ANNUAL POWER SYSTEM REVIEW

DECEMBER 2005

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Disclaimer

This review is based upon information received from participants in the Territory's electricity supply industry, and agencies within government on a 'reasonable endeavours' basis. The information on which the review is based is current as at 31 December 2005.

The review contains certain predictions, estimates and statements that reflect various assumptions concerning load growth forecasts including accounting for major developments which may impact on the Territory's power system over the period to 2014-15. The Commission believes that the contents are accurate within the normal tolerance of economic forecasts and that the broad analyses are correct.

The purpose of this document is to review and report to the Minister in accordance with section 45 of the Electricity Reform Act 2000. It is not intended to be relied upon or used for other purposes, such as making decisions to invest in further generation or network capacity. Any person proposing to use the information in this document for such other purposes should independently verify the accuracy, completeness, reliability and suitability of the information in this document, and the reports and other information relied upon by the Commission in preparing it. The Commission and its officers accept no liability (including liability to any person by reason of negligence) for any use of the information in this document or for any loss, damage, cost or expense incurred or arising by reason of any error, negligent act, omission or misrepresentation in the information in this document or otherwise.

CHAPTER 1

INTRODUCTION

1.1 The Power System Review is published annually by the Commission in response to the requirements of section 45 of the *Electricity Reform Act 2000* ("the Reform Act").

1.2 Section 45 of the Reform Act requires the Commission to:

- develop forecasts of overall electricity load and generating capacity in consultation with participants in the electricity supply industry and report the forecasts to the Minister and electricity entities;
- review and report to the Minister on the performance of the Territory's power system;
- advise the Minister on matters relating to the future capacity and reliability of the Territory's power system relative to forecast load;
- advise the Minister, either on its own initiative or at the request of the Minister, on other electricity supply industry and market policy matters; and
- submit to the Minister, and publish, an annual review of the prospective trends in the capacity and reliability of the Territory's power system relative to projected load growth.

1.3 In last year's review, the Commission noted that, while the scope of section 45 of the Act covers the Territory's power system as a whole (and so both generation and network elements of the system), previous reviews had focused mainly on generation reliability. The Commission recognised the importance of network adequacy to the reliability of supply, and undertook to include an assessment of this component of the Territory's power system in the 2005 Review.

1.4 As the Commission commented at the time, measuring and managing adequacy is more complex for a network than for generating capacity. In the event, consideration of this issue by the Commission has raised broader questions regarding the management, development and performance of the Territory's power system.

1.5 The Commission has therefore taken the opportunity provided by the 2005 Review to include an assessment of the arrangements under which power system reliability is addressed in the Northern Territory. This assessment and the Commission's conclusions form Part 1 of the Review. In Part 2, the Commission presents its review of prospective demand and supply conditions for the generation sector.

Consultation with interested parties

1.6 The Commission has again consulted with various parties, including participants in the Territory's electricity supply industry and agencies within Government. This report has benefited significantly from the comments received from parties consulted by the Commission, although the views expressed in the report are those of the Commission alone and are not necessarily those of the parties consulted.

Inquiries

1.7 Inquiries regarding the 2005 Review should be directed in the first instance to:

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PART 1
POWER SYSTEM PLANNING AND RELIABILITY

CHAPTER 2

PART 1 - SUMMARY OF KEY FINDINGS

2.1 A reliable and efficient supply of electricity is essential to the 21st century economy and the way of life that it supports. The reliability of supply is an outcome of the standards and processes by which the power system is operated, planned and developed.

2.2 For all practical purposes, power system planning and reliability (including that for transmission and distribution networks) continues to be managed – as it had been prior to the market reforms of 2000 – as an internal matter by Power and Water.

2.3 This is inconsistent with generally accepted industry practice. Among a number of disadvantages, it blurs the distinction between commercial interests and the public interest, makes the planning and investment process opaque and increases the risk that investment decisions may be sub-optimal from a power system perspective.

2.4 While acknowledging that Power and Water may have achieved relatively good system reliability outcomes to date in a harsh environment (as evidenced in the most recent industry statistics), the Commission is not in a position to provide an assessment of the *prospective* capacity and reliability of the power system as a whole in the Territory (including that for transmission and distribution networks) while differences with industry practice in other jurisdictions continue.

CHAPTER

3

DIMENSIONS OF POWER SYSTEM RELIABILITY

The electrical power system

3.1 Electricity is essential to the 21st century economy and the way of life that it supports. Electricity, and the electrical power system through which it is supplied, provides cooling, lighting, power to drive electric motors in thousands of domestic and industrial applications and the energy source for computers, control systems and communications across society.

3.2 Like many essential services, the importance of electricity tends to be appreciated most when its availability is called into question. When the supply of electricity is interrupted, a wide range of everyday activities in the home, in industry and across the community are at best severely reduced and at worst stop altogether.

3.3 The potential costs of failures in supply, in terms of reduced safety and security and the level of disruption to individuals and organisations are substantial. Future incomes may be affected if supply interruptions become a continuing problem leading to a loss of investment and a lowering of economic growth. As society and the economy become more reliant on technology powered by electricity, the costs of supply interruptions can be expected to increase. Reliability of supply is therefore an important matter of public policy for governments.

3.4 The purpose of the electrical power system is to make electricity available when it is required and where it is required, economically and efficiently. This means anticipating and providing for future demand as well as meeting current demand. The performance of the power system is measured by how well it is managed to meet current demand and how it is developed and expanded to meet future demand.

3.5 A power system developed to supply electricity at the standard required by a modern economy is a complex piece of equipment made up of many different parts. The power system takes a primary source of energy, such as gas or diesel, converts it via the process of electricity generation into just the right amount of electrical energy required by customers (and the system itself) and then transports this via a network of high voltage transmission cables and low voltage distribution lines to the houses, offices, factories, mines, etc. of customers.

3.6 The two main components of a power system are the generating units in which electricity is produced, and the transmission and distribution network over which electricity is transported to the locations at which it is finally consumed. The performance of each is critical to meeting the requirements of customers for a reliable supply of electricity at an acceptable standard of quality.

Power system control and planning

3.7 A key feature of electricity is that it is uneconomic to store in large amounts. As a result, with few exceptions power systems are required to produce and deliver

electricity at the instant it is required by customers. The amount of electricity generated in power stations and transported over the transmission and distribution network must follow the demand placed on the system by customers minute-by-minute. If not, the quality will suffer causing reduced performance or damage to customers' electrical appliances and equipment.

3.8 This has two important consequences. First, the power system must be closely and continually supervised to ensure that it remains within its physical performance limits, given the fluctuating demands placed upon it by customers. Secondly, there must be enough capacity available in the system to meet the maximum demand placed upon it by customers at any particular instant. Availability must allow for capacity that is temporarily out of service due to maintenance work, which may either be planned or, in the event of an equipment failure, unplanned. This applies equally to generating units and the main transmission and distribution network elements.

3.9 Supervising the power system to ensure that it remains safe and secure by operating within its performance limits is a critical function. This is known as *system control*. It involves managing the amount of quick-response generating capacity that is available to meet sudden increases in demand (due to unseasonably hot weather for example), coordinating maintenance work on generating and network elements and, should demand exceed available capacity for some reason, managing the reduction in customers' demand (load shedding) to restore system balance.

3.10 Deciding how much capacity is needed to meet demand is a difficult task. For example, daily fluctuations in weather can lead to spikes in demand. In the medium term, variations in economic conditions will affect the rate of growth in demand. Since it takes time to add new capacity (which could be several years in the case of larger generating units or transmission lines), the calculation of how much capacity is required on the system must include an allowance for the increase in demand during the construction of new capacity. However, capacity that is rarely used adds to costs. Managing the power system therefore requires assessments of risk, uncertainties and the probability of disruptive 'system contingencies'.

3.11 Over the longer term, the power system must respond to changes in the level and location of demand. Decisions are required on what and where new generating, transmission and distribution capacity is needed to meet customer demands and maintain quality standards. Often these decisions have the potential to affect costs and performance unevenly across the system, and so require central coordination to achieve the accepted technical and economic standards. Managing and coordinating the development and expansion of the system so that it continues to meet customer demands in the future is known as ***power system planning***.

Power system reliability

3.12 Two aspects of a power system's ***reliability*** can be distinguished:[1]

- ***adequacy***, which is the power system's ability to supply the aggregate energy requirements of end-use customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements; and
- ***security***, which is the power system's ability to withstand sudden disturbances such as electric short circuits or unanticipated loss of system elements.

3.13 Adequacy is a matter of installed generating capacity, contracted fuel supply and network infrastructure capable of delivering generated electricity to the customer's point of connection. Adequacy does not fluctuate from minute to minute. Security refers

[1] This distinction is based on the North American Electric Reliability Council's (NERC) 1996 glossary of terms, cited in Steven Stoft, *Power System Economics*, IEEE Press, New Jersey, 2002, p.135.

to the system's ability to withstand contingencies,[2] and system security can change from minute to minute. Immediately after a contingency, the system is much less secure.

3.14 A key determinant of the adequacy of power system capacity is what is termed the ***planning reserves*** of the power system. These are the reserves required to meet the highest demand expected on the system, including the expected increase in maximum demand during the period of time it takes to add new capacity to the system. This contrasts with ***operating reserves***, which are required to maintain system security by handling short-term disturbances to the system.[3]

3.15 Although security and adequacy are distinct concepts, they are closely linked. A system with adequate capacity can maintain enough security to reduce periods of involuntary load shedding to, say, a total of 1 day in 10 years. A system that maintains security for all but one day in 10 years can be said to have adequate installed capacity. Nevertheless, the two aspects of reliability are not simply different views of the same problem. With an inappropriate policy on operating reserves, the system will have insufficient security in spite of adequate capacity.

What determines reliability?

3.16 In theory, it is possible to design and construct a power system to deliver 100% reliability. It would require the very best quality equipment, combined with enough capacity held in reserve to cover all possible failures and contingencies. The problem is that such a system would be so expensive that very few customers would be able to afford the cost of the electricity produced.

3.17 Reliability, therefore, has a cost, and one of the primary determinants of the reliability of supply is the position that the community takes on the economic problem of balancing risk (of loss of supply) against cost. The process by which the trade-off implicit in this somewhat vague concept is translated into a set of technical parameters and performance standards for operating, maintaining and developing the power system is a key issue of public policy.

3.18 While there are similarities in the factors that influence the reliability of generation on the one hand and the transmission and distribution network on the other, measuring and managing the reliability of electricity networks is more complex and less clear-cut.

3.19 Both require back-up reserve capacity to cover routine maintenance outages, equipment failures and to meet peaks in demand. A decision is therefore required on how much reserve capacity is needed to meet customers' and the community's reliability expectations, bearing in mind the cost involved.

3.20 If equipment is poorly maintained, the risk of failure will increase. Therefore, the amount of reserve that is necessary to meet the required level of reliability is influenced by the maintenance standards applied.

3.21 As demand increases, new generation and network capacity will be required to maintain reserves at the level considered necessary to meet the reliability performance standard. Decisions will be required on what type and amount of new capacity is needed and where it should be located. Coordination will be necessary to ensure that the transmission network can accommodate additions to generating capacity. For both generation and networks, ensuring that the right amount of new

[2] A contingency is a possible or actual breakdown of a physical component of the power system. Typically, a generation unit becomes unavailable, leaving the system unbalanced with demand greater than supply. System frequency and voltage drop as a consequence, and the system controller may need to shed load.

[3] Operating reserves include spinning reserves.

capacity to maintain adequate reserve margins is brought into service when and where required is critical to maintaining reliability. The process by which this occurs is therefore a primary influence on reliability.

3.22 Generators are usually large, standalone items of equipment that produce a uniform output (bulk electricity) and can be added in separate 'lumps' of capacity. With some exceptions, the adequacy of generation capacity is relatively simply expressed by comparing supply capacity with maximum demand (actual or expected). Once the reserve margin falls below a reliability-based critical level, additional capacity is required.

3.23 By contrast, the network is made up of many elements of varying sizes that supply a service to customers that varies both by volume and location. When there is a shortfall in generating capacity, it affects the level of supply to the total system. A large number of customers may be affected, and the security of the system itself may be put at risk. When there is a shortfall in the capacity of a network element, it usually affects only those customers that are connected to it. However, for the customers concerned, the consequences are the same.

