Tight, Wage Pressures Increasing

The labour market is still very tight. Employers have been struggling to fill vacancies, especially for skilled workers. The demand side of the labour market is very strong – employment growth is running at 3 per cent, job vacancies are at record levels and there has been further growth in job ads over recent months.

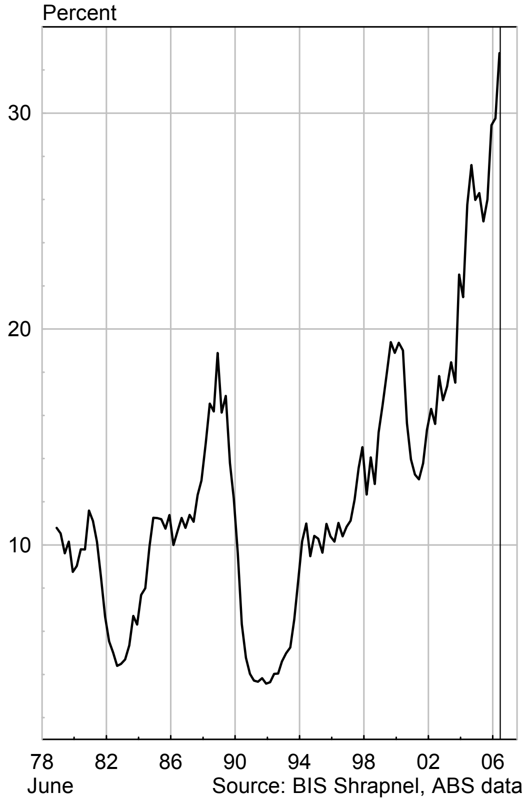
On the supply side, the unemployment rate is at a 30 year low level of 4.5 per cent with only 492,500 people unemployed, while the participation rate, at around 65 per cent, is at its highest recorded level.

Employment growth accelerated through 2006 and is now running at 3 per cent through-the-year to January 2007. Almost 300,000 new jobs have been created over the past 12 months, but more importantly, 200,500 of these jobs have been full-time positions.

Strong 'pent-up' demand for labour is still present. Job vacancies grew 5.9 per cent in the 3 months to November to reach a new peak of 163,700 (seasonally adjusted). The number of job

Job Vacancies as % of Unemployed

Total Australia



Source: BIS Shrapnel, ABS data

vacancies grew steadily through 2006, and in November 2006 were 21 per cent higher than November 2005. Demands on the remaining pool of spare labour are at unprecedented levels – job vacancies are running at around 33 per cent of total unemployed. Putting this another way, if all of these vacancies were filled out of the existing pool of spare labour, Australia would have an unemployment rate of 3.2 per cent, not 4.5 per cent.

Clearly there is significant 'pent-up' demand for skilled labour that is not readily available from Australia's dwindling pool of unemployed workers. Businesses seeking skilled workers are increasingly looking to poach staff from other businesses — the head-hunters are back in force. Strong profits and the urgency with which some businesses looking to expand capacity also means they are willing and able to offer the higher wages necessary to attract (and retain) staff. Tight labour markets can be slow to generate a wider pick-up in wages growth. Even when demand is strong, the proportion of workers moving from job to job is relatively small. And with wages for 60 per cent of workers set by awards or collective agreements many wage arrangements are less affected by market conditions. However, as labour shortages persist and businesses find they must 'meet the market' on remuneration in order to attract and retain staff, wages will eventually start to accelerate. The segment on individual contracts will lead the way and indeed, there are already signs that wages are starting to pick up in this part of the market (see table 3.2).

Despite the tightening in the labour market over 2006, wages growth did not appear to accelerate. However, both measures of aggregate wages growth (AWOTE and LPI) have been affected by the six-month delay in the granting of the increase in Federal Award minimum rates. Whereas in past years, the National Wage Case decisions in May would normally come into effect in the September quarter, delays associated with the introduction of the Australian Fair Pay Commission mean the latest review did not come into effect until December 1, with most of the impact on wage measures appearing in the March quarter.

As such, the latest figures are misleading and should be treated with caution. The timing delay means there will be a sustained dip in wages growth through the second half of 2006 before a sharp surge comes through in early 2007. Our estimates suggest the dip could take roughly 0.3 to 0.5 percentage points off annual wages growth initially before adding at about 0.5 to 0.8 percentage points once the award rise comes through). Because of the delay, the latest review also covers an 18 month period instead of the usual 12. The decision to give a $27.36 increase for those earning up to $700/week and a $22.04 increase for those earning more is significantly larger compares with the previous increase of around $17/week. Adjusting for the extra 6 month period gives an annual equivalent of around $18/week.

Bearing this in mind, a closer analysis of the latest data suggests wages growth is still running at close to 4 per cent and may even have picked up slightly. Key segments affected by awards such as labourers and elementary clerical, sales and service workers showed a big drop in wages growth in the September quarter, to their lowest levels since 2001, but other segments showed a continuation of strong growth in the quarter. Moreover, a measure of wage costs including bonuses has held at around 4 per cent, suggesting that that once adjusted for the delay in awards, underlying growth in total remuneration has picked up.

In addition, the LPI data (table 4.1) shows that labour shortages are starting to fuel an acceleration in underlying wage inflation in a number of critical sectors — particularly electricity, gas and water, mining, construction, wholesale trade, transport and storage and property and business services, while public sector wages growth has continued its above-average growth since mid-2003.

While a combination of compositional effects (see section 3.3) and the delay in the Fair Pay decision has recently seen the unusual situation of the LPI increasing faster than AWOTE through 2006, the strength of these rises in underlying wage inflation (as represented by the LPI) will eventually come through in the AWOTE measures over the next one-to-two years.

Meanwhile, productivity growth is still weak — less than 1 per cent per annum — and will only improve slowly over 2007. With unit labour costs still rising at well over 4 per cent a year, it will be very difficult to contain price inflation.

3.5 Short-term Outlook — Wage and Price Inflation Higher in 2007 and into 2008

We believe the latest up-shift in wages marks the start of a ‘market-driven’ surge that will be sustained for several years. Although employment growth is forecast to ease through the year from the current 3 per cent per annum back toward 2 per cent per annum by the end of 2007, the unemployment rate will remain between below 5 per cent and skilled labour shortages will persist. Household consumption expenditure has picked up recently due to a combination of strong employment growth and more purchasing power flowing from lower petrol and fruit prices. Consumer and related employment demand sectors should remain buoyant through the first half of 2007. Meanwhile, business investment — although slowing — combined with healthy public investment, will continue to drive solid growth in employment.

The upshot is that skilled labour will remain in short supply and wages will remain under pressure. Overall, wages growth is forecast to strengthen over 2007, accelerating to well over 4.5 per cent in terms of the wage cost index in ‘through-the-year terms’ (i.e. quarter-over-corresponding quarter of the previous year) and back to around 6 per cent for AWOTE in through-the-year terms. In ‘year average growth’ terms, wages growth is forecast to average 4.6 per cent for the labour price index and 5.5 per cent in terms of average weekly ordinary time earnings in calendar 2007, with growth at similar levels in 2007/08 financial year. However, there is likely to be a wide variation across different parts of the labour market:

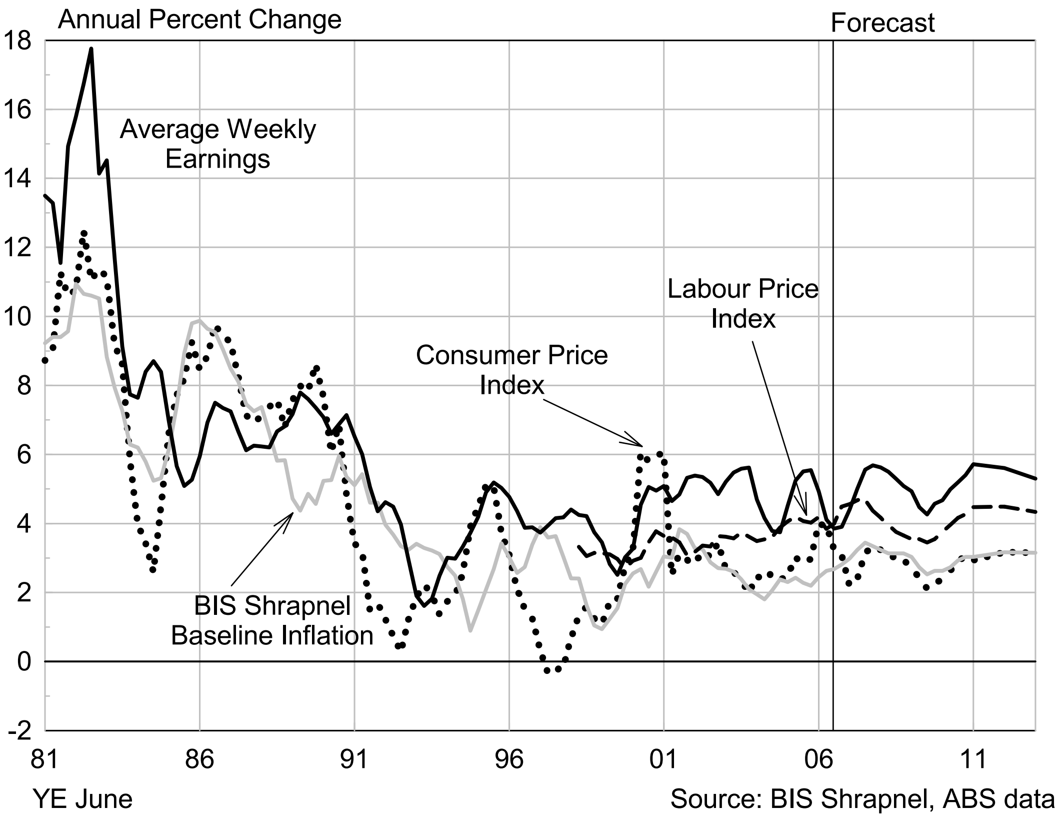
- Increases will be stronger at the skilled end, with wages growth around 6 per cent in wage cost index terms, and well over 7 per cent in AWOTE terms (i.e. after bonuses/incentives and ‘promotions’ are included).
- The pick-up in wages growth in collective agreements will be slower as these take time to get renegotiated — many will only rise as they incorporate the effects of higher inflation.
- Awards will continue to lag behind, and will tend to rise at an even lower rate after 2007 as the Federal Government’s new WorkChoices legislation is implemented, and the Fair Pay Commission attempts to limit future increases in award wages.

There is significant uncertainty surrounding the wages outlook. On the downside:

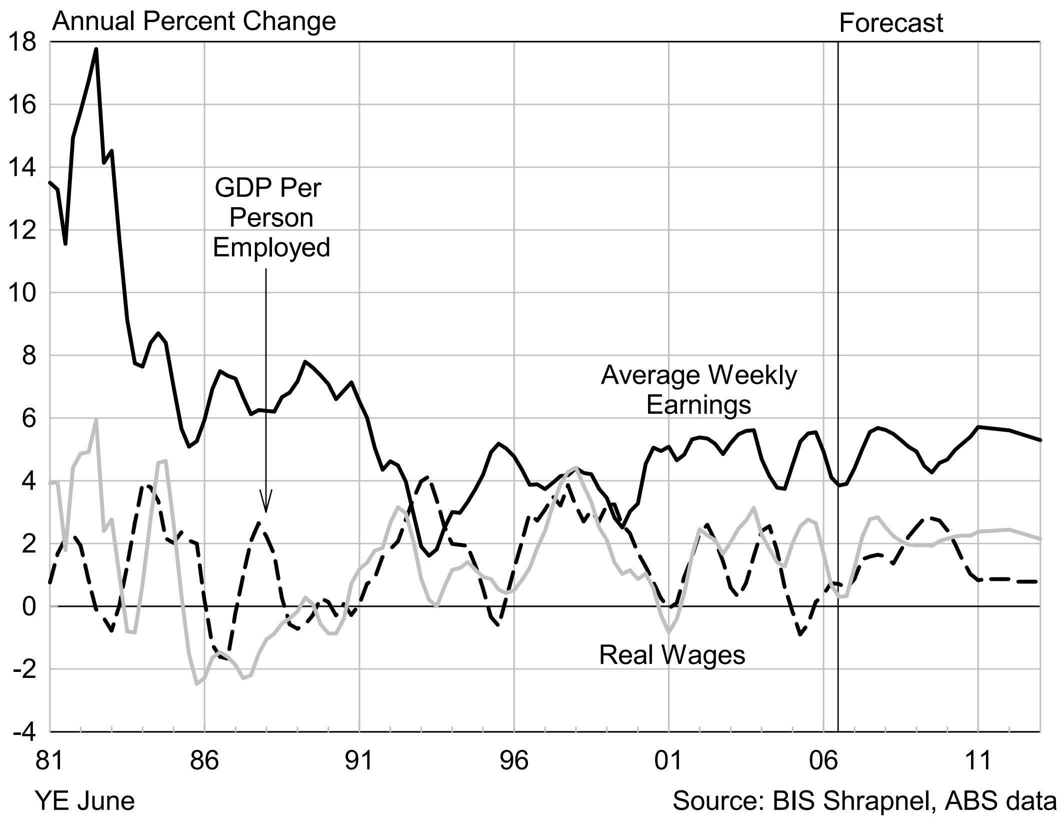
- The WorkChoices legislation could see significantly lower wages growth in collective agreements as well as awards, although the early signs are that the changes are mainly affecting penal rates and other conditions (i.e. non-wage labour costs) rather than wages.
- Many businesses may also remain cautious about giving overly-generous pay increases until they are sure the economy is on track for continued growth.
- Similarly, employees may be slow to realise the shift in the balance of power in labour markets, and may continue to see job security as more important than higher wages.