3.24 Network service is delivered through an integrated system of network elements with a design aspect (topology), hierarchy and spatial dimension. Depending on network configuration, reliability may be dependent on single network elements, such as high voltage transmission and distribution lines, transformers and substations, or shared across several elements where the network is meshed. As a result, unlike generation, assessments of network adequacy are not reducible to aggregate measures of supply/demand balance that are easily monitored or projected forward. At this level of detail, assessments of risk and the analysis of options for reliably meeting demand are necessarily more technical and asset-specific.

3.25 As a result, the task of measuring and managing network adequacy to ensure that the performance of the network meets the requirements of customers and the community now and in the future is more complex.

Reliability operating and planning standards

3.26 The objective of power system reliability is to supply customer load with a ***defined level of certainty***. Reliability operating and planning standards are derived from an analysis of the sources of uncertainty that place customer load at risk, the level of risk involved and the aspects of power system design, capacity and operation that mitigate the risk.

3.27 This is a complex analysis. However, in broad terms there are two sources of uncertainty that place customer load at risk – equipment failure and the variability of aggregate demand. Either event may cause demand on the system to exceed supply capability, requiring reserve capacity to be brought into service if supply is to be maintained. The question for power system operators and planners is what level and type of reserve capacity to provide.

3.28 The analysis of generation reserve levels begins with the determination of a target level of reliability for generation capacity. This is usually expressed as the percentage of total energy required by customers in a year that cannot be provided due to generating equipment failure – known as ***unserved energy***, or USE. System modelling is used to determine the level of generating reserves required to satisfy the USE standard. Alternatively, in small systems, the reliability standard may be expressed in terms of the loss of existing generation equipment that can be sustained without interrupting supply. For example, a level of reserve that is equal to or greater than the largest single unit of generation capacity is known as an ***N-1*** reserve capability.

3.29 The uncertainty of aggregate demand may be allowed for by combining a forecast of expected load with the estimated probability distribution for increases in

load above the forecast, or alternatively through the use of a range of demand scenarios. In either case, it is necessary to make an assessment of the probability of uncertain future levels of demand. While statistical analysis is helpful, ultimately the assessment of future demand is based on informed judgment.

3.30 The combination of demand forecasts and reliability-based generating reserve requirements allows system adequacy assessment exercises to be undertaken.

3.31 Network reliability planning standards are primarily expressed through:

- the methodology used to set reserve capacity levels;
- the reserve capacity standard applied to network asset categories;
- the extent of asset-specific load forecasting; and
- the allowance made for variability in demand.

3.32 Unlike the generation sector, there are no single measures of network reserve capacity that can be derived from a target for unserved energy. Because networks are made up of many interconnected elements, there is frequently more than one physical route by which customers can be supplied. The assessment of reserve capacity available to maintain supply following the loss of an individual network element is therefore complex, and may vary with assumptions made regarding conditions elsewhere on the network.

3.33 Supply is delivered via a sequence of progressively smaller and more local network elements. While higher order elements affect more customers, reliability for an individual customer is dependent upon all the network elements that link the customer to the source of generation.

3.34 Network planners have developed two broad methods for assessing the level of reserve capacity required for network elements – the probabilistic Reliability Assessment Planning method and the deterministic N-x approach.[4]

3.35 ***Reliability Assessment Planning*** (RAP) is based on the assumption that the network is designed to meet a system peak that is only a few hours long, with the probability of a fault during this peak being very small. The RAP methodology allows network equipment to be overloaded for short periods while load transfers are arranged, following a breakdown of a piece of network equipment. It tends to lead to higher levels of capacity utilisation but, as the Queensland experience demonstrates, this may come at the expense of reduced reliability.

3.36 The deterministic N-x method is simpler to apply and its consequences for reliability clearer. For example, the loss a piece of equipment rated N-1 would not lead to a loss of supply.

3.37 The ***N-x planning standard*** applied to network asset categories will naturally heavily influence the level of network reliability. For example, a network designed to deliver N-2 for large assets, N-1 for intermediate assets and N for the remainder will provide a high level of reliability, but at the cost of a relatively high proportion of rarely used capacity.

3.38 To be reliable, individual network elements must also have sufficient capacity to allow for expected demand and the variability in demand. How far downstream in the network the assessment of asset loading extends will influence the level of reliability that is planned for. Network planning requires forecasts at a local level – bottom-up forecasts – as well as system-wide, or top-down, forecasts. Bottom-up forecasts allow the ***expected loading*** on individual elements to be assessed.

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[4] This discussion uses material taken from the report of Queensland's Independent Panel for Electricity Distribution and Service Delivery for the 21st Century, July 2004 (the Sommerville inquiry).

3.39 For any given forecast of expected load at a point in the network derived from an assessment of economic and demographic factors, weather conditions will be a primary determinant of the possibility that the forecast may be exceeded. The variability in demand due to weather is expressed in terms of the probability that average daily temperatures will be exceeded (the ***probability of exceedance*** (PoE)). For example:

- a PoE 10 planning assumption involves investing in sufficient system capacity to cope with a daily mean temperature that occurs only one in every ten years; and
- a PoE 50 planning assumption involves investing in sufficient system capacity to cope with a daily mean temperature that occurs only one in every two years.

CHAPTER

4

POWER SYSTEM PLANNING AND RELIABILITY IN OTHER JURISDICTIONS

Reliability in the NEM

4.1 Reliability in the NEM is addressed through a combination of national and State-based regulatory and institutional arrangements. The primary components are:

- a special-purpose national body (the market and system operator) with responsibility for power system coordination and security, operation of the wholesale electricity market, facilitation of system development to meet expected growth in demand and the provision of advice and information on the status and performance of the power system;
- mandatory requirements for network management, planning and investment, made transparent by disclosure and reporting obligations, and applied through national rules, State-based codes of practice and government regulations, enforced by statutory or licence obligations; and
- performance-based financial incentives for network service, expressed either as variations in the allowed level of network charges or penalties linked to minimum reliability standards.

The market and system operator

4.2 The market and system operator – the National Electricity Market Management Company (NEMMCO) – plays a critical role in meeting government requirements for the safety, security and reliability of the power system under the NEM. Although there are also important differences, NEMMCO fulfils many of the functions that, pre-market, were known as system control, with its focus on minute-by-minute coordination and supervision of the power system, and system planning, with its focus on the future performance of the power system.

4.3 In keeping with these responsibilities, NEMMCO has broad powers regarding the operation of the power system and the participation by generators and networks in power system planning.

4.4 NEMMCO publishes an annual Statement of Opportunities and the Annual National Transmission Statement, which focus on the capacity of the NEM system to meet forecast load and power transfer requirements over a 10-year time horizon. These documents identify investment needs or opportunities in both generation and transmission and inform coordinated power system planning. Reliability standards are set by an independent Reliability Panel on which the participating jurisdictions are represented.

4.5 NEMMCO facilitates, but cannot direct, development of the power system. Investment in new capacity is undertaken by market participants on a commercial basis. NEMMCO's role is to facilitate efficient investment by providing information to the market and, if necessary, proposing changes to the market processes to improve its

functioning. Nevertheless, the central role given to NEMMCO by governments is illustrated by its reserve trading powers. If a shortfall in reserve generating capacity appears imminent – because the market fails to bring forward sufficient reserve capacity – NEMMCO has the power to contract directly for additional supply or demand-side response. In effect, to protect the reliability of the system, NEMMCO has the role of last resort acquirer of reserve generation capacity.[5]

4.6 NEMMCO's central role in the supervision of the power system and administration of the market requires independence and an absence of commercial conflicts. NEMMCO is carefully structured as a not-for-profit incorporated company owned by the participating state governments, who appoint the governing board. Funded by fees levied on market participants, it has a clear operating charter, well defined powers matched to its functions, and extensive consultation and reporting responsibilities.

Network management, planning and investment

4.7 The approach taken in the NEM to network reliability is shaped by two main considerations – the cost/service trade-off implicit in the form of regulation applied to network charges, and the more complex nature of network reliability itself.

4.8 Network service is a natural monopoly that in the NEM is provided on a commercial basis. Network charges are subject to incentive-based regulation. As an efficiency incentive network providers are able to retain the benefit of any reduction in costs.[6] But costs may also be reduced at the expense of service levels, including the level of reliability.

4.9 To counteract this possibility, the use of additional financial incentives linked to service performance is becoming more common. However, reflecting both the importance of network reliability and its complexity, governments have adopted a more direct approach that focuses on the methods used by network providers to manage, plan and develop their networks.

4.10 Network management, planning and investment are centrally regulated by the National Electricity Rules, and at State level:

- national rules (duplicated in some instances by State rules) require transmission network providers to monitor and report on the performance of their networks, prepare development plans to meet expected growth in demand and relieve potential network constraints, participate in system planning exercises under the direction of NEMMCO and submit all major network development proposals to independent economic evaluation; and
- a combination of national and State rules require distribution network providers to monitor and report on the performance of their networks, document their planning methodologies for meeting reliability and performance targets, prepare development plans to meet expected growth in demand and co-operate with transmission network service providers in joint network planning exercises.

National Electricity Rules

4.11 Section 5.6 of the National Electricity Rules (NER), Planning and Development of Networks, imposes requirements on transmission and distribution network providers to:

[5] NEMMCO has notified market participants that it will be seeking additional reserve capacity under its reserve trader powers to cover a potential shortfall in South Australia and Victoria in the summer months of 2005-06.

[6] At least until the next regulatory price reset.

- analyse the future operation of their networks, taking expected load growth and any other relevant data into account, covering a period of 10 years for transmission networks and 5 years for distribution networks;
- conduct and publish an annual planning review, including a review of the adequacy of existing capacity and proposals for new capacity; and
- follow specified procedures regarding the establishment of transmission assets, including application of the Australian Energy Regulator's regulatory test.

State-based codes and regulations

4.12 In ***Victoria***, sub-transmission and distribution networks are the subject of the Electricity Distribution Code, prepared by government and administered by the Essential Services Commission (ESC).

4.13 The Code requires network providers to:

- annually submit planning reports to the ESC detailing how they plan to meet predicted demand for electricity supplied through transmission connections, sub-transmission lines, zone substations and high voltage lines over the next 5 years for distribution and 10 years for transmission, and improve reliability;
- provide historical and forecast demand for each transmission connection and zone substation;
- assess the probability of loss of load at each transmission connection, sub-transmission line and zone substation over the next 10/15 years;
- describe the feasible options for meeting predicted unserved demand at each major network element, including embedded generation and demand management, the preferred options and the costs involved;
- describe the reliability improvement programs planned or in place; and
- evaluate the reliability improvement programs in place in the previous year.

4.14 The focus of these reports is primarily quantitative and asset-specific. They allow ESC to closely track network capacity, and provide transparency to the investment decision-making process. In addition, ESC makes direct information requests to distribution network providers prior to the summer peak each year regarding their capacity to meet expected loads. Responses are summarised to identify possible issues and provided to the Commissioners, but not published.

4.15 In January 2005, the ***Queensland*** government introduced an Electricity Industry Code, following recommendations from the Somerville inquiry into the performance of the State's two distribution network providers Energex and Ergon. The Code:

- requires the preparation of annual network management plans;
- sets minimum distribution service standards;
- sets guaranteed service levels for non-contestable customers; and
- sets reporting requirements.

4.16 In their annual network management plans, network providers are required to:

- describe how they plan to manage and develop the network to deliver an adequate, economic, safe and reliable connection and supply of electricity over the next 5 years;
- describe the operating environment and growth forecasts;
- set out their planning policies and assess compliance;

- set out their asset management policies, including key programs, and assess compliance;
- provide an analysis of reliability performance over the last 5 years and set targets for the next 5 years;
- set out major existing and planned reliability improvement programs, and capital, operating and maintenance expenditure initiatives;
- evaluate performance in the previous year against the management plan;
- provide a risk assessment of major constraints and options; and
- provide an analysis of the worst performing feeders.

4.17 Annual plans are submitted to the economic regulator, the Queensland Competition Authority, which may request amendments. Energex's first plan, to 2009-10, was released in July 2005.

4.18 In ***New South Wales***, planning and reporting requirements are set by government regulations, administered by the Department of Energy, Utilities and Sustainability (DEUS), rather than by an industry code of practice. The *Electricity Supply (Safety and Network Management) Regulation 2002* requires network providers to prepare annual network management plans, and to measure and report on network performance.

4.19 The purpose of the plans is to ensure that the network provides a safe and reliable supply of electricity of appropriate quality. The pro forma requirements are primarily directed at the documentation of processes and methodologies used in network planning and operation. The resulting plans are submitted to DEUS and published.

4.20 In ***South Australia***, the Electricity Supply Industry Planning Council was established in 1999 to provide expert, independent advice to the South Australian government and the economic regulator, the Essential Services Commission of SA (ESCOSA), on the state of the power system. Its board has two independent members and three representatives of the generation, transmission and distribution sectors.

4.21 The Planning Council prepares an Annual Planning Report for the government and the regulator on the performance of the power system and its future capacity and reliability looking ahead 10 years. The transmission and distribution network providers, ElectraNet SA and ETSA Utilities, are required to provide performance and planning data for inclusion in this report.

4.22 ElectraNET SA and ETSA Utilities develop forecasts of demand at each connection point on the transmission system and from this prepare plans for network augmentation, which are published and reviewed by the Planning Council. Network provision is subject to an Electricity Transmission Code and an Electricity Distribution Code. The Transmission Code sets reliability criteria (N-1 and N-2) for specific asset categories.

4.23 Arrangements in ***Tasmania*** have recently changed, following the State's entry into the NEM in May 2005. The transmission network provider is now required, as a licence condition, to prepare a Tasmanian Annual Planning Statement (TAPS). The content and timing of the TAPS is determined by the economic regulator, the Office of the Tasmanian Energy Regulator (OTTER). OTTER has proposed that the statement will provide information on:

- the performance of the existing transmission system and generating systems;
- power transfer capabilities within the transmission network;
- the adequacy of the transmission system and available generating systems to meet the forecast power transfer and forecast load over a 10 year period;

- the existence of transmission constraints; and
- the adequacy of ancillary services to meet forecast requirements over a 10 year period.

4.24 The Tasmanian Electricity Code also requires distribution network providers to prepare and submit to the regulator an annual Distribution System Planning Report, detailing how they plan to meet predicted demand over the following 5 years for sub-transmission lines, zone substations and high voltage lines and how they plan to improve reliability. The report includes forecasts of load, assessments of capacity and load at risk, planning standards, feasible options for meeting forecast demand and details on preferred options.

CHAPTER

5

POWER SYSTEM PLANNING AND RELIABILITY IN THE NT MARKET

The broad regulatory framework

5.1 The electricity industry in the Territory operates within regulatory and institutional arrangements principally determined by the provisions of the *Electricity Reform Act* (Reform Act) and the *Electricity Networks (Third Part Access) Act* (Networks Act). The legislation provides for competition in the generation and supply of electricity to contestable end-use customers, supervised by an economic regulator – the Utilities Commission.

5.2 Four industry activities are recognised – electricity generation, electricity trading and retail sales, network operation and system control. Each activity requires a licence, issued by the Commission. Electricity is traded between market participants on a bilateral basis, which creates a requirement for residual energy balancing in the event that aggregate physical transfers into and out of the power system do not match. Network access conditions are regulated by an Access Code, which forms a schedule to the Networks Act.

5.3 Power system planning and reliability are addressed in three separate parts of the regulatory framework:

- under the Reform Act, power system reliability, safety and security, including energy balancing, are the responsibility of the System Controller; supervision of the power system takes place under the provisions of a technical code developed by the System Controller and approved by the Commission;
- the Access Code places an obligation on network providers to plan and develop their networks according to good electricity industry practice; the Commission is responsible for enforcing compliance with the Access Code; and
- the Reform Act gives the Commission overall responsibility for advising the Regulatory Minister on the performance of the power system and its capacity to reliably meet supply requirements into the future.

System control and energy balancing

5.4 Under section 38 of the Reform Act, the System Controller has the function of monitoring and controlling the operation of the power system with the purpose of ensuring that the system operates reliably, safely and securely. The System Controller is to carry out its functions in accordance with a technical code prepared by the System Controller and approved by the Commission.

5.5 The System Control Technical Code[7] is the principal regulatory instrument for ensuring that the power system is operated in a reliable, safe and secure manner. It

[7] System Control Technical Code, Version 1.0, 1 July 2002

sets out the responsibilities, functions and powers of the System Controller and the obligations of system participants – licensed generators, network operators and retailers.

5.6 The Technical Code defines power system reliability to include:[8]

- generation – the availability of fuel supply, generating plant and stand-by plant;
- network – adequate transmission capacity to meet reasonably foreseeable future customer demand, and a contingency path to allow the credible outage of N-1; and
- adequate fast acting reactive power capability.

5.7 The Technical Code states[9] that the fundamental responsibility of System Control is to provide power system security by ensuring that:

- there is adequate reserve capacity above the capacity required to meet expected customer demand; and
- the power network is able to withstand the unexpected loss of one generating unit or item of transmission equipment.

5.8 System Control has responsibility for developing Secure System Guidelines[10], which set the criteria for determining whether the above conditions are met. In setting the criteria, System Control is required to take into account government policy, historic levels of reliability and costs and benefits.[11]

5.9 The Technical Code defines the scope of System Control's responsibilities in relation to network reliability to include detailed design issues. Specifically, System Control is responsible for ensuring that high voltage busbar and feeder configurations are arranged to provide optimum system security.[12]

5.10 The time frame over which System Control's reliability responsibilities apply is indicated by the requirement for it to undertake medium and short-term load forecasts.[13] It would be reasonable to interpret medium term in this context as a reference to the standard two year horizon for medium-term system adequacy exercises.

Energy balancing

5.11 The NT power market is designed as a bilateral contracting market in which network users – the sellers and buyers who transport electricity over the network – are required to keep their physical inputs to and off-takes from the power system in balance. System Control is responsible for monitoring contract positions and physical flows, and for maintaining power system stability when the amount of electricity generated does not match the market demand.[14] It does this by operating a market in out-of-balance energy – the amounts of energy added to or withdrawn from the system to keep it in balance – based on 'buy' and 'sell' bids from generators.

5.12 In line with its responsibilities for managing the interface between the contract market and the power system, System Control is also referred to as the Market Operator for the Territory.

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[8] s. 3.3.2

[9] s. 3.3.5 (f)

[10] s. 3.5

[11] s. 3.5.4

[12] s. 2.8

[13] s. 2.16

[14] ss. 5.7, 5.8, 5.9

Current arrangements

5.13 Power and Water is licensed as the System Controller in the Territory. Power and Water Networks, its network business arm, is also the licensed network provider. Following the exit of the NT Power Group from the market in 2002, Power and Water also has been the sole market generator and trader/retailer. Power and Water therefore contains both the System Control function and commercial activities that are the subject of System Control's supervisory and regulatory responsibilities.

5.14 In anticipation of the potential for conflict of interest between the System Controller's supervisory and regulatory responsibilities and Power and Water's commercial activities, the Reform Act provides for the Commission to include a condition in the system control licence requiring the separation of system control from generation.[15] In the current licence the requirement for business separation is defined in terms of compliance with the Commission's Ring-Fencing Code. (However, it should be noted that the Code's main purpose is to support the regulation of market power, in relation to network services in particular, rather than the management of potential conflicts where regulatory responsibilities and commercial activities are combined within the one organization.[16])

5.15 Within Power and Water, the system control functions are carried out as a departmental management responsibility. System Control reports to the Managing Director alongside the generation and network service groups and other business units. The Commission's understanding is that the Secure System Guidelines, which are intended to set key parameters for system reliability, have not yet been developed.

5.16 As the licensed System Controller, Power and Water is also the Market Operator, responsible for energy balancing and other market-related administrative and supervisory functions. At the present time, the absence of competition in the NT market has removed the need for energy balancing.

System capacity monitoring and planning

5.17 In addition to the operational responsibilities for power system reliability placed on the System Controller, the regulatory framework:

- requires network providers to undertake network planning and development that complies with 'good electricity industry practice';[17] and
- gives the Commission broad responsibility for monitoring power system capacity and reporting on future system capacity relative to forecast load.[18]

Network planning and development – the standard for good industry practice

5.18 The Access Code requires network providers to undertake network planning and development that complies with 'good electricity industry practice'. A reasonable interpretation of 'good electricity industry practice' in this context would be the standard expected of networks operating in the NEM. As described in Chapter 4, network planning in the NEM is subject to quite extensive regulatory oversight. Network providers are required to publish annual network management, planning and investment reports that include:

- descriptions of planning methods and investment criteria;

[15] s. 30 (1) (a). Note that the requirement for separation refers only to generation. No mention is made of networks or trading/retailing, where the potential for conflict also exists.

[16] Northern Territory Electricity Ring-Fencing Code, 1 July 2001. The Code's principal conditions are in relation to accounting separation, cost allocation and information separation.

[17] *Electricity Networks (Third Party Access) Act*, s. 9 (1)

[18] *Electricity Reform Act*, s. 45

- assessments of capacity relative to forecast load for periods of up to 10 years ahead for major network elements; and
- anticipated network constraints and the proposed responses.

5.19 There are requirements for participation in joint planning exercises, and, in some cases, mandatory reliability criteria for particular network assets are specified. Planned network development projects above a threshold size are subject to independent economic evaluation.

5.20 In the majority of NEM jurisdictions, these requirements are imposed directly by government, either through codes of practice or government regulations. Such measures represent one of the principal means by which governments address their public policy objective for reliable network service that is sustained into the future. Administration of the codes, including compliance monitoring, is undertaken by the various jurisdictional regulators.

5.21 The NT regulatory framework, in contrast, goes no further than to set a general requirement for network providers to apply good industry practice in their network planning and development. Responsibility for monitoring and compliance enforcement is given to the Commission, together with the power to 'do what is necessary' to achieve this,[19] but no further guidance is provided on the specific regulatory measures or instruments to be used.

5.22 Currently, the Commission does not actively monitor the planning and development activities of Power and Water Networks.

Reviewing future power system capacity

5.23 Section 45 of the Reform Act gives the Commission responsibility for reviewing the capacity of the power system to meet future load. The Commission is required to review and report on the performance of the power system and provide advice on its future capacity relative to forecast load, including an annual review of prospective trends in power system capacity, load and reliability. Its reporting relationship is principally to the Regulatory Minister, and to market participants and the public more generally.

5.24 While a requirement to forecast generating capacity is specifically referred to, the broader purpose of section 45 clearly is to review the capacity of the power system in total. The scope of section 45 therefore extends to both generation and network service.

5.25 However, the Commission's role is limited to reviewing and reporting. While this assists in informing the market of prospective capacity shortfalls and associated investment opportunities, there is no reference in the legislation to which party, if any, is responsible for ensuring adequacy in the event of market failure.

Assessing future generation adequacy - the Power System Review

5.26 As discussed in Chapter 3, the adequacy of future generating capacity typically is assessed by comparing forecasts of aggregate capacity and load. As a generalisation, capacity is considered adequate if it exceeds the total of maximum forecast load plus operating and planning reserves.

5.27 This is the approach that has been followed by the Commission in its annual Power System Review. Taking a 10-year time horizon, the review uses projections of generating capacity, incorporating retirements of existing capacity and additions of new capacity, provided by Power and Water. These are compared against Power and Water's load forecasts and alternative load growth scenarios developed by the Commission

[19] s. 10, *Electricity Networks (Third Party Access) Act.*

based on long run averages. In effect, the Power System Review looks over the shoulder of Power and Water and provides some transparency to its generation capacity planning.

Network adequacy

5.28 As discussed in Chapter 3, and illustrated in Chapter 4 with reference to the approach taken in the NEM, there are no simple aggregate measures of network adequacy that can be used to indicate future reliability. Rather, prospective network reliability typically is assessed in terms of the management, planning and investment processes used by the network provider to identify and respond to emerging capacity constraints.