But there are substantial upside risks as well:

Chart 3.2
Wages and Prices



Productivity and Real Wages



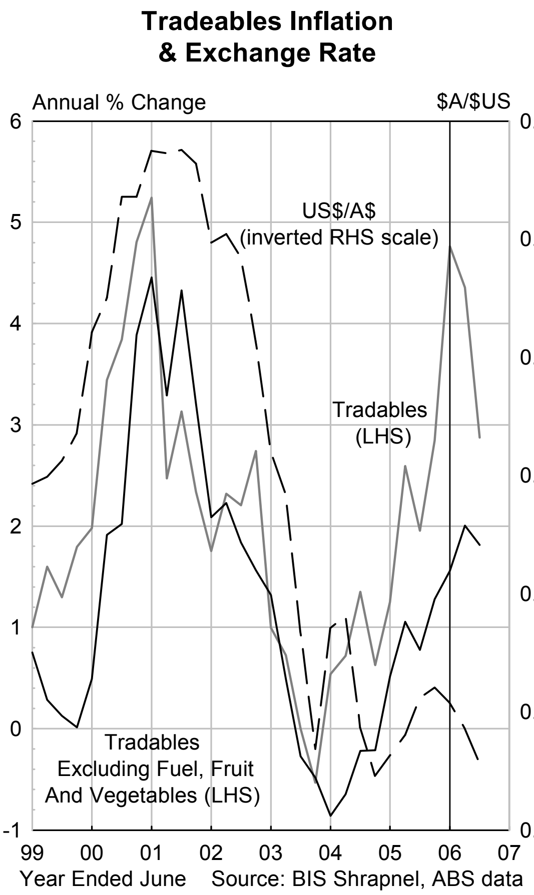
- The WorkChoices reforms may see employers again look to 'buy change', e.g. with higher one-off wage rises given in exchange for employees moving onto individual contracts.
- We may see harder bargaining from unions — although an outbreak of union militancy is unlikely, bit specific sectors could still drive wage settlements higher through this period.
- Skill shortages could drive an even stronger wage surge in the 'market-driven' segment — shortages emerged as a serious problem in the 1999/2000 peak in activity, with the AWOTE contribution from the workforce segment on individual contracts sustained at well over 7 per cent for the next two years (see Table 3.2). Shortages will be more severe this time around, and although the AWOTE contribution is forecast to again go over 8 per cent, it may go even higher.

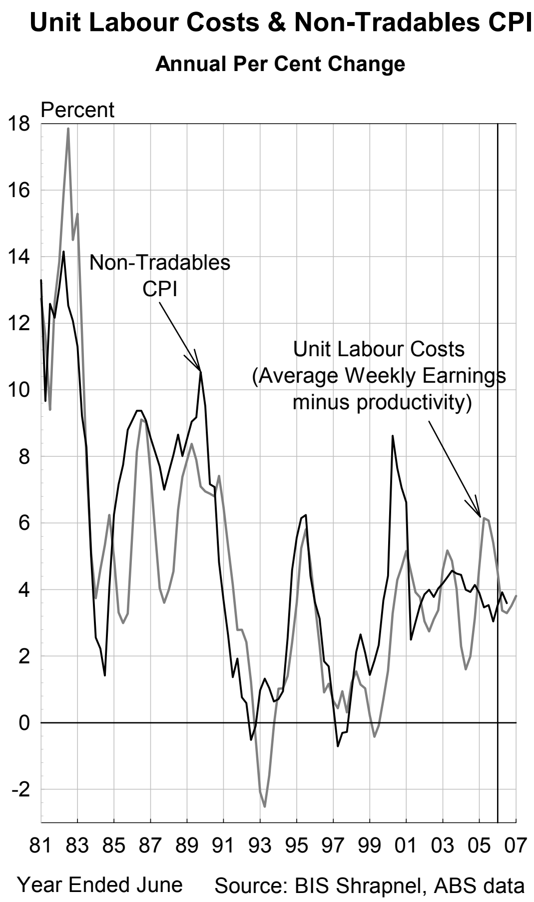
Our forecast assumes underlying wages growth (in labour price index terms) is contained below 5 per cent through the peak of the cycle. However, labour shortages will be more intense than at any time since the early 1970s. With the new wage bargaining environment untested in extremely tight labour market conditions, it is unclear how wages will develop through this period.

Also adding to the upside in wages will be higher underlying consumer price inflation in 2007 and 2008. Although headline CPI eased from 4.0 per cent in the June quarter, 2006 to 3.3 per cent in the December quarter 2006 as the mid-year spikes in oil and fruit prices unwound, underlying inflation increased from 2.4 per cent to 2.7 per cent at the same time. We are forecasting underlying inflation to rise further in 2007 and push over 3 per cent during the second half of the year and average over 3 per cent in 2007 and 2008. Meanwhile, headline CPI will ease further in through-the-year terms, but after the temporary spikes in petrol and fruit prices wash out, headline CPI will average around 3 per cent in both 2006/07 and 2007/08. These higher inflation outcomes will also underpin overall wage demands.

Key factors adding to underlying inflationary pressures:

- The drought — will provide some offset to the fall in banana prices, constraining production of fruit, vegetables and cereals. Higher costs for feed may also pass through into dairy and poultry prices. Conversely, dry conditions will encourage farmers to increase livestock slaughter, which will put downward pressure on meat prices. While the drought is likely to break later this year, lower prices for cereals, dairy products and some other foods are unlikely before the end of the year, when the harvest of the winter crop pushes down cereal and feed prices. Meanwhile, a breaking in the drought will see reduced livestock slaughter, with the reduced supply and strong overseas demand pushing up meat prices. Overall, food prices are likely to be flat (or decline slightly) in the March quarter, but increase strongly over the rest of the year.
- The exchange rate – while the exchange rate is forecast to remain in a US$0.76 to US$0.78 band over the first half of this year, both falling commodity prices and little chance of an interest rate rise after mid-year (when we are in election mode) will push the exchange rate down toward US$.70 by the end of the year. This will add upward pressure to tradeable inflation. In addition, the second round effects of high oil and commodity prices are starting to feed into consumer inflation overseas, while these effects have been present in capital goods and particularly intermediate goods prices for some time now.
- Rents – tight rental markets will continue to push up rents.





- Accelerating unit labour costs – the main determinant of prices increases in the non-tradeables sector is unit labour costs, as the accompanying chart shows. We expect wages growth to pick-up over 2007, and while productivity growth should improve, it will still remain weak. Overall, non-tradeables inflation will push back toward 4 per cent, from 3.5 per cent now.
- Margins – profitability is under pressure as a result of higher wage costs, higher materials and fuel costs, capacity constraints and weak productivity growth. Although oil prices are likely to fall further through 2007 and materials (commodity) prices will also pull back, it is unlikely producers will pass on these costs reductions. As the chart shows, margins are off their 2004 peaks, as producers absorbed some of the higher costs on the way up. Conversely, they are unlikely to pass on all of the lower fuel and materials costs through to consumers on the way down – particularly in an environment of strong demand.

The main dampening factor for underlying inflation will be an expected improvement in productivity — slowly through 2007 but strengthening in 2008 as new capacity comes onstream (and ramps up) from the current (and most recent) investment boom.

As a result of the slowdown in domestic demand through 2008, profits will come under significant pressure and employment is expected to decline. However, the easing in labour markets may be slow to affect wages. Inflation is expected to hold up at relatively high levels initially, keeping wages growth relatively strong in areas where agreements are partially or wholly indexed to inflation.

3.6 Medium to Longer Term Outlook – Wages Growth Eases but Pressures Persist

Overall, we expect growth in AWOTE to ease during 2008 and 2009, with AWOTE growth forecast to be 4.9 per cent in 2008/09 and 4.5 per cent in 2009/10. At the same time, the sharp slowdown in employment growth over 2008 and 2009 will push up the unemployment rate to a forecast peak of only 6.1 per cent by the end of 2009.

Subsequently, lower interest rates, the housing construction recovery, stronger household consumer spending and a turnaround in business investment will drive a recovery in employment growth, which will gather pace over 2010/11 and 2011/12. This is projected to quickly push the unemployment rate down, falling below 5 per cent again by early 2011. With the labour market again showing signs of tightness and skilled labour shortages re-emerging, we expect wage pressures to be re-ignited, with both AWOTE and the LPI rising to over 5 per cent and 4 per cent respectively (see table 3.1). We are projecting the economy to peak in the next cycle during 2011/12, before growth in both output and employment eases in 2012/13, which should relieve some wage pressures at that time.

Note that there is unlikely to be much impact from Australia's ageing workforce on the labour supply over this period. Although 2011 marks the first year that the baby-boomer generation starts to reach the official retirement age, and many will opt to take early retirement, the main effects on the aggregate labour supply don't start to hit until the middle of next decade.

Table 4.1
Labour Price Index Growth by Industry Sector, Occupation and by State

Sector	% of Total Employment Nov 2006	Labour Price Index Annual Percent Change June '02	June '03	June '04	June '05	Jun '06	Sep '06	Dec'06	Five-Year Average
Private	83.4	3.2	3.4	3.4	4.0	4.0	4.3	4.9	3.6
Public	16.6	3.1	4.2	4.0	4.7	4.4	4.2	4.5	4.3
Industry									
Mining	1.4	3.4	3.2	3.2	4.9	5.7	5.9	6.5	4.3
Manufacturing	10.7	3.1	3.7	3.4	4.0	3.6	3.4	3.4	3.6
Electricity, gas and water supply	0.8	4.0	4.5	4.7	3.8	6.8	6.0	5.9	4.7
Construction	9.6	2.8	3.7	4.3	4.9	5.4	4.9	5.1	4.3
Wholesale trade	4.8	2.7	3.5	3.1	3.6	3.7	3.3	4.2	3.5
Retail trade	15.1	2.8	3.0	3.4	3.6	3.3	2.7	2.3	3.1
Accommodation, cafes and restaurants	4.9	2.9	3.6	2.2	3.2	3.3	2.4	2.0	2.9
Transport and storage	4.6	2.6	3.5	3.1	3.1	4.6	3.8	3.9	3.5
Communication services	1.8	3.3	2.3	3.5	3.2	3.4	3.5	3.8	3.5
Finance and insurance	4.0	3.8	3.4	3.6	4.4	3.9	3.8	3.9	3.7
Property and business services	12.5	2.9	3.4	3.3	3.4	4.0	4.4	4.4	3.6
Government administration and defence	4.8	3.2	3.9	4.3	4.9	3.9	4.1	4.0	4.1
Education	7.2	3.4	4.7	3.6	5.6	4.4	4.1	4.4	4.3
Health and community services	10.9	3.2	3.7	4.1	4.1	4.5	4.1	4.4	4.2
Cultural and recreational services	2.8	3.1	3.8	3.3	4.4	3.3	3.5	3.4	3.7
Personal and other services	4.1	4.0	3.3	3.1	4.0	3.8	3.7	4.0	3.7
Occupation									
Managers & administrators	8.2	3.2	3.5	3.3	4.3	3.7	3.8	4.3	3.7
Professionals	19.3	3.4	4.1	3.6	4.4	4.5	4.3	4.5	4.1
Associate professionals	13.1	3.2	3.3	3.2	4.1	3.8	3.8	4.0	3.7
Tradepersons & related workers	12.7	3.1	3.5	3.6	4.5	4.7	4.3	3.7	3.8
Advanced clerical & service workers	3.7	2.4	3.3	4.0	3.6	3.8	3.8	3.8	3.6
Intermediate clerical, sales & service workers	16.5	3.2	3.5	3.7	3.8	3.8	3.5	3.5	3.6
Intermediate production & transport workers	8.6	2.9	3.4	3.8	4.0	4.8	4.1	4.1	3.8
Elementary clerical sales & service workers	8.3	2.8	3.3	3.2	3.5	3.5	2.6	2.7	3.2
Labourers & related workers	8.5	3.1	3.2	3.5	4.1	3.9	3.2	3.3	3.5
State/Territory									
New South Wales	32.3	3.1	3.8	3.8	3.9	4.0	3.8	3.8	3.7
Victoria	24.6	3.4	3.4	3.3	4.3	3.8	3.5	3.5	3.6
Queensland	20.2	2.9	3.3	3.7	3.9	4.8	4.5	4.5	3.9
South Australia	7.4	3.2	4.0	3.7	3.8	3.7	3.7	3.7	3.7
Western Australia	10.5	2.8	3.5	3.1	5.0	4.6	4.3	4.6	4.0
Tasmania	2.2	3.1	3.3	3.2	4.8	4.0	4.0	4.2	3.8
Northern Territory	1.0	3.3	3.1	3.7	4.2	4.0	4.1	3.5	3.5
Australian Capital Territory (ACT)	1.8	3.0	3.6	4.1	4.9	4.0	4.0	4.1	4.0
Total All(1)	100.0	3.2	3.6	3.5	4.1	4.1	3.8	3.9	3.7

1) Excludes Agriculture, Forestry & Fishing. Source: BIS Shrapnel, ABS data

4. WAGE PRESSURES IN THE ELECTRICITY, GAS & WATER INDUSTRIES

4.1 Strong demand for skilled labour will keep wage rises higher in the utilities sector

Unfortunately we do not have more reliable measures of labour supply that shed light on shortages by industry sector or occupation. However, we can infer where the problems are likely to be on the basis of recent employment growth and the overall level of job vacancies (which tells us both about the demand for labour and the difficulty businesses are having in filling positions).

Skills shortages have been evident in the electricity, gas and water sector for the past two to three years, and in some segments and occupations skills shortages have been chronic. Vacancies have been rising and strong demand for increasingly scarce labour has seen the price of labour (i.e. wages) bid up significantly over the past 18 months. Underlying wages growth as measured by the labour price index has accelerated particularly since early 2006, with the LPI in the June quarter 2006 6.8 per cent higher than the June quarter 2005, and was still 5.9 per cent through calendar 2006. Growth over the past 18 months is the fastest rate of growth in the LPI for the electricity, gas and water sector since its inception in 1997, and is well above the steady 4 to 4.5 per cent per annum growth exhibited over the 2000 to 2005 period. It also represents the fastest wages growth (in labour price index terms) of all the industry sectors, including mining and construction, which have also been reporting severe skilled labour shortages.

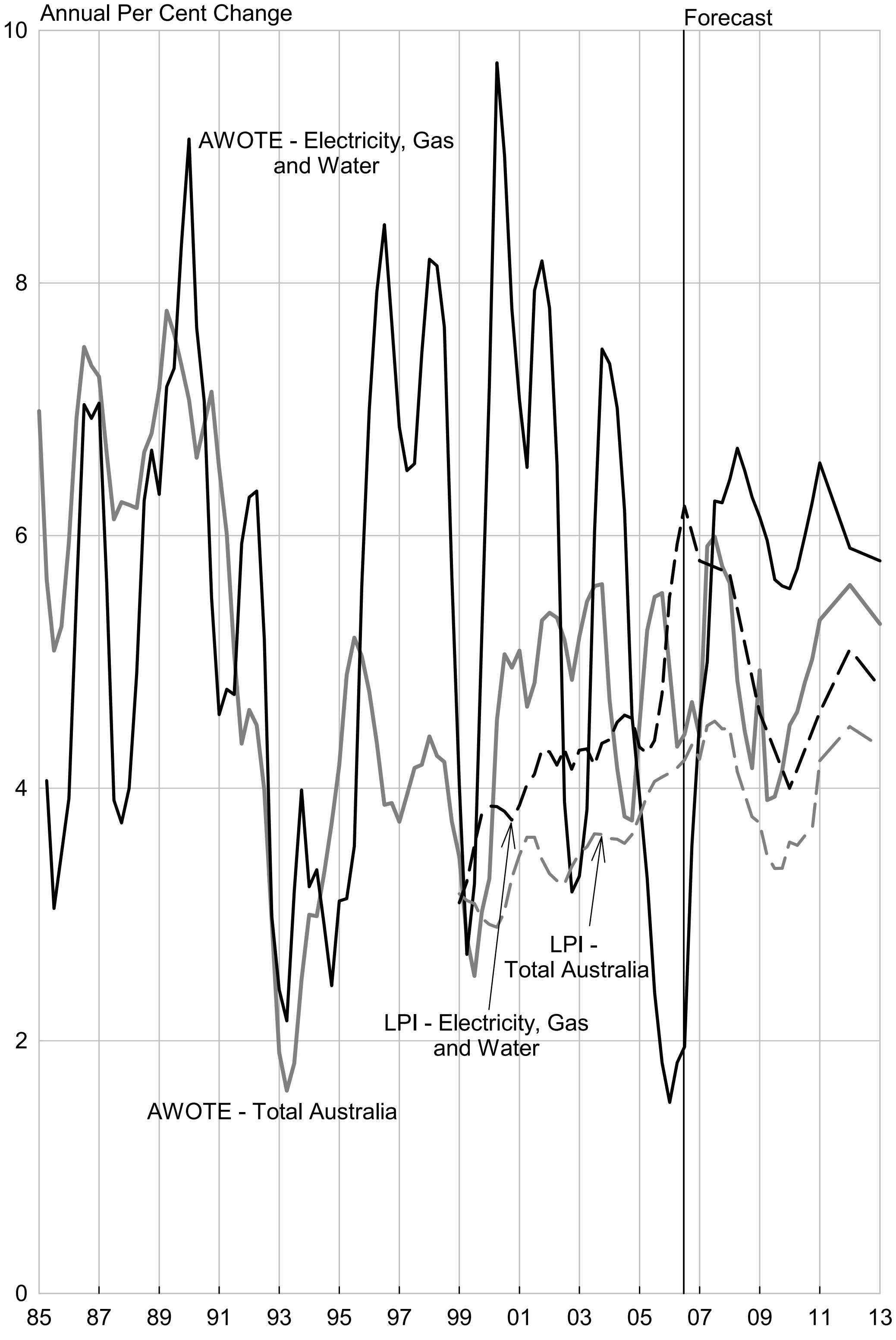
On the other hand, the growth in average weekly earnings in the electricity, gas and water sector has actually slowed in comparison, particularly over 2005/06, due to composition effects of strong employment growth in the sector. Total employment in the electricity, gas and water industry increased 16.4 per cent between May 2005 and May 2006 (a year average growth of 13.9 per cent – see table 4.4). Given the low AWOTE (average weekly ordinary time earnings) growth of 1.8 percent from May 2005 to May 2006 (compared to the LPI of 6.9 per cent), it is likely the biggest growth in employment was in the lower paid segments in the industry sector, which would have pushed down the average wage for the whole sector of 2005/06.

Table 4.2: Australia
AWOTE Growth by Industry Sector

Industry Sector	% of Total Employment Nov 2006	Average Weekly Earnings[1]								
		$	Annual Percent Change							Five-Year
		At Nov '06	May '01	May '02	May '03	May '04	May '05	May '06	Nov '06	Average
Mining	1.4	1 713.60	4.9	4.5	3.6	3.8	4.7	6.4	9.2	5.0
Manufacturing	10.7	1 004.90	3.0	6.3	10.0	3.5	3.7	3.9	5.4	5.4
Electricity, Gas & Water Supply	0.8	1 281.80	7.2	5.3	5.5	5.0	2.9	2.5	2.6	3.4
Construction	9.6	987.40	-2.0	9.0	13.1	3.0	9.2	-0.8	1.4	4.8
Wholesale Trade	4.8	1 019.90	5.5	3.5	2.8	5.8	5.3	3.2	5.8	5.0
Retail Trade	15.1	804.20	2.0	3.8	7.3	3.2	4.3	8.8	3.1	4.9
Accommodation, Cafes & Rest.	4.9	782.90	6.6	2.8	2.7	0.6	2.3	6.8	10.2	3.4
Transport & Storage	4.6	1 046.40	4.6	0.8	5.7	5.6	7.3	5.4	2.2	4.4
Communication Services	1.8	1 156.80	3.0	6.5	0.6	0.1	4.6	5.5	4.9	3.5
Finance & Insurance	4.0	1 338.60	3.7	6.1	7.9	4.8	5.4	4.1	2.1	4.8
Property & Business Services	12.5	1 113.10	9.8	8.1	2.9	-1.8	7.5	5.0	2.4	3.3
Government Admin & Defence	4.8	1 145.80	5.8	4.3	2.6	6.0	5.6	5.0	3.9	4.6
Education	7.2	1 174.50	7.1	3.3	4.2	4.1	5.2	4.7	3.9	4.3
Health & Community Services	10.9	1 028.40	5.6	2.9	6.3	6.0	5.2	-0.6	1.5	4.1
Cultural & Recreational Services	2.8	1 011.80	6.3	7.7	8.5	1.1	10.1	-8.2	-3.5	3.4
Personal & Other Services	4.1	1 016.40	8.0	6.8	2.5	0.4	8.2	2.9	1.3	3.6
Total All Industries(2)	100.0	1 058.60	5.3	5.2	6.3	3.1	6.0	3.5	3.2	4.5

e: estimate Source: BIS Shrapnel, ABS data
(1) Full Time Adult Ordinary Time earnings for persons
(2) Excludes Agriculture, Forestry and Fishing sector

Chart 4.1: AWOTE & LPI
Total Australia and Electricity, Gas and Water
Moving Annual Averages



Year Ended June

Source: BIS Shrapnel, ABS data

Following the strong growth in employment over the four quarters to May 2006, there was a sharp drop in recorded employment in electricity, gas and water over the six months to November 2006 (-7.8 per cent). AWOTE growth in the utilities sector rebounded in the three months to August, but then surprisingly weakened in the three months to November. Nevertheless, given the high underlying rate indicated by the LPI, we expect an increased probability of higher AWOTE figures over the next one-to-two years.

The divergent growth patterns of average weekly ordinary time earnings (AWOTE) and the labour price index over 2006 highlight the problems associated with changes in the composition of employment within industries.

This strong growth in employment since 2002 has been associated with a pick-up in infrastructure and maintenance work as well as an ongoing reversal in the sharp losses in employment seen through the 1990s. Privatisation and rationalisation were the drivers of the job cuts in the 1990s, but in some cases the desire to be streamlined left only a ‘skeleton’ crew in-house for routine operations and emergency disruptions, while capital and maintenance works (both minor and major) tended to be contracted out. Capital expenditure in the utilities sector during the 1990s was also relatively low, and this way also have contributed to weaker employment.