5.29 Currently in the Territory, there are no regulatory provisions regarding network management, planning and investment comparable to those in the NEM. As a result, the Commission has no basis on which to form a view regarding the capacity of the network to reliably meet future demand. To the present time, network adequacy has not been included in the Power System Review.

CHAPTER

6

COMPARISON AND ASSESSMENT

6.1 With the commencement of the NEM in 1996, the State jurisdictions in eastern and southern Australia transferred control of their electricity systems to a mix of market-based commercial entities and State and national regulatory agencies.

6.2 Essentially, the Territory has faced the same issues in managing power system safety, security and reliability within a market environment. In broad terms, the approach taken in the Territory has also followed similar lines.

6.3 There are important differences however, both in design and implementation. These principally concern:

- the role, functions and structure of the market and system operator;
- the emphasis placed on network management, planning and investment in NEM jurisdictions;
- the broad range of responsibilities placed on the economic regulator in the Territory; and
- the extent of regulatory discretion.

6.4 The approach taken in the NEM is not necessarily optimal. Most participants would agree that it has limitations and areas of weakness, and is a work in progress. The power systems covered by the NEM are also many times larger than the Territory system. Arrangements that are cost effective for the NEM may not be practical in the Territory. Nevertheless, as the benchmark for generally accepted industry practice in Australia, the NEM provides a valuable point of comparison.

6.5 Perhaps of equal significance in its implications for the Territory is the movement toward consistency in regulatory arrangements that has been accepted in principle by all Australian State and Territory governments. The NEM forms the focus of this movement. In the Commission's view, consistency of regulation, which effectively means consistency with arrangements in the NEM, will become an increasingly important consideration in all jurisdictions, including the Territory.

The role and structure of the Market and System Operator (MSO)

6.6 NEMMCO plays a central role in the operation of the national electricity market and the supervision, coordination and development of the power system. NEMMCO's importance is reflected in the care taken by the participating governments in determining its powers, responsibilities and governance.

6.7 In the Territory, the detailed operational functions and powers of the Market and System Operator (the System Controller) are principally determined by the System Controller itself, through its authorship of the System Control Technical Code (SCTC). Moreover, the entity that is licensed as the System Controller is also a market participant and, as a generator and network provider, a commercial operator and developer of system assets subject to oversight by the System Controller. Inevitably this leads to a potential for conflicts of interest, affecting both the determination of System

Control functions and exercise of System Control powers, which requires careful management.

6.8 There is potential for conflict between the commercial interests of Power and Water and the commercial interests of other market participants. This is an issue of competitive neutrality.[20] There is also potential for conflict between the System Controller's power system supervisory and regulatory responsibilities, and the commercial interests of Power and Water as a generator and network provider. This is of direct relevance to the public policy interest in ensuring that the power system is safe, secure and reliable.

6.9 In attempting to balance commercial and public policy interests, Power and Water faces an unenviable task. Added to this are the complications that come with imposing the System Controller's supervisory and regulatory functions on established internal working relationships. Perhaps reflecting these factors, the SCTC lacks clarity in defining the responsibilities and powers of the System Controller where these impinge on Power and Water's commercial generation and network activities. This is particularly the case for the System Controller's system security, planning and coordination responsibilities.

6.10 Many of the expected System Control operating standards and procedures are not specified for example, including the Secure System Guidelines.[21] As a consequence, a number of key System Control functions that form an integral part of the market and regulatory design suffer from a lack of definition, procedural rules and transparency.

6.11 Capacity planning – the maintenance of generation and network adequacy – is central to the reliability of the system. Within a market environment, it has both a commercial and a public interest dimension. In the national market, NEMMCO is responsible for bringing transparency to the process, providing a coordinating role and a 'last resort' power to step in if the system is threatened. The rules and procedures, while not perfect, are clear. The commercial participants are required to operate within these rules, but otherwise operate according to their self-interest.

6.12 There is no party within the NT system that has responsibilities for generation adequacy comparable with NEMMCO. Capacity planning is largely an internal Power and Water process, in which the System Controller's public interest concerns are resolved by Power and Water alongside the commercial interests of PW Generation and PW Networks.

6.13 Power and Water is the primary source of technical expertise regarding the operation of the Territory power system, comparable in its context to the expertise provided by NEMMCO to the NEM power system. The current arrangements, by combining commercial interests and regulatory responsibilities within the one organisation without the necessary safeguards, inadvertently may increase the level of risk for the power system.

Network management, planning and investment

6.14 All NEM jurisdictions use network codes (or government regulations in the case of NSW) to impose operating, planning and investment obligations on network providers, directed at a range of economic and network performance objectives. The disclosure and reporting of planning methods and investment proposals directed at ensuring network adequacy is a particular focus.

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[20] Competitive neutrality issues have separately been raised by the Commission in recent advice prepared for the Minister on the effectiveness of the Reform Act.

[21] Similar criticism of the SCTC was made in a recent independent expert review of the roles and functions of system control undertaken for Power and Water.

6.15 There are no comparable regulatory instruments in the Territory, or consequent obligations for reporting and transparency set by government. There appears to be no concise statement in the NT framework about which party is responsible for ensuring network adequacy. Network planning, investment decision-making and the associated assessments of risk and reliability are left as internal matters for Power and Water to determine. This is in contrast to the NEM jurisdictions, which spell out the responsibilities of network providers in legislation, regulations, codes and licences.

6.16 Arguably, the value of transparency in planning and investment is potentially greater in the NEM. From an efficiency perspective, there may be a broader range of alternatives to network augmentation for example, which can be brought into play by opening up the investment decision. Given the size and complexity of the networks, there may also be more at stake in individual planning decisions. And the value of reporting is maximised only if the information provided is actively monitored by the regulator, which requires expertise, time and effort.

6.17 Nevertheless, currently a primary determinant of the reliability of electricity supply in the Territory is, strictly speaking, under the control of a commercial entity and largely outside the scope of independent review.

The role of the economic regulator

6.18 The Reform Act gives the Commission primary responsibility for advising the Regulatory Minister on the performance and reliability of the power system, and approving a range of documents related to the management of the power system. This is a task that requires considerable technical expertise. In the national market, NEMMCO takes this role, drawing on its detailed knowledge of the day-to-day operation of the power system and highly qualified professional staff.

6.19 In the Territory, the System Controller has, under the System Control Technical Code, medium-term system adequacy assessment-type responsibilities (although Power and Water's system control department does not appear to undertake this task). Arguably, the System Controller is in a better position to comment on performance, reliability and technical parameters than the Commission.

6.20 The difficulty, anticipated in the Reform Act, is the placement of the System Control function within Power and Water alongside the commercial activities of generation and network service. Although the Commission is primarily an economic regulator with limited power system expertise, it is the only independent body available for these tasks.

6.21 A similar situation existed in Tasmania prior to its entry into the NEM. The State government not only gave the economic regulator broad responsibility for advising on the power system, but also required it to establish technical advisory bodies drawn from the main power system operators. These advisory bodies were responsible for investigating and recommending on technical matters specified by the government, under the broad direction of the regulator. In effect, the regulator administered these technical functions on behalf of the State government.

The extent of regulatory discretion

6.22 A final point of difference concerns the extent of regulatory discretion. Taken together, the Reform Act and the Networks Act give the Commission a number of very general responsibilities related to the manner in which the power system is operated, planned and developed. No further guidance is provided on the specific matters that are intended to be covered, or on the parameters, methods and instruments to be used.

6.23 The absence of a government-authorised network code, discussed above, is an example. The Commission has a broad responsibility for ensuring compliance with 'good electricity industry practice' in relation to network planning and development. However, the relevant aspects of 'good electricity industry practice', the setting of standards and the form of regulation are not discussed. In NEM jurisdictions, this level of detail is provided in the network codes that form part of the regulatory package developed by government and administered by the regulatory agency.

6.24 Although the boundary between what constitutes regulatory policy-making and implementation is by nature vague, the extent of discretion given to the Commission in relation to power system matters is, arguably, both considerable and unusual compared with generally accepted practice.

Conclusions

6.25 For a number of reasons, including practical constraints imposed by the small NT system, the rearrangement of responsibilities, rules and procedures that accompanied the shift to the NEM in eastern and southern Australia has not occurred in the Territory.

6.26 As a result, the current arrangements in the Territory are distinctive in that:

- the responsibilities, accountabilities and powers of the main participants – the System Controller, PW Generation and PW Networks and the Commission itself – are largely undefined; and
- there is limited recognition regarding the desirability of separating public interest responsibilities from commercial interests.

6.27 This sees the management of power system planning and reliability within the NT electricity market lacking:

- clarity of definition of the role, powers and governance of the System Controller, including its relationship to Power and Water and the Commission;
- documentation of the various technical parameters that define the safety, security and reliability of the power system;
- an established process for providing independent technical support and advice on power system matters ; and
- an established process and instruments for providing oversight of network management, planning and investment, appropriate to the scale of the NT system.

6.28 For all practical purposes, power system planning and reliability continues to be managed, as it had been prior to the market reforms of 2000, as an internal matter by Power and Water.

6.29 Although replication of National Electricity Market (NEM) arrangements in the Territory is impractical, the NEM is important both as a benchmark for generally accepted industry practice, and because of the move towards consistency across jurisdictions. Over the next two to three years, there is likely to be increased weight placed by governments generally on the desirability of minimising differences in regulation. One possible outcome, which the Commission considers to have some potential benefits, is the extension of NEM regulatory jurisdiction to the Territory in some form.

6.30 The arrangements that applied in Tasmania prior to it joining the NEM in May 2005 may be instructive for the small NT system. For example, key technical functions, such as the determination of power system security and reliability standards, were allocated to a Reliability and Network Planning Panel established by the regulator.

6.31 While acknowledging that Power and Water has achieved relatively good system reliability outcomes to date in a harsh environment (as evidenced in the most recent industry statistics), there is no guarantee that this will necessarily continue.

6.32 However, while differences with industry practice in other jurisdictions continue, the Commission is not in a position to provide an assessment of the *prospective* capacity and reliability of the power system as a whole in the Territory, especially as it relates to transmission and distribution networks.

PART 2
GENERATION CAPACITY

CHAPTER 7

PART 2 - SUMMARY OF KEY FINDINGS

7.1 Part 2 of the 2005 Review examines the adequacy of generation capacity and gas supplies over the medium term to 2008-09, and the longer term to 2014-15.

7.2 Most interest is likely to be centered on the medium term, when decisions regarding the next increments to capacity and replacement arrangements for Amadeus Basin gas will be required.

Generation capacity in the medium term

7.3 The Commission has assessed the 'adequacy' of generation capacity over the 2005-06 to 2008-09 period by comparing a baseline projection of capacity with its forecast of peak demand in each of the three regulated systems, Darwin-Katherine, Alice Springs and Tennant Creek.

Demand forecasts

7.4 Demand has been forecast by considering three primary influences – economic and demographic conditions, the 'intensity' of electricity consumption and peak demand, and the relative price of electricity.

7.5 Economic and demographic conditions are currently strong and are expected to remain relatively buoyant over the medium term. For the Territory as a whole output, employment and total population are forecast to record average growth rates of 4%, 2% and 1.5% respectively per annum.

7.6 No discernable trends have been identified suggesting the Territory will experience a marked increase in peak demand similar to that recorded in the NEM. Accordingly, the intensity of peak demand has been assumed to have a neutral influence over the medium term.

7.7 In contrast, upward pressure on electricity prices over the medium term, principally due to increases in the cost of purchased gas, is expected to have a marginally negative impact on consumption and peak demand.

7.8 Overall, consumption and peak demand are forecast to increase by an average of 3% per annum in the Darwin-Katherine system, and 2.5% in the Alice Springs and Tennant Creek systems.

Capacity projections

7.9 Baseline capacity has been projected by adjusting existing capacity for additions and retirements that are considered to be firm – either announced or scheduled for the near term. This is comparable with the approach taken by NEMMCO in developing its annual Statement of Opportunities. It has the advantage of avoiding assessments of the likelihood of uncommitted projects proceeding.

7.10 Given the current structure of the NT power market, it is likely that Power and Water is the only party actively planning to invest in new capacity. If the Commission were to include Power and Water's long-term investment plans in the analysis it may inadvertently create the impression that additions to capacity are reserved for Power and Water.