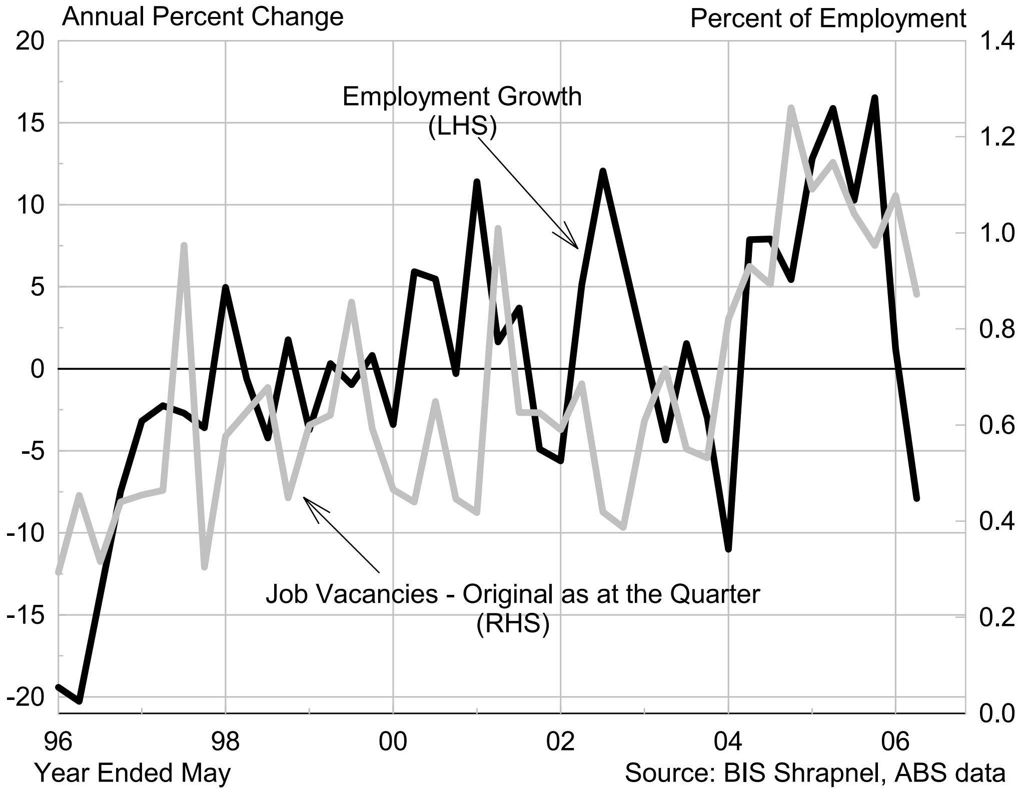
The emergence of skilled labour shortages over recent years has encouraged firms to boost their in-house response capabilities, while increasing competition has shifted the business focus towards customer service in order to enhance product differentiation with an accompanying increase in employment not directly related to the provision of electricity, gas and water services. The entrance of new players in the sector has also exacerbated this situation as it has increased demand for all occupations within this sector.

Nevertheless, the recent pattern of wages growth continues the historical trend where wages growth in the electricity, gas and water sector has averaged higher than the total Australian national (all industry) average. The labour price index growth has consistently been above the national average since the index’s inception in 1997 (except in 1998/99) and has averaged 0.7 per cent higher over 1998 to 2006. While growth in average weekly ordinary time earnings of the electricity, gas and water sector has displayed considerably more volatility (related to compositional effects) over the 18-year period since 1988/89, AWOTE growth in the sector has still averaged 0.9 per cent higher than the national average.

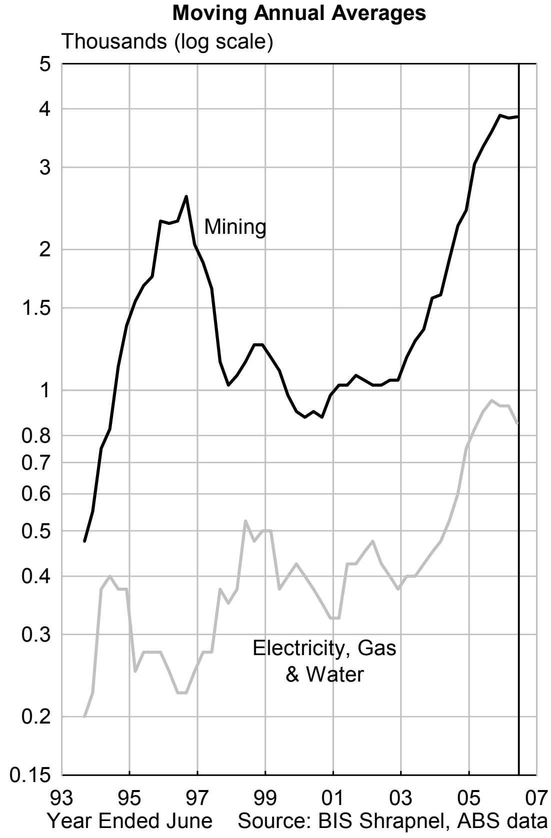
Skills shortages have been evident in the electricity, gas and water sector for the past three years, which is demonstrated in the sharp increase in job vacancies during this period. The latest ‘skills in demand’ lists released by the Department for Employment and Workplace Relations show that all states are experiencing skills shortages in the engineering trades, while Queensland, South Australia, Western Australia and Tasmania all report shortages of gas fitters. Shortages in the electrical trades are also widespread.

We expect wages growth in the electricity, gas and water sector to push well above the national average (which is forecast to average over 5 per cent in AWOTE terms) over the next two years, given the relatively high levels of job vacancies in the sector and the current levels of skills shortages being reported. Increased demand for labour will continue in the sector over the next two years at least.

Chart 4.2
Employment Growth and Job Vacancies
- Electricity, Water and Gas



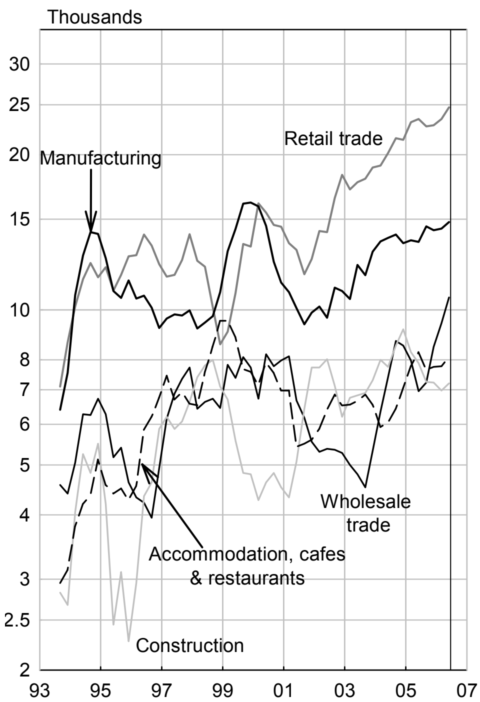
Job Vacancies
Moving Annual Averages



The demand for gas in Australia will continue to increase and the majority of new power stations will be gas fired which will further increase demand for gas-related workforce occupations. Meanwhile, a number of electricity utilities across several states are embarking on major maintenance and refurbishments of their networks. Added to this is our expectation that a number of peak, intermediate and base load power stations will be built over the next decade, while pipeline construction levels will remain high with a number of major developments expected to proceed, as well as continued local reticulation pipeline construction.

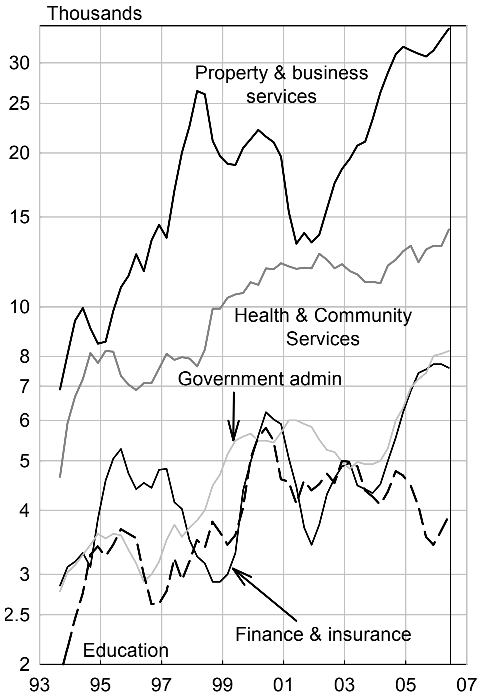
The electricity, gas and water sector is having to compete against mining, construction and manufacturing, all of which are experiencing strong demand for skilled labour with similar desired skills (i.e. engineers, engineering trades, gas-fitters, electricians, etc). Mining is well into an extraordinary investment boom which has at least two more years to run at elevated levels. We are anticipating some decline in investment levels later this decade, but overall resources investment will still stay at historically high levels. Meanwhile, construction will stay strong due to non-dwelling building and infrastructure activity and, later this decade, a recovery in residential construction. This points to the need to offer high wages to attract and retain skilled labour in electricity, gas and water.

Job Vacancies
Moving Annual Averages



Year Ended June Source: BIS Shrapnel, ABS data

Job Vacancies
Moving Annual Averages



Year Ended June Source: BIS Shrapnel, ABS data

Electricity, gas and water supplies are essential services where reliability of supply is paramount. Accordingly, this requires adequate skilled labour to maintain reliability of supply. Unlike other sectors experiencing labour shortages, routine activity cannot be postponed in the electricity, gas and water sector until a point where labour becomes less scarce or cheaper.

Further out, the utilities sector will not be immune from the forecast downturn in employment growth and easing in wage inflationary pressures over 2008/09 and 2009/10. However, wages growth in the electricity, gas, water sector, while easing, is unlikely to drop below the national average during these two years. Thereafter, we expect that it once again should remain comfortably above the national average during the upturn.

Overall, it is BIS Shrapnel's opinion that wages growth in the electricity, gas, water sector — expressed in average weekly ordinary time earnings (AWOTE) — will average 5.7 per cent per annum (0.5 per cent higher than the national AWOTE average of 5.2 per cent per annum) over the next six years from 2007/08 to 2012/13. Meanwhile, we anticipate growth in the labour price index (LPI) for the electricity, gas, water sector will average 4.9 per cent per annum (0.7 per cent higher than national LPI growth of 4.2 per cent per annum) over the six years to 2012/13. The faster wages growth expected in the electricity, gas and water sector over the next six years is in line with historical movements over the past 15 years (see table 4.3).

For the purposes of estimating wage cost changes in Envestra's operating expenses, BIS Shrapnel recommends that movements in average weekly ordinary time earnings (AWOTE) for the electricity, gas and water sector should be used, for the following reasons:

- AWOTE includes all wage costs relevant to business and government, including over-award payments, bonuses and incentives. It also captures the effect of promotions for employees (with a higher salary), which increases an employer's total wage bill. The labour price index does not include bonuses or incentives and because it measures wage change based on a fixed basket of occupations, it does not pick up the effect on the total firm's wage bill of a promotion (promotions to a higher occupation category are often given by employers because they may be constrained by an enterprise or other agreement preventing them giving a wage increase with a certain award). A discussion of the relative merits of the AWOTE is given in section 3.1.

- Envestra's employees are mostly categorised to the electricity, gas and water sector. This sector is a largely capital intensive industry whose employees have higher skill, productivity and commensurate wage levels than most other sectors (see table 4.2). With many of the particular skills relevant to the electricity, gas and water sector expected to remain in relatively high demand, wage increases are expected to remain higher in this industry than the national average. In addition, the overall national average tends to be dragged down by the lower wage and skilled sectors such as the Retail Trade, Wholesale Trade, Accommodation, Cafés and Restaurants, and also Manufacturing and Construction. These sectors tend to be highly cyclical, with weaker employment suffered during downturns impacting on wages growth in particular.

We have included year-to-year movements for AWOTE in the electricity, gas and water sector over the six years to 2012/13, which are presented in table 4.3 (and chart 4.3). Real AWOTE movements, deflated using the headline CPI series, are presented in table 1.1. However, note these year-to-year movements are *indicative only*, and are based on the midpoint of our opinion of the divergence between average wages in the electricity, gas and water sector and that of the national average. We have made an *indicative* allowance in AWOTE movements for compositional changes of employment within the sector through the cycle, which can distort year-to-year movements. We have, however, not carried out a full detailed analysis of occupations within the sector. Such an analysis is outside the scope of this study.

Table 4.3
Average Weekly Ordinary Time Earnings and Labour Price Index
Total Australia and Electricity, Gas & Water
(Year Average Growth)

Year Ended June	Average Weekly Ordinary Time Earnings (1)				Labour Price Index (2)			
	Total Australia		Electricity, Gas and Water		Total Australia		Electricity, Gas and Water	
	$	%CH	$	%CH	Index	%CH	Index	%CH
1989	515.7	7.2	521.9	5.2				
1990	552.2	7.1	569.6	9.1				
1991	588.3	6.5	595.7	4.6				
1992	615.4	4.6	633.3	6.3				
1993	627.2	1.9	648.5	2.4				
1994	646.0	3.0	669.4	3.2				
1995	673.0	4.2	690.2	3.1				
1996	705.1	4.8	738.4	7.0				
1997	731.4	3.7	789.1	6.9				
1998	763.6	4.4	853.7	8.2	82.2		79.2	
1999	790.0	3.5	888.1	4.0	84.8	3.2	81.7	3.1
2000	816.0	3.3	951.9	7.2	87.3	2.9	84.8	3.9
2001	857.5	5.1	1,019.3	7.1	90.3	3.5	88.1	3.9
2002	903.7	5.4	1,098.8	7.8	93.3	3.3	91.9	4.3
2003	950.7	5.2	1,135.1	3.3	96.5	3.5	95.8	4.3
2004	995.3	4.7	1,218.6	7.4	100.0	3.6	100.0	4.4
2005	1 040.2	4.5	1,266.6	3.9	103.8	3.8	104.3	4.3
2006	1 091.6	4.9	1,285.8	1.5	108.1	4.1	110.1	5.5
2007e	1 139.7	4.4	1,342.3	4.4	112.6	4.2	116.5	5.8
Forecasts								
2008	1 203.8	5.6	1,425.5	6.2	117.7	4.5	123.2	5.8
2009	1 263.2	4.9	1,502.5	5.4	122.2	3.8	129.1	4.8
2010	1 320.0	4.5	1,579.2	5.1	126.7	3.7	134.6	4.2
2011	1 390.4	5.3	1,675.5	6.1	132.0	4.2	140.7	4.6
2012	1 468.4	5.6	1,774.3	5.9	137.9	4.5	147.9	5.1
2013	1 546.9	5.4	1,877.2	5.8	143.9	4.4	155.0	4.8
Long Term Averages								
1990-00	4.0		5.3					
2001-07	4.9		5.0		3.7		4.6	
2008-13	5.2		5.7		4.2		4.9	

e : estimate
(1) Earnings of males only are used in order to obtain the most consistent time series. Data is year ended May.
(2) Ordinary time hours excluding bonuses.