7.11 This is not the case. The NT power market is open to investment from any source that meets the licence criteria. The Commission makes no assumption as to who will build the new capacity that its analysis indicates is required. The Commission's role is to provide information to all interested parties on the prospective supply-demand balance, to facilitate efficient investment from whatever source and the development of a competitive market.

Indicators of system adequacy

7.12 As the discussion in Part 1 of this Review has indicated, the reliability criteria against which system adequacy is measured play a central role in the management, development and performance of the power system.

7.13 In large complex systems such as the NEM, reliability criteria are initially defined in terms of a target level for unserved energy, and translated through extensive system modelling studies into quantitative trigger levels for the various classes of reserve capacity.

7.14 In smaller systems where such an approach may be impractical, a commonly used alternative is to set the trigger levels to allow for the loss of the largest single unit of capacity. This is the N-1 standard. If operational conditions or customer requirements warrant a more stringent standard, N-2 is used. This allows for the loss of the two largest units of capacity.

7.15 In its discussion in Part 1, the Commission concluded that reliability criteria for the NT system should be made explicit on the advice of an appropriately constituted expert advisory body. Such criteria could then be used in future reviews of system adequacy. In the absence of formal criteria, the Commission has reported against both the N-1 and N-2 standard.

Darwin-Katherine regulated system

7.16 The assessment of capacity adequacy for the Darwin-Katherine system over the medium term depends critically on the reserve standard that is applied.

7.17 If the N-1 standard is considered appropriate, capacity is adequate through to 2008-09, although conditions are tightening by the last year.

7.18 However, if N-2 is considered to be the appropriate standard the picture is quite different. Capacity is critically tight in the first year, 2005-06, and falls below the standard in 2006-07. By 2008-09 the shortfall is approaching 30MW. If the N-2 standard is to be satisfied, additional capacity will be required by 2006-07.

Alice Springs regulated system

7.19 Conditions are expected to remain tight on the Alice Springs system.

7.20 Additional capacity is required prior to the commencement of 2008-09 in order to satisfy the N-1 reserve standard.

7.21 Based on the Commission's forecasts of demand, the reserve margin on the Alice Springs system does not meet the N-2 standard at any time over the 2006-07 to 2008-09 period.

Tennant Creek regulated system

7.22 At N-1 capacity remains adequate over the medium-term period. To meet the N-2 standard, additional capacity would be required prior to 2006-07.

Generation capacity in the longer term

7.23 For the period 2009-10 to 2014-15, the Commission has assessed the requirement for new capacity by comparing its baseline capacity projection with high and low growth demand scenarios.

7.24 The high demand growth scenario assumes demand growth of 3.5% per annum in Darwin-Katherine and 3% in Alice Springs and Tennant Creek. The comparable rates in the low demand growth scenario are 2% and 1.5%.

7.25 For each scenario, the additional capacity required to satisfy the N-1 and N-2 reserve standard has been calculated.

Darwin-Katherine regulated system

7.26 Under the high demand growth scenario, an additional 40MW of capacity is required by 2014-15 to meet the N-1 standard and approximately 90MW is required to meet the N-2 standard.

7.27 Under the low demand growth scenario, the comparable figures are 12MW and 60MW.

Alice Springs regulated system

7.28 In the Alice Springs system, additional capacity of 10MW and 20MW is required by 2014-15 under the high demand growth scenario, and 5MW and 15MW under the low demand growth scenario.

Tennant Creek regulated system

7.29 In the Tennant Creek system, projected baseline capacity is sufficient to meet N-1 reserve standard under both the low and high demand growth scenarios. The N-2 reserve standard is satisfied under the high and low demand growth scenarios by the addition of 2MW and 1MW of capacity respectively.

Adequacy of gas supplies

Gas supply-demand to 2009

7.30 It is now likely that, for the remaining four years of their term, gas volumes available under the existing Amadeus Basin contracts will not meet Power and Water's gas requirements. [22]

7.31 The extent of the expected shortfall will depend on the volumes of gas available from the problematic Palm Valley field, the rate of growth in electricity consumption across the system and the level of conversion efficiency achieved on average by Power and Water's generators. Each of these factors is uncertain.

7.32 Even if there is a credible risk that gas supplies will be less than adequate, this does not imply that there is an increased risk of interruptions to electricity supply.

[22] For the purposes of this review Power and Water is assumed to continue as the sole generator/retailer on the three regulated systems. Power and Water's gas requirement is therefore equivalent to the aggregate regulated system requirement.

Most of Power and Water's gas fuelled generating plant will also run on liquid fuel, and Power and Water maintains substantial liquid fuel stocks which can be used to maintain generation in the event of a reduction in gas supply. However, this would clearly be a more expensive outcome.

Alternative gas supply arrangements

7.33 In its 2004 Review, the Commission concluded that:[23]

> *"….until alternative longer-term arrangements are in place, it is not possible to say with reasonable confidence that sufficient gas supplies will be available at acceptable cost to maintain power system adequacy in the latter years of this decade."*

7.34 On 23 December 2005, Power and Water announced the signing of a Heads of Agreement with ENI Australia Limited to buy gas from the Blacktip field in the Bonaparte Gulf for up to 25 years.

7.35 The Commission recognises that this preliminary agreement is an important step, but that security of supply concerns will not be finally allayed until commercial arrangements for development of the Blacktip field are fully in place.

7.36 From the Commission's perspective there are two key conclusions to report:

- while the signing of the Heads of Agreement between Power and Water and ENI Australia Limited is an important step in the right direction, there is still some way to go before firm arrangements are in place for the supply of gas for electricity generation beyond the existing Amadeus Basin contracts which, except for a small amount of Palm Valley gas, will cease sometime around January 2009; and
- given the lead times involved for field development and the construction of pipeline infrastructure, some uncertainty remains whether offshore gas from Blacktip or any other presently undeveloped field will be available in time to replace gas supplied under the existing Amadeus Basin contracts.

[23] Utilities Commission, *Power System Review*, December 2004, p.44

CHAPTER

8

OUTLOOK FOR ELECTRICITY DEMAND

8.1 This chapter examines prospects for electricity demand in the Territory's regulated power systems.

8.2 The period under review extends to 2014-15. While a 10 year horizon allows longer term questions regarding the sequencing and size of capacity requirements to be explored, most interest is centered on the next few years. Medium-term system adequacy assessment exercises, for example, generally examine system adequacy for a period up to two years ahead. Similarly, NEMMCO's horizon for its annual *Statement of Opportunities* provided to help market participants evaluate investment opportunities is 10 years, but in its role as reserve trader its horizon for assessing system adequacy is limited to two years.

8.3 The approach taken in this Review is to look in some detail at the next four years (2005-06 to 2008-09) - a period during which decisions are likely to be required on the next units of generation capacity in some if not all of the Territory's three regulated systems (in addition to decisions concerning replacement gas supplies – see Chapter 10) - and then project forward another six years using broader brush demand scenarios.

Forecasting electricity demand

8.4 Electricity is consumed by individuals in households, by service organisations such as hospitals, schools and government administration, and by commercial entities in offices, shops, manufacturing, agriculture and mining. The quantity of electricity consumed is determined by the number and type of electricity-using appliances and the rate at which they are used. Since data at this level of detail is not generally available, the demand for electricity is usually assessed by focusing on its relationship with measures of economic activity and demographic change and movements in relative prices.

8.5 By examining the relationship between overall electricity consumption and economic, demographic and relative price variables, 'top-down' forecasts of future electricity consumption can be developed based on assessments of expected economic and demographic conditions and price changes. If the data is available, top-down forecasts for broad customer groups – households, commercial offices and shops and other industrial, mining and agricultural activities for example – can also be developed.

8.6 Top-down forecasts in effect average out the actions of individual customers. However, where the market for electricity is fairly small, or there is a need to identify local impacts, as in network planning for example, a bottom-up approach that takes account of the expected consumption of large individual customers may add value.

The Commission's approach

8.7 For the period 2005-06 to 2008-09 the Commission has based its forecast of electricity demand on an assessment of three primary influences:

- aggregate economic and demographic conditions - the general level of activity in the Territory economy, employment growth and the rate of population increase;
- energy intensity – the rate at which electricity consumption varies relative to the rate of general economic activity; and
- relative prices – the impact of changes in the price of electricity relative to the price of competing sources of energy and consumer services.

8.8 The forecast method is essentially top-down. In this approach, the impact of individual projects is accounted for in the assessment of overall economic conditions, rather than as separately identified additions to a baseline forecast of demand.

Economic and demographic conditions

8.9 Economic and demographic conditions are a primary driver of electricity demand. As economic activity increases and population levels rise, both the stock of electricity-using equipment and the rate of utilisation increases.

8.10 Conditions in the NT economy are principally influenced by three factors: global economic conditions and their link to resource development and the commodity price cycle, government spending on defence and infrastructure projects, and the performance of the tourist sector in attracting domestic and overseas visitors. If these sectors are doing well they provide a stimulus to employment, incomes and population growth which in turn flows through to the housing, retail and service sectors.

8.11 Following on from a period of relatively flat economic conditions, the Territory is currently in the midst of a strong upswing. In its most recent review of economic conditions, Access Economics has commented:[24]

> *"Two and a half years ago the Northern Territory's population was declining, as the completion of some big ticket projects (including the Alice-to-Darwin railway) left housing markets stagnant and retail spending sputtering.*
>
> *Now population growth in the Top End is back above the national average and still climbing, it has one of the few housing markets in Australia where prices are still rising, the forward pipeline for housing construction looks excellent and, although retail spending has eased of late, its short term prospects remain rather better than those seen nationwide……*
>
> *…….businesses are still investing in the Territory at a rapid rate – the overall commercial construction spend is rapid, that on equipment investment is even more rapid, housing investment is finally getting the sort of kick along that the rest of Australia saw in recent years, and international tourist arrivals are growing in leaps and bounds."*

8.12 Against this background and an expectation of continued growth in the resource sector Access Economics conclude that, although there are risks attached in the short term:

> *"…the outlook is excellent – the Territory's resource sector is gearing up to meet Chinese demand, and its housing construction sector is gearing up to meet the (associated) improvement in population prospects."*

8.13 Looking further ahead the outlook remains relatively upbeat, as the forecasts in Tables 8.1 and 8.2 illustrate.

[24] Access Economics, *Business Outlook*, September 2005, pp. 116-117.

Table 8.1 – Economic and Demographic Forecasts
Australia
(percentage changes)

	2005-06	2006-07	2007-08	2008-09
Real gross domestic product	3.1	3.4	4.5	3.8
Real final demand	2.9	2.1	2.5	3.3
Employment	2.5	0.7	1.8	1.5

Source: Access Economics

Table 8.2 – Economic and Demographic Forecasts
Northern Territory
(percentage changes)

	2005-06	2006-07	2007-08	2008-09
Real gross state product	5.4	4.4	5.0	4.5
Real final demand	14.6	5.0	3.7	4.0
International tourist arrivals	13.3	7.9	7.7	4.4
Employment	2.2	1.9	2.9	2.8
Population	1.6	1.7	1.6	1.6
Population aged 15 and over	2.0	2.1	2.0	2.0

Source: Access Economics

8.14 While somewhat on the high side, this assessment appears broadly in line with the views of a majority of analysts. The consensus view appears to be that the Territory has a good chance of achieving rates of economic and demographic growth consistently above the national average over the next three to four years.

8.15 Table 8.3 summarises the growth outlook used by the Commission in preparing its forecasts of electricity demand for the period 2005-06 to 2008-09.

Table 8.3 – Indicative Economic and Demographic Forecasts
Northern Territory, 2005-06 to 2008-09
(average annual percentage changes)

Real gross state product	4.0
Real final demand	3.5
Employment	2.0
Population	1.5
Population aged 15 and over	1.8

Energy intensity

8.16 Energy intensity refers to the relationship between the quantity of electricity consumed (or the level of peak demand) and an underlying measure of economic activity – for example, the production of goods and services measured by Gross Domestic Product, or the level of expenditure by households on consumer goods and services.

8.17 Where data and resources permit, it is usual for this relationship to be estimated statistically using econometric techniques, supported by information from detailed market analysis where available. For this Review, however, the Commission is limited to a qualitative assessment.

8.18 When considering the intensity of electricity consumption, it is important to distinguish between the behaviour of individuals and businesses with relatively low levels of electricity use, and those businesses for which electricity is a major cost. The experience of most individuals and businesses is that continuing rapid expansion in the range of electrical appliances and equipment in the home and the office leads to electricity consumption increasing at a faster rate than consumption of other goods and services.

8.19 However, it is the behaviour of the biggest electricity users that has the greatest influence on the total volume of electricity consumed, and for these businesses improvements in the efficiency of electricity use have an important influence on profitability. As a result, while the intensity of consumption may be increasing for most households and businesses, the effect on economy-wide average intensity may be out-weighed by the actions of the largest users seeking increased efficiency of electricity use.

8.20 A second distinction to be considered is between the volume of electricity consumed, which is measured over a period of time (in kiloWatt hours – kWh – for example), and instantaneous peak demand, measured in kiloWatts (kW) or megaWatts (MW). While both are relevant to the assessment of system adequacy, having sufficient capacity available to meet peak demand is critical for reliability. The Commission's primary interest therefore is in developing forecasts of peak demand.

8.21 Assessing trends in the intensity of peak demand is a complex task. The hour-by-hour pattern of electricity demand varies significantly between groups of customers (households, offices and shops, manufacturing, mining, etc.) and with climatic conditions. Patterns in peak demand observed in New South Wales for example will not necessarily apply to the Darwin-Katherine region.

8.22 For this reason the Commission is reluctant to accept the view current in the NEM States that the intensity of peak demand will continue to increase quite strongly over the medium term. While the increase in peak demand in the Darwin-Katherine system outstripped consumption in 2004-05, there is as yet no evidence of a clear trend emerging.

8.23 In developing its forecasts for this Review the Commission has made the assumption that both the intensity of electricity consumption and the intensity of peak demand will maintain a neutral influence on the growth in consumption and peak demand over the period to 2008-09.

Price effects

8.24 A third influence on the level of electricity consumption and demand is the price charged.

8.25 The relationship between price and demand is measured by the price elasticity of demand. A high figure (a value greater than unity) means that a change in price causes an equal or greater change in demand. If the price elasticity of demand is less than unity the demand response is less than the price change.

8.26 Econometric studies typically show that electricity has a relatively low price elasticity of demand – in the order of -0.2 in the first year following a price change, increasing to a maximum of around -0.6 after several years as households and

businesses slowly react and adjust their consumption.[25] However, there is some suggestion that the increased emphasis on electricity markets in recent years may have caused business customers in particular to become more price responsive.

8.27 In a pricing context, electricity customers in the NT fall into two groups. Medium and large customers are 'contestable' and pay a price determined by Power and Water that reflects the cost of supply. On the other hand small customers, including households, pay a price regulated by the Territory government that is below the cost of supply by a considerable margin. Contestable customers are therefore exposed to movements in Power and Water's costs of supply, while regulated customers are exposed to government decisions regarding the appropriate level of the price subsidy.

8.28 Over the period to 2008-09, there is an increased prospect of an acceleration in Power and Water's cost of supply, principally due to an increased possibility of a rise in its average cost of gas (for reasons that are discussed further in Chapter 10). This raises the prospect of increasing upward pressure on both contestable and regulated retail prices, as Power and Water passes on its higher costs to contestable customers and the government seeks to limit the drain on consolidated revenue from its subsidy to small customers. On the balance of probabilities the Commission has made the assumption that price changes will exert a marginally negative influence on electricity consumption and demand over the medium term.

Electricity forecasts 2005-06 to 2008-09

8.29 The picture that emerges from this analysis is of an electricity market supported by a relatively strong and vibrant local economy, with solid employment and population growth, no discernable trends suggesting a marked change in the intensity of electricity consumption or peak demand, but the prospect of price increases applying some negative pressure on consumption and demand at the margin.

8.30 This overall picture requires translating into forecasts of electricity consumption and peak demand for each of the three regulated networks – Darwin-Katherine, Alice Springs and Tennant Creek.

8.31 The Darwin-Katherine region is expected to be the primary location and beneficiary of the relatively buoyant economic and demographic conditions forecast for the next few years. Accordingly, the Darwin-Katherine system is expected to record the highest rates of consumption and peak demand growth.

8.32 Based on forecast output, employment and population growth averaging just above 4%, 2% and 1.5% respectively, growth in electricity consumption and peak demand in the Darwin-Katherine system are forecast to average 3% per annum.

8.33 Economic and demographic conditions are expected to record marginally lower rates of growth in Alice Springs and Tennant Creek. Accordingly, electricity consumption and peak demand in these systems are forecast to grow at rates averaging 2.5% and 2.0% respectively.

8.34 Table 8.4 presents the Commission's medium-term forecasts of electricity consumption and demand.

[25] The elasticity of demand in shown as a negative value because as price increases demand decreases, and *vice versa.*

Table 8.4 – Peak Demand and Energy
Actual and Forecast to 2008-09 – Regulated Systems

	Darwin-Katherine		Alice Springs		Tennant Creek	
Financial Year	Demand (MW)	Energy (GWh)	Demand (MW)	Energy (GWh)	Demand (MW)	Energy (GWh)
2000-01	218	1291	44	205	6	27
2001-02	223	1357	43	210	7	31
2002-03	233	1253	48	220	8	33
2003-04	227	1241	50	223	7	30
2004-05	234	1273	50	229	7	31
2005-06	241	1311	51	234	7	32
2006-07	248	1350	53	240	7	32
2007-08	256	1391	54	246	8	33
2008-09	263	1432	55	252	8	34

Longer term demand scenarios

8.35 For the remaining six years of the period under review the Commission has applied high and low growth demand scenarios.

8.36 In last year's Review, a broad analysis by the Commission of peak demand and consumption in the Darwin-Katherine region indicated a longer-term average annual growth rate of approximately 3.5-3.7% for both series. While rates of growth in recent years have been significantly lower than the longer-term average, the Commission used this average to develop a higher demand growth scenario, in which peak demand and energy use increased at an annual rate of 3.5%. For Alice Springs and Tennant Creek, the higher demand growth scenario assumed average annual growth in peak demand and energy use of 3%.

8.37 These values are retained for the high demand growth scenario applied to the period 2009-10 to 2014-15 and the resulting levels presented in Table 8.5.

Table 8.5 – Peak Demand and Energy
High Growth Scenario – Regulated Systems

	Darwin-Katherine		Alice Springs		Tennant Creek	
Financial Year	Demand (MW)	Energy (GWh)	Demand (MW)	Energy (GWh)	Demand (MW)	Energy (GWh)
2000-01	218	1291	44	205	6	27
2001-02	223	1357	43	210	7	31
2002-03	233	1253	48	220	8	33
2003-04	227	1241	50	223	7	30
2004-05	234	1273	50	229	7	31
2005-06	241	1311	51	234	7	32
2006-07	248	1350	53	240	7	32
2007-08	256	1391	54	246	8	33
2008-09	263	1432	55	252	8	34
2009-10	273	1483	57	260	8	35
2010-11	282	1534	59	268	8	36
2011-12	292	1588	60	276	9	37
2012-13	302	1644	62	284	9	38
2013-14	313	1701	64	293	9	39
2014-15	324	1761	66	301	9	40

8.38 For the low demand growth scenario the Commission has adopted annual rates of growth in electricity consumption and peak demand for the period 2009-10 to 2014-15 of 2% for Darwin-Katherine and 1.5% for Alice Springs and Tennant Creek. The resulting levels are presented in Table 8.6.

Table 8.6 – Peak Demand and Energy
Low Growth Scenario – Regulated Systems

	Darwin-Katherine		Alice Springs		Tennant Creek	
Financial Year	**Demand (MW)**	**Energy (GWh)**	**Demand (MW)**	**Energy (GWh)**	**Demand (MW)**	**Energy (GWh)**
2000-01	218	1291	44	205	6	27
2001-02	223	1357	43	210	7	31
2002-03	233	1253	48	220	8	33
2003-04	227	1241	50	223	7	30
2004-05	234	1273	50	229	7	31
2005-06	241	1311	51	234	7	32
2006-07	248	1350	53	240	7	32
2007-08	256	1391	54	246	8	33
2008-09	263	1432	55	252	8	34
2009-10	269	1461	56	256	8	34
2010-11	274	1490	57	260	8	35
2011-12	279	1520	58	264	8	35
2012-13	285	1550	59	268	8	36
2013-14	291	1581	59	272	8	36
2014-15	297	1613	60	276	9	37

CHAPTER

9

ADEQUACY OF GENERATION CAPACITY

9.1 This chapter first outlines the generation capacity available in the Territory's regulated power systems. Against the background of the demand forecasts canvassed in the previous chapter, the prospective supply-demand position in the Territory's power system is then examined.

Existing capacity

9.2 Supply of electricity in the Territory's regulated power systems is predominantly provided by Power and Water, either from its own sources or under the terms of power purchase agreements it has with a number of IPPs. At the regional level, about 80% of all generation capacity in the Territory's regulated networks is installed in the Darwin-Katherine system, with the bulk of this capacity located at the Channel Island Power Station. The remaining 20% of generation capacity is installed in the Alice Springs and Tennant Creek regulated systems.

9.3 The Territory's generation facilities, consisting mainly of gas and liquid fuel driven turbines, are summarised in table 9.1. Three indicators of 'supply capacity' are provided:

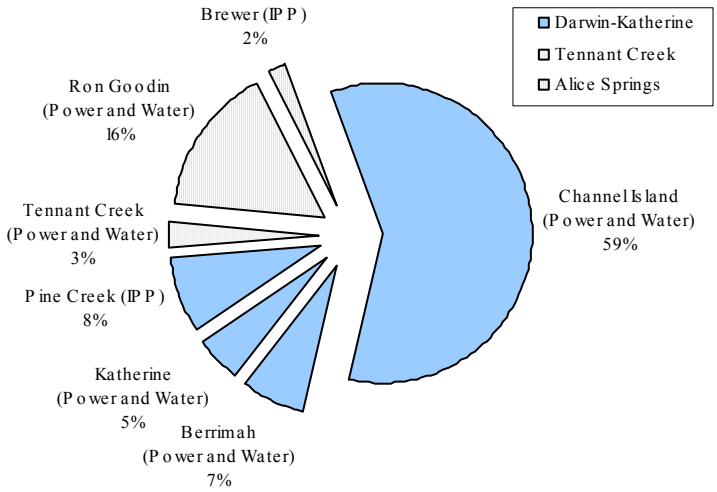
- total capacity (in MW);
- N-1 capacity (in MW), which indicates the generation capacity excluding the largest generating set in a particular system; and
- N-2 capacity (in MW), which indicates the generation capacity excluding the two largest generating sets in a particular system.

Table 9.1 – Power Facilities in Regulated Systems
30 June 2005

Region / Power station	Operator	Capacity (MW)	% of Total	Capacity at N-1	Capacity at N-2
Darwin-Katherine Regulated System:					
Channel Island	P&W	253.7			
Berrimah	P&W	30.0			
Katherine	P&W	21.3			
Pine Creek	IPP	34.1			
Total		**339.1**	**79%**	**291.1**	**243.1**
Tennant Creek Regulated System:					
Tennant Creek	P&W	12.8			
Total		**12.8**	**3%**	**8.9**	**6.8**
Alice Springs Regulated System:					
Ron Goodin	P&W	68.4			
Brewer	IPP	8.5			
Total		**76.9**	**18%**	**65.2**	**55.2**
Total Capacity in Regulated Systems		**428.8**	**100%**		

9.4 Power and Water has power purchase agreements with two IPPs which operate in regulated systems: EDL NGD (NT) Pty Ltd (Pine Creek Power) and Central Energy Power Pty Ltd (Brewer). Overall, about 43MW of capacity is currently available from these IPPs.