4.2 Slow productivity growth will also put pressure on unit labour costs

Productivity is another key factor influencing unit labour costs and overall profitability in the electricity, gas and water sector. Increases in wages can be offset by productivity increases per employee. BIS Shrapnel is predicting productivity (output per employee) in the electricity, gas and water sector to increase by an average 0.8 per cent per annum over the next six years from 2007/08 to 2012/13 (see table 4.5). This compares with an annual average of 1.5 per cent per annum for total Australia (see table 4.4). Note the real output measure for the utilities sector is Gross Value Added (GVA) in constant 2004/05 prices. Gross Value Added is gross output minus intermediate inputs — in other words, the real value added in production. GVA is not industry revenue or industry profit.

The average productivity growth of 0.8 per cent per annum forecast for the utilities sector over the next six years compares unfavourably with the average of 7.3 per cent per annum achieved in the 1990s, but is better than the last seven years, when real output per worker declined by an average of 2.6 per cent per annum (including 2006/07, when productivity is estimated to have surged 7.5 per cent).

The strong growth in productivity achieved in the second half of the 1980s and during the 1990s flowed from the corporatisation and privatisation of the (mainly) public sector utilities which forced them to become more efficient. The move to enterprise bargaining during the 1990s also contributed to the increased efficiency, with many of the productivity gains coming from the elimination of inefficient manning practices and other significant one-off gains. This saw employment in the sector more than halve by the late 1990s and output per employee more than triple (see table 4.5).

However, the relatively ‘easy’ efficiency enhancing measures have now been implemented — with ‘all the low hanging fruit having now been picked’, further productivity gains are now likely to be much harder to achieve over the medium term. Indeed, the significant labour shedding — which drove the productivity gains in the 1987 to 2000 period — was probably overdone, as suggested by the solid growth in employment despite low output growth since 2000/01, and a reversal of the previous productivity gains. New entrants to the industry may have also contributed to the employment growth since 2000/01, although a number of the utilities have had to increase employment levels to address both run-down infrastructure and the need for new connections to service the large growth in new housing over the first half of the decade. With a number of utilities across several states expected to maintain — or even increase — major capital works, upgrading of infrastructure and maintenance programs over the next few years, employment levels are expected to at least hold at around current levels, before easing later this decade.

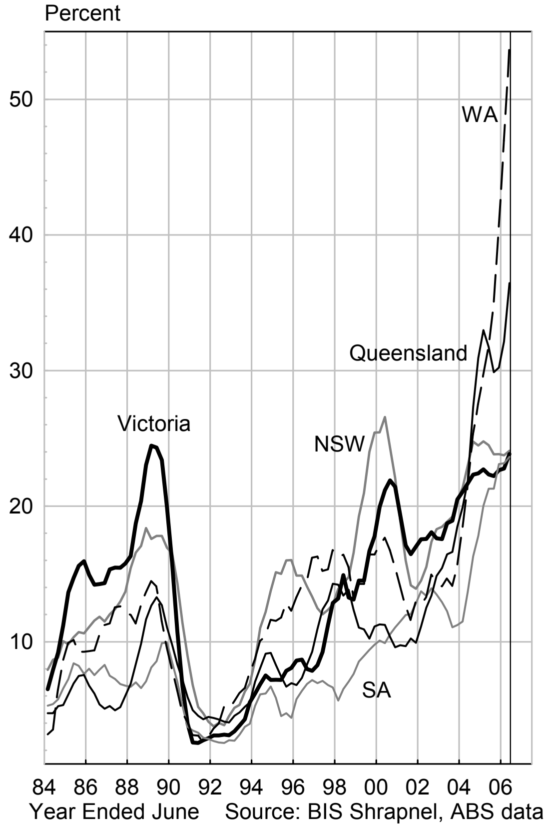
However, only modest growth in output is expected over the medium to long term — meaning that only relatively weak growth in productivity will result, given some minor growth in employment.

Real gross value added is forecast to average only 1.7 per cent per annum growth for the period 2007/08 to 2012/13. Continued demand management and energy efficiency measures are key factors underpinning this modest growth – although this is higher than the 1.2 per cent per annum averaged over the last seven years from 2000/01 to 2006/07 inclusive.

4.3 Wage pressures in Victoria

Labour market conditions are tight across all states, including Victoria, as indicated by the chart below which shows vacancies for each state as a proportion of state-wide unemployment. Although the chart indicates that the labour markets in Queensland and Western Australia are tighter, it shows that the labour market in Victoria has tightened considerably over the past two years. Job vacancies in Victoria have been over 20 per cent of the total unemployed in that state since mid 2004, a level which is well above long term averages and is only surpassed by the boom period of the late 1980s and brief 'dot-com' period in 2000/01.

Job Vacancies as % of Unemployed
Moving Annual Averages



The unemployment rate in Victoria in January 2007 (latest figures) was 4.6 per cent, below the national average of 4.5 per cent, while employment growth in the 12 months to January 2007 was 2.8 per cent, slightly below the national growth of 3.0 per cent. Employment growth in Victoria (and Australia generally) has picked up through 2006, after a period of weakness in the second half of 2005.

Although some job markets are effectively national (or at least encompass several states/territories), the state based job vacancies and employment measures provide some idea of the extent of localised labour market pressures. The measures indicate tight labour market conditions in Victoria which are exacerbating wage pressures.

With regard to wage pressures in the electricity, gas and water sectors in each state, the current demand for labour across virtually all states is quite strong. Employment growth has been particularly robust over the past year Australia-wide, with strong growth occurring in Victoria over the past two years. Further growth in employment in the sector is expected in most states – including Victoria – over the next two years, with continued strong demand for labour maintaining relatively high wage pressures within each states' utilities sector.

Although the forecasts (in the following tables) suggest slower employment growth in Victoria's electricity, gas and water sector, compared to the Australian average, the wage pressures will be no less acute. The Victorian utilities sector will need to offer competitive wages to retain its existing workforce and attract new recruits. While overall wage pressures in Western Australia and Queensland may lead to higher wage outcomes in those two states utilities over the next two-to-three years, we believe that growth in both AWOTE and the wage cost index in Victoria's electricity, gas and water sector will be at, or close to, the national average for the electricity, gas and water sector.

Table 4.4
Total Australia
Output and Employment

Year Ended June	Gross Domestic Product $m(04/05$'s)	A%Ch	Employment '000	A%Ch	Productivity $000/empl.	A%Ch
1986	478 019	4.4	6862	4.3	69.7	
1987	489 563	2.3	7057	2.8	69.4	-0.4
1988	514 811	5.4	7271	3.0	70.8	2.1
1989	533 858	4.0	7564	4.0	70.6	-0.3
1990	554 858	3.9	7849	3.8	70.7	0.2
1991	551 282	-0.6	7802	-0.6	70.7	0.0
1992	551 727	0.1	7658	-1.8	72.0	2.0
1993	571 876	3.7	7659	0.0	74.7	3.6
1994	595 335	4.1	7803	1.9	76.3	2.2
1995	622 057	4.5	8114	4.0	76.7	0.5
1996	647 659	4.1	8331	2.7	77.7	1.4
1997	673 099	3.9	8403	0.9	80.1	3.0
1998	703 257	4.5	8518	1.4	82.6	3.1
1999	739 628	5.2	8689	2.0	85.1	3.1
2000	769 046	4.0	8869	2.1	86.7	1.9
2001	784 018	1.9	9058	2.1	86.6	-0.2
2002	813 542	3.8	9166	1.2	88.8	2.5
2003	839 186	3.2	9393	2.5	89.3	0.7
2004	873 197	4.0	9563	1.8	91.3	2.2
2005	896 569	2.6	9845	2.9	91.1	-0.3
2006	922 386	2.7	10067	2.3	91.6	0.6
2007e	954 330	4.3	10337	2.7	92.3	0.8
Forecasts						
2008	986 240	2.8	10522	1.8	93.7	1.5
2009	1 013 540	2.8	10548	0.2	96.1	2.5
2010	1 054 850	4.0	10713	1.6	98.5	2.5
2011	1 096 160	3.9	11038	3.0	99.3	0.9
2012	1 134 140	3.5	11325	2.6	100.1	0.8
2013	1 161 370	2.4	11494	1.5	101.0	0.9
Long Term Averages						
1986-2006	3.3		1.9		1.4	
1990-1995	2.3		0.7		1.6	
1996-2000	4.3		1.8		2.5	
2001-2007	3.1		2.2		0.9	
Forecasts 2008-2013	3.3		1.8		1.5	

e : estimate

Source: BIS Shrapnel, ABS data

Table 4.5
Electricity, Gas and Water — Australia
Output and Employment

Year Ended June	Gross Value Added $m(04/05$'s)	A%Ch	Employment '000	A%Ch	Productivity $'000/empl.	A%Ch
1986	13 914	3.8	144.1	5.6	96.5	-1.7
1987	14 227	2.2	133.0	-7.7	107.0	10.8
1988	14 923	4.9	124.2	-6.6	120.2	12.3
1989	15 592	4.5	119.3	-4.0	130.7	8.8
1990	16 347	4.8	108.7	-8.9	150.4	15.0
1991	16 609	1.6	103.4	-4.9	160.7	6.8
1992	16 752	0.9	106.2	2.8	157.7	-1.8
1993	17 044	1.7	97.6	-8.1	174.7	10.8
1994	17 584	3.2	92.2	-5.5	190.7	9.2
1995	18 032	2.5	86.8	-5.9	207.9	9.0
1996	18 273	1.3	80.6	-7.1	226.6	9.0
1997	18 213	-0.3	66.5	-17.6	274.1	20.9
1998	18 857	3.5	64.5	-3.0	292.5	6.7
1999	19 164	1.6	64.9	0.6	295.5	1.0
2000	19 539	2.0	64.2	-1.0	304.2	2.9
2001	19 840	1.5	65.4	1.8	303.6	-0.2
2002	19 690	-0.8	67.3	2.9	292.8	-3.6
2003	19 867	0.9	72.5	7.8	274.1	-6.4
2004	20 000	0.7	75.0	3.4	266.8	-2.7
2005	20 146	0.7	76.5	2.1	263.2	-1.3
2006	20 471	1.6	87.2	13.9	234.9	-10.8
2007e	21 170	3.4	83.9	-3.8	252.4	7.5
Forecasts						
2008	21 660	2.3	86.2	2.8	251.2	-0.5
2009	22 030	1.7	86.3	0.1	255.2	1.6
2010	22 430	1.8	85.3	-1.1	262.8	3.0
2011	22 790	1.6	85.8	0.6	265.5	1.0
2012	23 130	1.5	88.0	2.5	262.8	-1.0
2013	23 410	1.2	88.2	0.2	265.4	1.0
Long Term Averages						
1986-2006	1.9		-2.5		4.5	
1990-1995	2.0		-4.4		6.7	
1996-2000	1.6		-5.8		7.9	
2001-2007	1.2		3.9		-2.6	
Forecasts						
2008-2013	1.7		0.8		0.8	

e : estimate

Source: BIS Shrapnel, ABS data

Table 4.6
Electricity, Gas and Water — Victoria
Output and Employment

Year Ended June	Gross Value Added $m(04/05$'s)	Gross Value Added A%Ch	Employment '000	Employment A%Ch	Productivity $'000/empl.	Productivity A%Ch
1986	4125.4	3.4	41.3	9.0	99.9	-5.1
1987	4471.4	8.4	37.3	-9.8	120.0	20.2
1988	4503.4	0.7	34.3	-7.9	131.3	9.4
1989	4586.6	1.8	35.5	3.5	129.2	-1.6
1990	4909.7	7.0	28.9	-18.6	169.9	31.5
1991	4654.3	-5.2	28.1	-2.9	165.8	-2.4
1992	4531.7	-2.6	25.7	-8.4	176.2	6.3
1993	4627.9	2.1	21.4	-17.0	216.8	23.0
1994	4895.7	5.8	22.6	5.6	217.1	0.2
1995	4792.6	-2.1	20.3	-10.0	236.1	8.7
1996	5166.8	7.8	18.3	-9.9	282.3	19.6
1997	5200.2	0.6	13.8	-24.9	378.2	34.0
1998	5034.1	-3.2	14.3	3.8	352.6	-6.8
1999	5833.4	15.9	16.8	17.3	348.3	-1.2
2000	5820.6	-0.2	15.2	-9.4	383.6	10.1
2001	5629.4	-3.3	15.7	3.1	359.7	-6.2
2002	5507.4	-2.2	16.5	5.6	333.3	-7.3
2003	5502.2	-0.1	16.4	-1.0	336.5	1.0
2004	5609.9	2.0	17.3	5.8	324.2	-3.7
2005	5667.8	1.0	19.2	10.8	295.6	-8.8
2006	5789.1	2.1	21.4	11.8	270.0	-8.7
2007e	5910.6	2.1	21.0	-2.1	281.6	4.3
Forecasts						
2008	5981.6	1.2	21.1	0.7	283.0	0.5
2009	6071.3	1.5	21.2	0.4	286.1	1.1
2010	6168.4	1.6	21.5	1.1	287.5	0.5
2011	6273.3	1.7	21.6	0.9	289.8	0.8
2012	6386.2	1.8	21.9	1.3	291.3	0.5
2013	6450.1	1.0	21.9	0.0	294.2	1.0
Long Term Averages						
1986-2006	1.7		-3.2		5.1	
1990-1995	-0.5		-6.8		6.8	
1996-2000	4.0		-5.7		10.2	
2001-2007	0.2		4.7		-4.3	
Forecasts						
2008-2013	1.5		0.7		0.7	

e : estimate

Source: BIS Shrapnel, ABS data

5. REVIEW OF ACCESS ECONOMICS REPORT: "WAGE GROWTH FORECASTS IN THE UTILITIES SECTOR"

The Australian Energy Regulator (AER) recently commissioned a report from Access Economics Pty Ltd (AE) on the outlook for wages in the utilities sector to 2015/16. This section will address the findings of the Access Economics report, with particular reference to areas of difference between AE and BIS Shrapnel regarding the wage and productivity forecasts presented in sections 1 to 4 of this report for Envestra/SP–AusNet/Multinet Gas.

5.1 Summary of Review — Major Differences BIS Shrapnel V. Access Economics

Overall, BIS Shrapnel believes that AE has underestimated nominal wages growth and overestimated productivity growth in the utilities sector to 2016. The main source of the difference between BIS Shrapnel and AE is that BIS Shrapnel believes the labour market for the utilities, mining and construction sector will remain relatively tight for longer than AE, thus leading to the maintenance of higher wages in the utilities sector over the period from 2009/10 to 2015/16.

Key reasons why BIS Shrapnel expects higher employment and wages than AE in the utilities sector include:

- a major phase of network infrastructure upgrades and maintenance now underway, combined with a desire to increase the 'in-house' skills within the utilities sector, will sustain the current strong demand for skilled labour in the utilities sector for a number of years.
- with this strong demand for skilled labour to continue, the utilities sector will need to continue to offer higher wages (and higher wages growth) to both attract and retain skilled labour.
- the delivery of electricity, gas and water (and sewerage) are essential services. The utilities sector must retain adequate skilled labour in order to maintain reliability of supply, and with the demand for skilled labour in the utilities, mining and construction to remain relatively solid over the short, medium and long-terms, it is likely wages growth in the utilities sector will remain above the national (all industries) average, as it has on average, for the past two decades.

5.2 Review of Total Australia Wage, Price and Productivity Forecasts

While BIS Shrapnel is in broad agreement with AE that underlying price inflation is expected to move higher over the next two years, we believe that higher national wage outcomes (than AE) combined with lower national productivity (than forecast by AE) will underpin higher price inflation, both for headline CPI and underlying inflation. Both of BIS Shrapnel's price inflation measure — headline and baseline — are projected to average 2.9 per cent per annum over the next decade, while AE's headline and underlying measure appear to average around 2.5 per cent p.a. Although BIS Shrapnel's 'Baseline' inflation measure is different to the 'Underlying CPI Index' used by AE (table1, page 14 and footnote 2 on page 2 of AE report), we expect inflationary pressures to re-emerge by 2010/11 once domestic demand picks up strongly through 2009/10, 2010/11 and 2011/12, with the BIS Shrapnel Baseline inflation and headline inflation measures to accelerate (see table 3.1) at a faster rate than the forecasts provided in table 1 of the AE report.

Given that underlying inflation is a key component of wages growth (as stated in AE report, page 1), this will tend to push up wages. The labour market is also expected to remain relatively tight over the medium term, while BIS Shrapnel's lower productivity forecast means unit labour costs are higher, forcing businesses to pass on these higher costs in the form of higher prices.

Table 5.1
Access Economics Wage & Productivity Growth
Using Labour Price Index

	All Industries - Access Economics Forecasts						**Utilities - Access Economics forecasts**					
Year Ended June	Labour Price Index Nominal Wage index	%ch	Wage-Productivity(2) index	%ch	Implied productivity(3) $000/empl.	%ch	Labour Price Index Nominal Wage index	%ch	Wage-Productivity(2) index	%ch	Implied productivity(3) $000/empl.	%ch
1998	82.2		90.8		82.6		79.2		73.0		292.5	
1999	84.8	3.2	90.9	0.1	85.1	3.1	81.7	3.1	74.5	2.1	295.5	1.0
2000	87.3	2.9	91.8	1.1	86.7	1.9	84.8	3.9	75.2	0.9	304.2	2.9
2001	90.3	3.5	95.2	3.6	86.6	-0.2	88.1	3.9	78.2	4.1	303.6	-0.2
2002	93.3	3.3	95.9	0.8	88.8	2.5	91.9	4.3	84.4	7.8	292.8	-3.6
2003	96.5	3.5	98.6	2.8	89.3	0.7	95.8	4.3	93.4	10.7	274.1	-6.4
2004	100.0	3.6	100.0	1.4	91.3	2.2	100.0	4.4	100.0	7.1	266.8	-2.7
2005	103.8	3.8	104.0	4.0	91.1	-0.3	104.3	4.3	105.7	5.7	263.2	-1.3
2006	108.1	4.1	107.7	3.5	91.6	0.6	110.1	5.5	122.9	16.3	234.9	-10.8
2007f	112.7	4.3	110.4	2.5	93.3	1.8	116.0	5.4	126.9	3.3	239.8	2.1
Forecasts												
2008	117.9	4.6	112.1	1.6	96.1	3.0	122.9	5.9	127.7	0.6	252.5	5.3
2009	122.8	4.2	113.7	1.4	98.8	2.8	129.3	5.2	131.6	3.1	257.8	2.1
2010	128.0	4.2	116.4	2.4	100.5	1.8	133.6	3.4	136.0	3.3	258.1	0.1
2011	133.4	4.2	119.7	2.8	101.9	1.4	138.2	3.4	138.7	2.0	261.7	1.4
2012	138.7	4.0	122.3	2.2	103.8	1.8	143.6	3.9	141.6	2.1	266.4	1.8
2013	144.0	3.8	124.7	1.9	105.8	1.9	148.5	3.4	144.0	1.7	270.9	1.7
2014	149.4	3.8	127.3	2.1	107.6	1.7	153.7	3.5	146.6	1.8	275.5	1.7
2015	156.5	4.7	130.5	2.5	109.9	2.2	159.3	3.7	149.4	1.9	280.5	1.8
2016	163.8	4.7	133.6	2.4	112.4	2.3	165.4	3.8	152.5	2.1	285.2	1.7
Long Term Averages												
1986-2006												
1990-00												
1998-2006	3.5		2.2		1.3		4.2		6.7		-2.7	
2001-07	3.7		2.7		1.0		4.6		7.8		-3.3	
2008-13	4.2		2.0		2.1		4.2		2.1		2.1	
2008-16	4.2		2.1		2.1		4.0		2.1		1.9	
2002-06	3.7		2.5		1.1		4.6		9.4		-5.0	
2007-11	4.3		2.1		2.2		4.7		2.5		2.2	
2012-16	4.2		2.2		2.0		3.7		1.9		1.7	
2007-16	4.2		2.2		2.1		4.2		2.2		2.0	

f Access Economic forecast

Source: , ABS data

(1) Average weekly ordinary time earnings for persons
(2) Nominal wage excluding productivity
(3) Forecasts derived from difference between Nominal Wage and Wage-Productivity in table on page iii of AE Report. Actuals to 2006 from National Accounts and Labour Force data

Table 5.2
BIS Shrapnel Wage & Productivity Growth
Using Labour Price Index

Year Ended June	**All Industries** Labour Price Index Nominal Wage index	%ch	Wage-Productivity(2) index	%ch	Productivity(3) $000/empl.	%ch	**Utilities** Labour Price Index Nominal Wage index	%ch	Wage-Productivity(2) index	%ch	Productivity(3) $000/empl.	%ch
1998	82.2		90.8		82.6		79.2		73.0		292.5	
1999	84.8	3.2	90.9	0.1	85.1	3.1	81.7	3.1	74.5	2.1	295.5	1.0
2000	87.3	2.9	91.8	1.1	86.7	1.9	84.8	3.9	75.2	0.9	304.2	2.9
2001	90.3	3.5	95.2	3.6	86.6	-0.2	88.1	3.9	78.2	4.1	303.6	-0.2
2002	93.3	3.3	95.9	0.8	88.8	2.5	91.9	4.3	84.4	7.8	292.8	-3.6
2003	96.5	3.5	98.6	2.8	89.3	0.7	95.8	4.3	93.4	10.7	274.1	-6.4
2004	100.0	3.6	100.0	1.4	91.3	2.2	100.0	4.4	100.0	7.1	266.8	-2.7
2005	103.8	3.8	104.0	4.0	91.1	-0.3	104.3	4.3	105.7	5.7	263.2	-1.3
2006	108.1	4.1	107.7	3.5	91.6	0.6	110.1	5.5	122.9	16.3	234.9	-10.8
2007f	112.6	4.2	111.4	3.5	92.3	0.8	116.5	5.8	120.8	-1.7	252.4	7.5
Forecasts												
2008	117.7	4.5	114.7	2.9	93.7	1.5	123.2	5.8	128.4	6.3	251.2	-0.5
2009	122.2	3.8	116.2	1.3	96.1	2.5	129.1	4.8	132.5	3.2	255.2	1.6
2010	126.7	3.7	117.6	1.2	98.5	2.5	134.6	4.2	134.1	1.2	262.8	3.0
2011	132.0	4.2	121.5	3.3	99.3	0.9	140.7	4.6	138.9	3.6	265.5	1.0
2012	137.9	4.5	126.0	3.6	100.1	0.8	147.9	5.1	147.4	6.1	262.8	-1.0
2013	143.9	4.4	130.4	3.5	101.0	0.9	155.0	4.8	153.0	3.8	265.4	1.0
2014	149.4	3.8	132.3	1.5	103.4	2.3	161.7	4.3	156.2	2.1	271.3	2.2
2015	155.8	4.3	135.9	2.8	105.0	1.5	169.6	4.9	161.5	3.4	275.4	1.5
2016	163.1	4.7	139.4	2.5	107.2	2.2	178.4	5.2	168.0	4.0	278.7	1.2
Long Term Averages												
1986-2006												
1990-00												
1998-2006	3.5		2.2		1.3		4.2		6.7		-2.7	
2001-07	3.7		2.8		0.9		4.6		7.0		-2.6	
2008-13	4.2		2.7		1.5		4.9		4.0		0.8	
2008-16	4.2		2.5		1.7		4.9		3.7		1.1	
2002-06	3.7		2.5		1.1		4.6		9.4		-5.0	
2007-11	4.1		2.5		1.6		5.0		2.5		2.5	
2012-16	4.3		2.8		1.5		4.9		3.9		1.0	
2007-16	4.2		2.6		1.6		4.9		3.2		1.7	

f BIS Shrapnel forecast

Source: BIS Shrapnel, ABS data

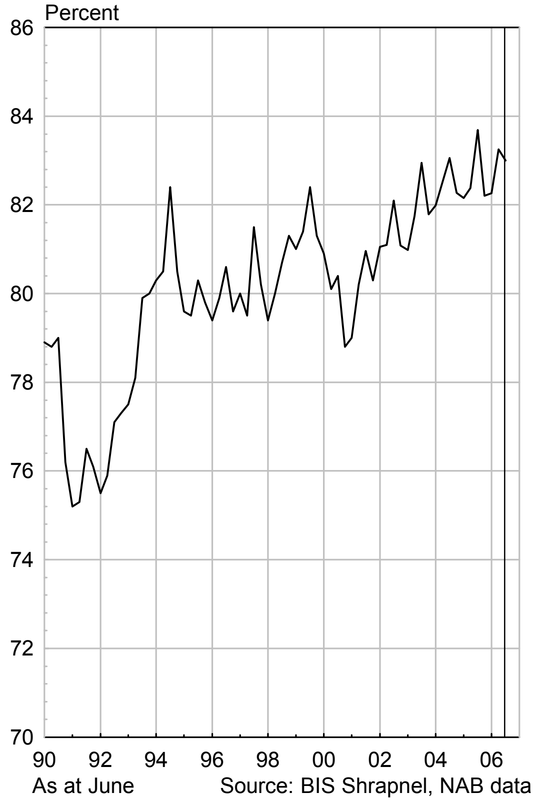
(1) Average weekly ordinary time earnings for persons