Chart 9.1 – Regulated System Power Station Capacities



9.5 Power and Water is also responsible for the provision of power services to remote indigenous communities and townships that are not connected to the regulated power system. Some of these areas include Yulara, Borroloola, Timber Creek, Daly Waters, Newcastle Waters, Elliot, Ti-Tree and Kings Canyon. The generation capacity associated with these rural areas has not been included in system supply (for the purposes of this review) and is consistent with the treatment of associated demand in Chapter 8.

Changes to capacity during 2004-05

9.6 During the last year Power and Water entered into an agreement to extend the IPP capacity provided from Pine Creek station by 7.5MW. The additional capacity will be available until June 2008. As a result capacity on the Darwin-Katherine system increased to 339.1MW.

9.7 At Alice Springs two units of 3.9MW and one unit of 10.1MW were added at Ron Goodin power station, increasing capacity on the system to 76.9MW. However, the two 3.9MW units are scheduled to be transferred to Tennant Creek within the next 12 to 24 months.

9.8 Capacity at Tennant Creek declined to 12.8MW following the retirement of 3.5MW of capacity.

Baseline capacity projections

9.9 In developing its baseline capacity projections, the Commission has taken the approach of including only those changes to capacity that are considered to be firm – either because they have been publicly announced as committed and proceeding or are clearly scheduled for near term action.

9.10 This is comparable with the approach taken by NEMMCO in developing its annual *Statement of Opportunities*. It has the advantage of avoiding assessments of the likelihood of uncommitted projects proceeding.

9.11 Given the current structure of the NT power market, it is likely that Power and Water is the only party actively planning to invest in new capacity. If the Commission were to include Power and Water's long-term plans in the analysis, it may inadvertently create the impression that additions to capacity are reserved for Power and Water.

9.12 This is not the case. The NT power market is open to investment from any source that meets the licence criteria. The Commission makes no assumption as to who will build the new capacity indicated by its analysis. The Commission's role is to provide information to all interested parties on the prospective supply-demand balance, to facilitate efficient investment from whatever source and the development of a competitive market.

9.13 Tables 9.2 to 9.4 contain the Commission's baseline capacity projections.

Table 9.2 – Darwin-Katherine Baseline Capacity Projection (MW)

Financial Year	Retire-ments	New Capacity	Total Capacity	N-1	N-2
2005-06		1.0	340.1	292.1	244.1
2006-07			340.1	292.1	244.1
2007-08			340.1	292.1	244.1
2008-09	(7.5)		332.6	284.6	236.6
2009-10			332.6	284.6	236.6
2010-11			332.6	284.6	236.6
2011-12			332.6	284.6	236.6
2012-13			332.6	284.6	236.6
2013-14			332.6	284.6	236.6
2014-15			332.6	284.6	236.6

9.14 Committed increases in capacity in Darwin-Katherine are limited to a 1MW addition sourced from landfill gas at Shoal Bay. In 2008-09 capacity is reduced by 7.5MW due to the expiry of the Pine Creek B power purchase agreement.

Table 9.3 – Alice Springs Baseline Capacity Projection (MW)

Financial Year	Retire-ments	New Capacity	Total Capacity	N-1	N-2
2005-06	(5.9)		71.0	59.3	49.3
2006-07	(3.9)		67.1	55.4	45.4
2007-08			67.1	55.4	45.4
2008-09			67.1	55.4	45.4
2009-10			67.1	55.4	45.4
2010-11			67.1	55.4	45.4
2011-12			67.1	55.4	45.4
2012-13			67.1	55.4	45.4
2013-14			67.1	55.4	45.4
2014-15			67.1	55.4	45.4

9.15 Capacity changes at Alice Springs reflect the transfer of two 3.9MW units to Tennant Creek and the retirement of a 2MW unit in 2005-06.

Table 9.4 – Tennant Creek Baseline Capacity Projection (MW)

Financial Year	Retire-ments	New Capacity	Total Capacity	N-1	N-2
2005-06		5.4	18.2	14.3	12.2
2006-07	(8.5)	5.4	15.1	11.2	7.3
2007-08			15.1	11.2	7.3
2008-09			15.1	11.2	7.3
2009-10			15.1	11.2	7.3
2010-11			15.1	11.2	7.3
2011-12			15.1	11.2	7.3
2012-13			15.1	11.2	7.3
2013-14			15.1	11.2	7.3
2014-15			15.1	11.2	7.3

9.16 Capacity at Tennant Creek is initially expanded by the transfer of two 3.9MW units from Alice Springs and the installation of two 1.5MW diesel generators, and reduced by the retirement of three units totalling 8.5MW.

Indicators of system adequacy

9.17 As the discussion in Part 1 of this Review has indicated, the reliability criteria against which system adequacy is measured play a central role in the management, development and performance of the power system.

9.18 In large complex systems such as the NEM, reliability criteria are initially defined in terms of a target level for unserved energy, and translated through extensive system modelling studies into quantitative trigger levels for the various classes of reserve capacity. As operating conditions and the system itself change over time these trigger levels are periodically reset.

9.19 In smaller systems where such an approach may be impractical, a commonly used alternative is to set the trigger levels to allow for the loss of the largest single unit of capacity. This is the N-1 standard. If operational conditions or customer requirements warrant a more stringent standard, N-2, is used. This allows for the loss of the two largest units of capacity.

9.20 In its discussion in Part 1, the Commission concluded that reliability criteria for the NT system should be made explicit on the advice of an appropriately constituted expert advisory body. Such criteria could then be used in future reviews of system adequacy. In the absence of formal criteria, the Commission has reported against both the N-1 and N-2 standard.

Supply-demand balance in the medium term

9.21 In the following sections, supply-demand conditions are examined for each of the regulated systems over the period to 2008-09.

Darwin-Katherine regulated system

9.22 Table 9.5 indicates the reserve position of the Darwin-Katherine system at the N-1 reserve standard and N-2 reserve standard based on the Commission's medium-term forecast of demand and its baseline capacity projection.

Table 9.5 – Medium Term Supply-Demand Balance Forecast Darwin-Katherine (MW)

Financial Year	Total Capacity	N-1	N-2	Peak Demand	Reserve Margin over N-1	Reserve Margin over N-2
2005-06	340.1	292.1	244.1	241	51	3
2006-07	340.1	292.1	244.1	248	44	-4
2007-08	340.1	292.1	244.1	256	36	-12
2008-09	332.6	284.6	236.6	263	21	-27

9.23 At N-1, capacity is adequate through to 2008-09, although conditions are tightening by the last year when the margin over N-1 falls to approximately 20MW.

9.24 The picture at N-2 is quite different. Capacity is critically tight in the first year, 2005-06, and falls below the standard in 2006-07. By 2008-09 the shortfall relative to N-2 is approaching 30MW. If N-2 is the appropriate reserve criteria for the Darwin-Katherine system then, on the basis of the Commission's forecast of demand, additional capacity will be required by 2006-07.

Alice Springs regulated system

9.25 Table 9.6 indicates the reserve position of the Alice Springs system at N-1 and N-2.

Table 9.6 – Medium Term Supply-Demand Balance Forecast Alice Springs (MW)

Financial Year	Total Capacity	N-1	N-2	Peak Demand	Reserve Margin over N-1	Reserve Margin over N-2
2005-06	71.0	59.3	49.3	51	8	-2
2006-07	67.1	55.4	45.4	53	3	-7
2007-08	67.1	55.4	45.4	54	2	-8
2008-09	67.1	55.4	45.4	55	0	-10

9.26 At N-1, reserve conditions are adequate at the beginning of the period. However, the margin is fully eroded by 2008-09, indicating that additional capacity is required prior to the commencement of 2008-09 in order to satisfy the N-1 reserve standard.

9.27 Based on the Commission's forecasts of demand, the reserve margin on the Alice Springs system does not meet the N-2 standard at any time over the 2006-07 to 2008-09 period.

Tennant Creek regulated system

9.28 Table 9.6 indicates the reserve position of the Tennant Creek system at N-1 and N-2.

Table 9.7 – Medium Term Supply-Demand Balance Forecast
Tennant Creek
(MW)

Financial Year	Total Capacity	N-1	N-2	Peak Demand	Reserve Margin over N-1	Reserve Margin over N-2
2005-06	18.2	14.3	12.2	7	7	5
2006-07	15.1	11.2	7.3	7	4	0
2007-08	15.1	11.2	7.3	8	4	0
2008-09	15.1	11.2	7.3	8	3	-1

9.29 At N-1, capacity remains adequate over the medium-term period. To meet the N-2 standard additional capacity will be required prior to 2006-07.

Supply-demand balance in the longer term

9.30 Comparisons of longer-term demand forecasts with baseline capacity projections allow estimates to be made of the total additions to capacity that will be required for the period in question. Because the baseline capacity projections do not include assumptions regarding future capacity investments that may be expected to occur, the comparison does not reflect the actual supply-demand balance that is expected to develop.

9.31 For each of the three regions, the Commission has compared high and low growth demand scenarios for the period 2009-10 to 2014-15 with its baseline projections of capacity.

Darwin-Katherine regulated system

9.32 Table 9.8 indicates that, if demand increased at an average rate of 3.5% per annum over the 2009-10 to 2014-15 period, approximately 40MW of additional capacity would be required to satisfy the N-1 reserve standard and approximately 90MW of additional capacity would be required to satisfy the N-2 standard.

Table 9.8 – Longer Term Supply-Demand Balance
High Growth Scenario
Darwin-Katherine
(MW)

Financial Year	Total Capacity	N-1	N-2	Peak Demand	Reserve Margin over N-1	Reserve Margin over N-2
2009-10	332.6	284.6	236.6	273	12	-36
2010-11	332.6	284.6	236.6	282	2	-46
2011-12	332.6	284.6	236.6	292	-7	-55
2012-13	332.6	284.6	236.6	302	-18	-66
2013-14	332.6	284.6	236.6	313	-28	-76
2014-15	332.6	284.6	236.6	324	-39	-87

Table 9.9 – Longer Term Supply-Demand Balance
Low Growth Scenario
Darwin-Katherine
(MW)

Financial Year	Total Capacity	N-1	N-2	Peak Demand	Reserve Margin over N-1	Reserve Margin over N-2
2009-10	332.6	284.6	236.6	269	16	-32
2010-11	332.6	284.6	236.6	274	11	-37
2011-12	332.6	284.6	236.6	279	5	-43
2012-13	332.6	284.6	236.6	285	0	-48
2013-14	332.6	284.6	236.6	291	-6	-54
2014-15	332.6	284.6	236.6	297	-12	-60

9.33 Alternatively, as indicated by Table 9.9, if demand increased by an average of only 2% per annum the additional capacity required by 2014-15 to meet N-1 and N-2 falls to 12MW and 60MW respectively.

Alice Springs regulated system

9.34 Tables 9.10 and 9.11 present the comparable analysis for the Alice Springs system.

9.35 Demand growth in the longer term of 3% per annum creates a requirement for 10MW of additional capacity by 2014-15 to meet the N-1 reserve standard and 20MW of additional capacity to meet the N-2 standard.

Table 9.10 – Longer Term Supply-Demand Balance
High Growth Scenario
Alice Springs
(MW)

Financial Year	Total Capacity	N-1	N-2	Peak Demand	Reserve Margin over N-1	Reserve Margin over N-2
2009-10	67.1	55.4	45.4	57	-1	-11
2010-11	67.1	55.4	45.4	59	-3	-13
2011-12	67.1	55.4	45.4	60	-5	-15
2012-13	67.1	55.4	45.4	62	-7	-17
2013-14	67.1	55.4	45.4	64	-9	-19
2014-15	67.1	55.4	45.4	66	-10	-20

Table 9.11 – Longer Term Supply-Demand Balance
Low Growth Scenario
Alice Springs
(MW)

Financial Year	Total Capacity	N-1	N-2	Peak Demand	Reserve Margin over N-1	Reserve Margin over N-2
2009-10	67.1	55.4	45.4	56	-1	-11
2010-11	67.1	55.4	45.4	57	-1	-11
2011-12	67.1	55.4	45.4	58	-2	-12
2012-13	67.1	55.4	45.4	59	-3	-13
2013-14	67.1	55.4	45.4	59	-4	-14
2014-15	67.1	55.4	45.4	60	-5	-15

9.36 Alternatively, if demand growth averages only 1.5% per annum, the requirement for additional capacity falls to 5MW and 15MW respectively to meet the N-1 and N-2 reserve standards.