(2) Nominal wage excluding productivity

(3) Forecasts from BIS Shrapnel. Actuals to 2006 from National Accounts and Labour Force data

The economy is close to a 'full capacity' economy, with low unemployment rate, chronic skills shortages and high capacity utilisation being key indicators of this phenomenon. While the investment boom of recent years (and expected to run another year) will add new capacity — and ease physical capacity restraints in the goods producing (and exporting) sector in particularly — a lack of new labour supply (particularly skilled labour) will leave the labour still relatively tight. Over the past decade, cutbacks to tertiary education in real terms means the growth of the skills base of the workforce has not kept pace with demand. While some measures are now being implemented to address in adequate education funding, it will still take the best part o a decade to sufficiently build up the skills base to drive strong increases in productivity.

Capacity utilisation
Proportion of available capacity



Productivity growth per employee has increased by only 0.9 per cent on average since 2000. This compares unfavourably with the 2.1 per cent averaged through the 1990s, and the long run rate of around 1.5 per cent. Key factors driving the strong productivity growth during the 1990s were:

- the increasing utilisation of spare capacity, both physical capacity and among the employed, following the recession in 1990/91 which resulted in a considerable fall in capacity utilisation and a sharp rise in unemployment.
- a series of major industrial relations and labour market reforms, plus other microeconomic reforms over the 1980s and 1990s which improved the efficiency of the use of both labour and capital.
- the rapid take-up and widespread proliferation of computers and other information technology added to productivity.
- the expansion of the tertiary education sector in the 1980s and early 1990s provided the expanded skills base to take advantage of the new technology and labour market and microeconomic reforms.

BIS Shrapnel is forecasting national productivity growth to average 1.6 per cent per annum over the next 10 years to 2015/16 — similar to the long run average — while AE has forecast productivity growth to average to 2.1 per cent over the same period — the same as the 1990s. However, to achieve such a strong rate of productivity growth seems more like 'a leap of faith'. While the current investment boom will add to capacity (particularly export capacity), there are a number of factors while will limit productivity growth over the next decade:

- most of the IR, labour market and microeconomic reforms have been done. Further reforms will only add marginally to efficiency and productivity (including the Federal Government's 'WorkChoices' legalisation). In effect, all the 'easily reached, low hanging fruit' has been picked.

- further technology applications are unlikely to add as much to productivity growth as in the 1990s.
- there is little spare capacity in the labour market. Australian workers are already working close to the longest hours in the industrialised world. On our forecasts, the rate of unemployment tops out at around 6 per cent during the 2008/09 domestic downturn, but following the recovery, quickly falls back below 5 per cent and toward 4.5 per cent again during 2011. Added to this is an acceleration in the ageing of the workforce after 2011.
- even if an 'education revolution' started now, a significant expansion of tertiary education (including trade skills) would not produce a marked strengthening in productivity before 5 years and would probably take close to a decade to manifest.

5.3 Review of Utilities Wage, Employment and Productivity Forecasts

AE's forecasts of output in the utilities sector (as presented in chart 9, page 10 of AE report) appear to be broadly similar to BIS Shrapnel's, apart from the near-term period to 2008. However, AE's outlook for employment, wages and productivity (the latter two indicators are shown in table 5.1) are somewhat different to BIS Shrapnel's forecasts, which are presented in table 4.5 and table 5.2.

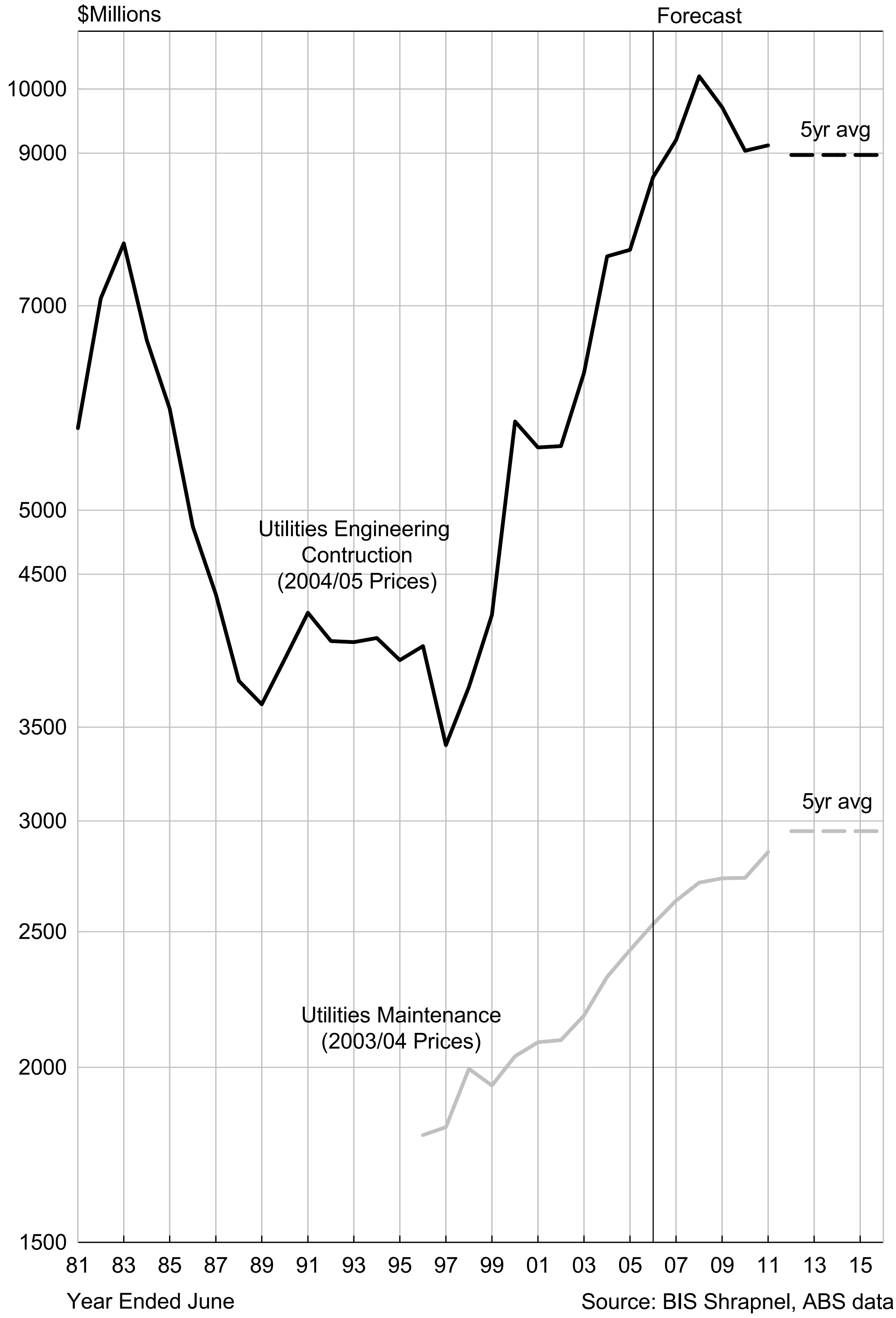
Overall, BIS Shrapnel has higher employment and wages growth forecasts and lower productivity forecasts for the utilities sector than AE. BIS Shrapnel is forecasting employment growth in the utilities sector to average 0.8 per cent per annum over the next decade. Employment growth in the utilities sector was very strong over the 2001 – 2006 period, averaging 5.9 per cent p.a. — much higher than the national average. Employment surged almost 14 per cent in 2005/06, but fell back sharply in the second half of calendar 2006. We expect employment to bounce back over 2007 before stabilising over 2008/09 and then weaken over 2009/10, and subsequently pick up modestly over the following two years. Little growth is then projected over the 2013 to 2016 period.

They key reasons for BIS Shrapnel's higher employment growth (modest though it is) compared to AE are a large long-term capital works and maintenance program and a desire to increase engineering, construction and maintenance skills within the utilities sector.

Both capital and maintenance expenditure is expected to be at higher levels, on average, over the next decade, compared to the past decade — as presented in BIS Shrapnel's reports *Engineering Construction in Australia: 2006 to 2021* and *Maintenance in Australia: 2005 to 2010.* Chart 5.1 provides a summary from these reports of the combined utilities sector (electricity generation and supply, gas pipelines and water and sewerage) expenditure on engineering construction and maintenance. Although the construction of major projects (such as major pipelines, power stations and water/wastewater treatment works) will still be mostly contracted out to companies classified to the construction sector, long term programs covering upgrades are increasingly being brought 'in-house', rather than contracted out. There has been a growing desire to build up in-house capabilities and skills, which has been given added impetus from the escalation of contractor costs over recent years. Furthermore, the much higher levels of the long tem programs to upgrade networks and increase maintenance are part of a 'catch-up' phase of upgrading and maintenance after weak levels of expenditure in these areas during the 1990s.

Given these larger long term capital works and maintenance programs, it is unlikely employment levels will fall from 2006/07 to 2011/12, as implied by AE's productivity, output and employment forecasts presented in chart 4 of the AE report.

Chart 5.1
Utilities Construction and Maintenance
(Constant Prices)



The main reason provided by AE for the decline in employment growth is their "longer term expectations for productivity growth in the utilities sector are that it will return to growth in line with national trends. As we [Access Economics] anticipate utilities sector output will lag the broader economy, this implies relatively weak employment growth in the sector to maintain productivity growth" (page 5, AE report). However, the AE report provides no reasons or evidence to support their claim that employment levels in the sector are expected to fall. The AE report simply states that "the recent strength in [utilities] sector employment is anticipated to ease in the next few years allowing productivity levels to rebound (page 6, AE report).

The AE report suggests that the significant increases in employment over recent years is due largely to the "construction of new infrastructure [which] is related to expected future demand for electricity and water rather than demand right at the moment, [and this] increasing employment can be required to run new facilities even before their output is fully utilised" (page 6 of AE report).

While this argument has some merit, AE's employment forecasts would suggest the construction boom in new utilities infrastructure is now over, and that no new facilities are expected over the next 6 years which would require increased employment.

However, as the accompanying chart shows, utilities infrastructure (i.e. engineering construction work done) and maintenance expenditure are forecast to experience further strong increases in utilities employment over the next two years. And while the engineering construction forecasts show a decline over 2008/09 and 2009/10, most of this is related to the completion of a number of major power stations, water/wastewater treatment plants and dams. Meanwhile, construction work on transmission and distribution upgrades and expansions, and on maintenance work generally, is expected to be maintained or even increased. With work on upgrades and maintenance increasingly being brought 'in-house' (i.e. into the utilities sector), employment is expected to increase over the next two-to-three years.

The sharp easing in wages growth in the utilities sector in 2009/10 predicted by AE is based on their "broad expectation that the impact of skills shortages in the industry (and the economy in general) will decline across the next three years". While we also expect some easing in wage pressures, we believe it is highly unlikely that wages growth in the utilities sector would remain well below the national average for the seven years from 2009/10 to 2015/16.

The utilities sector will still compete with the mining and construction sectors for skilled labour, and as table 5.4 shows, the demand for labour in these sectors (combined) is expected to remain strong in 2006/07, and only ease modestly over 2007/08 and 2008/09, before again picking up from 2009/10 through to 2012/13. Both the utilities and mining sectors in particular, as well as that part of the construction sector building infrastructure, will still need to offer relatively higher wages to both retain and attract skilled labour. Given that the very strong demand for engineers and skilled tradespersons in these sectors is currently outstripping the supply of those skilled labour types, the modest easing in overall labour demand for the 3 combined sectors will probably only see that portion of the labour market approach balance, but still remain relatively tight in historical terms. Accordingly, we expect wages growth in the utilities, mining sector to remain above the national average, in line with historical trends. We have provided an analysis of AWOTE (table 5.3), as this has a much longer historical series (back to the early 1980s) of wages and productivity.

Another key reason why BIS Shrapnel expects utilities wages growth to remain above the national average is that electricity, gas and water (and sewerage) are essential services, where reliability of supply is paramount. As explained in section 4.1, the utilities sector *must* retain adequate skilled

Table 5.3
BIS Shrapnel Wage & Productivity Growth Using AWOTE

	All Industries - persons				All Industries						Utilities					
Year Ended June	Access Economics Forecast AWOTE(1) $/week	%ch	BIS Shrapnel Forecast AWOTE(1) $/week	%ch	AWOTE - Males Nominal Wage $/week	%ch	Wage-Productivity(2) index	%ch	Productivity(3) $000/empl.	%ch	AWOTE - Males Nominal Wage $/week	%ch	Wage-Productivity(2) index	%ch	Productivity(3) $000/empl.	%ch
1998	716.8	4.1	716.8	4.1	763.6	4.4	84.7	1.3	82.6	3.1	853.7	8.2	64.6	1.5	292.5	6.7
1999	743.3	3.7	743.3	3.7	790.0	3.5	85.0	0.4	85.1	3.1	888.1	4.0	66.5	3.0	295.5	1.0
2000	768.2	3.4	768.2	3.4	816.0	3.3	86.2	1.4	86.7	1.9	951.9	7.2	69.4	4.2	304.2	2.9
2001	808.8	5.3	808.8	5.3	857.5	5.1	90.7	5.3	86.6	-0.2	1019.3	7.1	74.4	7.3	303.6	-0.2
2002	853.6	5.5	853.6	5.5	903.7	5.4	93.3	2.8	88.8	2.5	1098.8	7.8	82.9	11.4	292.8	-3.6
2003	897.6	5.2	897.6	5.2	950.7	5.2	97.6	4.5	89.3	0.7	1135.1	3.3	90.9	9.7	274.1	-6.4
2004	941.3	4.9	941.3	4.9	995.3	4.7	100.0	2.5	91.3	2.2	1218.6	7.4	100.0	10.0	266.8	-2.7
2005	984.7	4.6	984.7	4.6	1040.2	4.5	104.8	4.8	91.1	-0.3	1266.6	3.9	105.3	5.3	263.2	-1.3
2006	1032.0	4.8	1032.0	4.8	1091.6	4.9	109.3	4.3	91.6	0.6	1285.8	1.5	118.2	12.3	234.9	-10.8
2007f	1072.4	3.9	1074.9	4.2	1139.7	4.4	113.3	3.6	92.3	0.8	1342.3	4.4	114.6	-3.1	252.4	7.5
Forecasts																
2008	1126.0	5.0	1136.7	5.7	1203.8	5.6	117.9	4.1	93.7	1.5	1425.5	6.2	122.2	6.7	251.2	-0.5
2009	1170.3	3.9	1192.4	4.9	1263.2	4.9	120.8	2.4	96.1	2.5	1502.5	5.4	126.9	3.8	255.2	1.6
2010	1217.3	4.0	1244.8	4.4	1320.0	4.5	123.2	2.0	98.5	2.5	1579.2	5.1	129.5	2.1	262.8	3.0
2011	1262.8	3.7	1311.2	5.3	1390.4	5.3	128.7	4.5	99.3	0.9	1675.5	6.1	136.2	5.1	265.5	1.0
2012			1384.7	5.6	1468.4	5.6	134.9	4.8	100.1	0.8	1774.3	5.9	145.5	6.9	262.8	-1.0
2013			1458.8	5.4	1546.9	5.4	140.9	4.5	101.0	0.9	1877.2	5.8	152.5	4.8	265.4	1.0
2014			1528.1	4.8	1620.4	4.8	144.3	2.4	103.4	2.3	1971.1	5.0	156.8	2.8	271.3	2.2
2015			1596.1	4.5	1692.5	4.5	148.5	2.9	105.0	1.5	2077.6	5.4	162.9	3.9	275.4	1.5
2016			1682.3	5.4	1783.9	5.4	153.3	3.2	107.2	2.2	2204.3	6.1	170.9	4.9	278.7	1.2
Long Term Averages																
1986-2006	4.9		4.9		4.9		3.5		1.4		5.5		0.4		4.5	
1990-00	4.0		4.0		4.0		1.9		2.1		5.3		-2.4		7.3	
1998-2006	4.7		4.7		4.6		3.2		1.3		5.3		7.8		-2.7	
2001-07	4.9		4.9		4.9		4.0		0.9		5.0		7.4		-2.6	
2008-13			5.2		5.2		3.7		1.5		5.7		4.9		0.8	
2008-16			5.1		5.1		3.4		1.7		5.7		4.5		1.1	
2002-06	5.0		5.0		4.9		3.8		1.1		4.8		9.7		-5.0	
2007-11	4.1		4.9		5.0		3.3		1.6		5.4		2.9		2.5	
2012-16			5.1		5.1		3.6		1.5		5.6		4.7		1.0	
2007-16			5.0		5.0		3.4		1.6		5.5		3.8		1.7	

f BIS Shrapnel forecast, except for Access Economics AWOTE forecast

Source: BIS Shrapnel, ABS data

(1) Average weekly ordinary time earnings for persons
(2) Nominal wage excluding productivity
(3) Forecasts from BIS Shrapnel. Actuals to 2006 from National Accounts and Labour Force data

labour to maintain reliability of supply. The network upgrades, maintenance and other routine activity in the utilities sector cannot be postponed until labour costs fall, or labour shortages ease.

Finally, as discussed in section 3 of this report, BIS Shrapnel believes the most appropriate wage measure which should be used is the average weekly ordinary time earnings (AWOTE) measure. The reasons are set out in section 3. Accordingly, we have extended the AWOTE analysis to 2015/16 for both the national (all industries) and utilities sector (see table 5.3). A comparison of AE's forecast for the national wage (to 2010/11 only) is also shown in table 5.3).

Table 5.4
Gross Value Added and Employment
Electricity, Gas and Water, Mining and Construction Sectors – Australia

Year Ended	Electricity, Gas & Water				Mining				Construction				Sub-total of 3 Sectors			
	GVA		Employment		GVA		Employment		GVA		Employment		GVA		Employment	
June	$m	A%Ch	'000	A%Ch	$m	A%Ch	'000	A%Ch	$m	A%Ch	'000	A%Ch	$m	A%Ch	'000	A%Ch
1985	13399		136.5		20584		94.1		27076		470.7		61059		701.3	
1986	13914	3.8	144.1	5.6	22745	10.5	105.8	12.5	28598	5.6	477.7	1.5	65257	6.9	727.7	3.8
1987	14227	2.2	133.0	-7.7	21323	-6.3	101.1	-4.5	27742	-3.0	503.7	5.4	63292	-3.0	737.8	1.4
1988	14923	4.9	124.2	-6.6	25137	17.9	97.7	-3.3	29942	7.9	507.8	0.8	70002	10.6	729.7	-1.1
1989	15592	4.5	119.3	-4.0	26388	5.0	98.0	0.3	32993	10.2	571.3	12.5	74973	7.1	788.5	8.1
1990	16347	4.8	108.7	-8.9	29036	10.0	103.9	6.0	33749	2.3	603.3	5.6	79132	5.5	815.9	3.5
1991	16609	1.6	103.4	-4.9	30687	5.7	95.1	-8.5	31552	-6.5	575.0	-4.7	78848	-0.4	773.5	-5.2
1992	16752	0.9	106.2	2.8	32090	4.6	89.7	-5.7	28928	-8.3	519.4	-9.7	77770	-1.4	715.4	-7.5
1993	17044	1.7	97.6	-8.1	32410	1.0	86.8	-3.3	30633	5.9	535.1	3.0	80087	3.0	719.5	0.6
1994	17584	3.2	92.2	-5.5	32975	1.7	89.4	3.0	32521	6.2	559.7	4.6	83080	3.7	741.3	3.0
1995	18032	2.5	86.8	-5.9	35337	7.2	86.1	-3.7	34304	5.5	591.4	5.7	87673	5.5	764.3	3.1
1996	18273	1.3	80.6	-7.1	38276	8.3	85.0	-1.3	34828	1.5	602.4	1.9	91377	4.2	768.0	0.5
1997	18213	-0.3	66.5	-17.6	38786	1.3	86.3	1.4	35712	2.5	587.9	-2.4	92711	1.5	740.6	-3.6
1998	18857	3.5	64.5	-3.0	40156	3.5	82.8	-4.0	39314	10.1	598.7	1.8	98327	6.1	745.9	0.7
1999	19164	1.6	64.9	0.6	40022	-0.3	80.0	-3.3	42848	9.0	632.4	5.6	102034	3.8	777.3	4.2
2000	19539	2.0	64.2	-1.0	42468	6.1	77.9	-2.7	45488	6.2	687.1	8.6	107495	5.4	829.2	6.7
2001	19840	1.5	65.4	1.8	45704	7.6	78.5	0.8	39106	-14.0	670.1	-2.5	104650	-2.6	814.0	-1.8
2002	19690	-0.8	67.3	2.9	45735	0.1	81.2	3.4	43776	11.9	694.6	3.7	109201	4.3	843.0	3.6
2003	19867	0.9	72.5	7.8	45596	-0.3	88.2	8.7	50974	16.4	718.2	3.4	116437	6.6	878.9	4.3
2004	20000	0.7	75.0	3.4	43949	-3.6	88.2	0.0	54353	6.6	776.7	8.2	118302	1.6	939.9	6.9
2005	20146	0.7	76.5	2.1	46152	5.0	106.4	20.6	56941	4.8	837.3	7.8	123239	4.2	1020.3	8.5
2006	20471	1.6	87.2	13.9	45038	-2.4	129.6	21.9	62277	9.4	876.3	4.7	127786	3.7	1093.1	7.1
Forecasts																
2007	21170	3.4	83.9	-3.8	49000	8.8	136.9	5.6	64920	4.2	938.4	7.1	135090	5.7	1159.2	6.1
2008	21660	2.3	86.2	2.8	53700	9.6	139.7	2.0	63690	-1.9	917.9	-2.2	139050	2.9	1143.9	-1.3
2009	22030	1.7	86.3	0.1	58320	8.6	141.2	1.0	61710	-3.1	893.8	-2.6	142060	2.2	1121.3	-2.0
2010	22430	1.8	85.3	-1.1	61000	4.6	137.4	-2.7	63060	2.2	903.4	1.1	146490	3.1	1126.1	0.4
2011	22790	1.6	85.8	0.6	63500	4.1	136.8	-0.4	65660	4.1	936.0	3.6	151950	3.7	1158.7	2.9
2012	23130	1.5	88.0	2.5	66040	4.0	136.8	0.0	66870	1.8	955.2	2.0	156040	2.7	1180.0	1.8
2013	23410	1.2	88.2	0.2	68290	3.4	134.8	-1.5	67700	1.2	978.8	2.5	159400	2.2	1201.7	1.8
2014	23740	1.4	87.5	-0.8	71430	4.6	134.9	0.1	68000	0.4	973.4	-0.6	163170	2.4	1195.8	-0.5
2015	24240	2.1	88.0	0.6	75720	6.0	138.1	2.4	68250	0.4	971.1	-0.2	168210	3.1	1197.3	0.1
2016	24770	2.2	88.9	1.0	79130	4.5	139.4	0.9	71630	5.0	997.3	2.7	175530	4.4	1225.5	2.4
Compound Annual Average Growth Rates																
1985-2006	2.0		-2.1		3.8		1.5		4.0		3.0		3.6		2.1	
1991-2000	1.8		-5.1		3.9		-2.8		3.0		1.3		3.1		0.2	
2001-2006	0.8		5.2		1.0		8.9		5.4		4.1		2.9		4.7	
2007-2016	3.2		0.3		9.8		1.2		2.4		2.2		5.4		1.9	

e: estimate

Source: BIS Shrapnel, ABS Data