Tennant Creek regulated system

9.37 Tables 9.12 and 9.13 present the comparable analysis for Tennant Creek.

9.38 The projected baseline capacity is sufficient to meet the N-1 reserve standard under both the low and high demand growth scenarios.

9.39 The N-2 reserve standard is satisfied under the high and low demand growth scenarios by the addition of 2MW and 1MW of capacity respectively.

Table 9.12 – Longer Term Supply-Demand Balance
High Growth Scenario
Tennant Creek
(MW)

Financial Year	Total Capacity	N-1	N-2	Peak Demand	Reserve Margin over N-1	Reserve Margin over N-2
2009-10	15.1	11.2	7.3	8	3	-1
2010-11	15.1	11.2	7.3	8	3	-1
2011-12	15.1	11.2	7.3	9	3	-1
2012-13	15.1	11.2	7.3	9	2	-2
2013-14	15.1	11.2	7.3	9	2	-2
2014-15	15.1	11.2	7.3	9	2	-2

Table 9.13 – Longer Term Supply-Demand Balance
Low Growth Scenario
Tennant Creek
(MW)

Financial Year	Total Capacity	N-1	N-2	Peak Demand	Reserve Margin over N-1	Reserve Margin over N-2
2009-10	15.1	11.2	7.3	8	3	-1
2010-11	15.1	11.2	7.3	8	3	-1
2011-12	15.1	11.2	7.3	8	3	-1
2012-13	15.1	11.2	7.3	8	3	-1
2013-14	15.1	11.2	7.3	8	3	-1
2014-15	15.1	11.2	7.3	9	3	-1

CHAPTER

10

ADEQUACY OF GAS SUPPLIES

10.1 In the Territory context, system *adequacy* concerns can also arise if there is insufficient gas available to generate the expected level of electricity required. This chapter addresses this issue.[26]

Natural gas supply

10.2 Over 99% of electricity in the Territory's regulated system is generated from natural gas-fuelled plant through direct powering of gas turbines and reciprocating engines and the production of steam through the recovery of waste heat from the gas turbines.

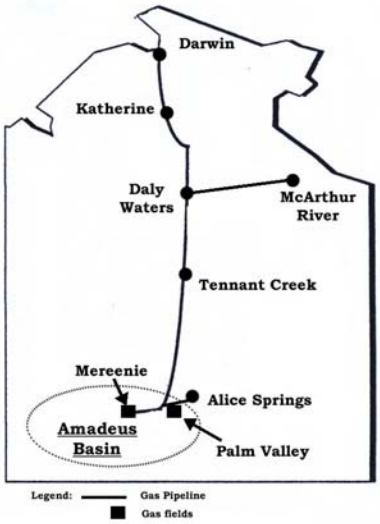
10.3 These plants are serviced by two gas fields in the Amadeus Basin: the Palm Valley field operated by Magellan Petroleum Australia Ltd and the Mereenie field operated by Santos Ltd. Each operator has significant interest in both fields. The location of these gas fields is shown in chart 10.1.

10.4 In 1983, Power and Water entered into an agreement with the operator of the Palm Valley field to supply gas to Alice Springs primarily for electricity generation.

10.5 In 1985, the Power and Water subsidiary Gasgo contracted to purchase gas totalling 200 petajoules (PJ) over the period to 2012 from the Palm Valley field to fuel electricity generation in the Darwin-Katherine region. In the same year, Gasgo also entered into a gas purchase agreement with the operator of the Mereenie field for the supply of 66PJ over the period to 2009. Since that time, natural gas has been the major fuel source for electricity generation in the Territory.

[26] The 2002 Review addressed system *security* issues associated with fuel, finding that the gas supply system and the back-up liquid fuel supplies have proven reliable over the past 15 years and electricity supply has not been interrupted through a fuel-related contingency. The Commission indicated that it was comfortable that the levels of liquid fuel storage maintained by Power and Water and the scope for pipeline line pack should together continue to allow the maintenance of electricity supply during short-term interruptions to gas production or transportation. For this reason, the Commission has not had the need to review the matter of system security since the 2002 Review.

Chart 10.1 – Location of Amadeus Basin Gas Fields

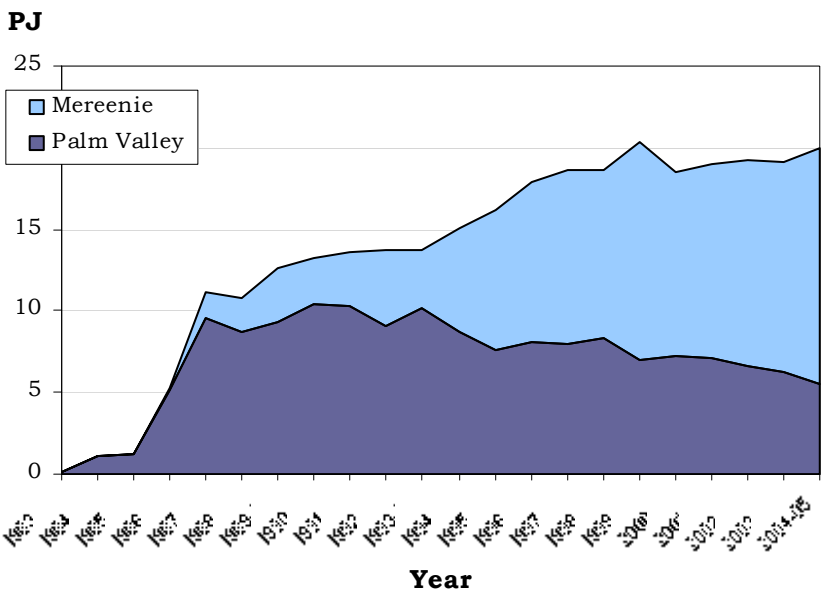


10.6 The Palm Valley field has not met original expectations and, although Gasgo has funded substantial development work as required by the gas purchase agreement, the operator has downgraded the resource (including forecast cumulative production) to approximately 50% of the original reserves figure.

10.7 The poor performance of the Palm Valley field and greater than expected energy demand resulted in two other contracts being established for the purchase of 113PJ of Mereenie gas over the period to 2009.

10.8 Chart 10.2 illustrates the declining production of the Palm Valley field and the increasing reliance upon the Mereenie field over recent years.

Chart 10.2 – Gas Sales
1983-84 to 2004-05



10.9 The Gasgo contracts for the supply of gas from Mereenie expire in 2009. Gas volumes permitting, the Palm Valley contract expires in 2012.

Gas supply-demand over the past year

10.10 2004-05 marked a turning point in the performance of the existing Amadeus Basin gas supply contracts.

10.11 As a result of a 4.6% increase in Power and Water's gas requirement and a further decline in Palm Valley production, Power and Water used the maximum amount of gas allowed for the year under its Mereenie contracts, together with all of its "banked", or unused gas, from previous years. This has changed the expected supply-demand balance for the remainder of the contract term from approximate balance to deficit.

10.12 The increase in Power and Water's gas requirement in 2004-05 from 18.8PJ to 19.7PJ is only partly explained by the growth in electricity consumption, which increased by approximately 2.5%. Other factors which appear to have influenced the quantity of gas used in power generation are increases in the level of spinning reserve operated by Power and Water for reliability reasons and the lower availability of more efficient generating plant due to maintenance problems.

Gas supply-demand to 2009

10.13 It is now likely that, for the remaining four years of their term, gas volumes available under the existing Amadeus Basin contracts will not meet Power and Water's gas requirements.[27]

10.14 The extent of the expected shortfall will depend on the volumes of gas available from the problematic Palm Valley field, the rate of growth in electricity consumption across the system and the level of conversion efficiency achieved on average by Power and Water's generators. Each of these factors is uncertain.

10.15 Using forecasts of Palm Valley production published by the operator, the Commission's estimate is that the shortfall will be in the range of 4.5PJ to 8.5PJ over the four years 2005-06 to 2008-09. At the upper end, this represents approximately 10% of expected gas requirements over the period.

10.16 Declines in Palm Valley production greater than forecast by the operator would increase the extent of the shortfall, as would the emergence of new large electricity loads that add to demand. Increases in the conversion efficiency of Power and Water's generating plant on the other hand, through the introduction of more efficient new plant for example, would reduce the shortfall.

10.17 With regard to Mereenie gas, it is important to note that the shortfall refers to contract volumes, not to a shortage of the resource itself. The Commission's understanding is that the Mereenie field contains enough gas to meet Power and Water's requirements for several years beyond 2009, albeit at a cost that may not be competitive with alternative sources. The Commission also understands that production rates from Mereenie could be increased to meet Power and Water's monthly requirements over the next four years.

10.18 Gasgo has advised the Commission that it is examining options for increasing the maximum annual quantities that can be purchased under the existing contracts. This would have the effect of bringing forward gas purchases and result in an earlier termination of the contracts (and, consequently, an earlier required starting date for replacement contracts).

[27] For the purposes of this review Power and Water is assumed to continue as the sole generator/retailer on the three regulated systems. Power and Water's gas requirement is therefore equivalent to the aggregate regulated system requirement.

10.19 Nevertheless, the fact remains that, at the time of writing, a proportion of the gas required to meet the expected load on the power system in the current year and the following three years is not yet subject to secure purchase arrangements.

10.20 The Commission also notes that this outcome was anticipated as early as December 2002. Following an assessment of the prospective gas supply-demand balance in its Power System Review for that year, focusing particularly on the uncertain level of future Palm Valley gas production, the Commission concluded:[28]

> *"Overlaying the Commission's optimistic and pessimistic supply views, and just considering the existing sources of gas (the Mereenie and Palm Valley fields), it is possible that:*
>
> - *there could be a gas supply shortfall as early as 2006 under a pessimistic scenario; and*
> - *such a shortfall could be in prospect as late as 2009 under an optimistic scenario."*

10.21 The Commission also raised the prospect of a shortfall in supply from the Amadeus Basin in last year's review. At that time the Commission estimated the shortfall to be in the order of 3 to 4 PJ. The questions raised last year apply now with even greater force: whether Power and Water can gain access to a sufficient amount of additional Mereenie gas to make up the shortfall, and whether the required volumes of gas will be available on terms commercially acceptable to Power and Water[29]:

> *"The first question arises because it cannot be assumed that Power and Water would necessarily be the only prospective purchaser of additional Mereenie production. It is quite possible that other gas users with access to the pipeline that connects the Amadeus Basin to Darwin may also require additional supplies of gas in the next few years. Should this situation arise, Power and Water would encounter competition for the available supplies, which could lead to its requirements failing to be met in full.*
>
> *The second question arises because the costs of increased Mereenie production are expected to be relatively high. Power and Water may be faced with a situation where sufficient additional supplies are indeed available to make up the shortfall, but at a substantially increased (and possibly uneconomic) cost."*

10.22 Until secure supply contracts are in place that cover expected requirements, including some allowance for contingencies, the NT power system is faced with a credible risk that gas supplies will be less than adequate.

10.23 This does not imply that there is an increased risk of interruptions to electricity supply. Most of Power and Water's gas fuelled generating plant will also run on liquid fuel, and Power and Water maintains substantial liquid fuel stocks which can be used to maintain generation in the event of a reduction in gas supply. However, this would clearly be an expensive and undesirable outcome.

Alternative gas supply arrangements

10.24 In previous Reviews, the Commission has considered the possible alternative sources of gas that may become available as a replacement for Amadeus Basin gas.

10.25 In its 2004 Review the Commission concluded that[30]:

> *"….until alternative longer-term arrangements are in place, it is not possible to say with reasonable confidence that sufficient gas supplies will be available at acceptable cost to maintain power system adequacy in the latter years of this decade.*

[28] Utilities Commission, Annual Power System Review, December 2002, p.50

[29] Utilities Commission, Power System Review, December 2004, p.42.

[30] Utilities Commission, Power System Review, December 2004, p.44

In part this is unavoidable. Negotiations are necessarily conducted on a commercial-in-confidence basis. Moreover, the Territory is in the fortunate position of being on the threshold of a period of significant development of the extensive nearby gas reserves. This will provide opportunities for an economic and secure supply of gas to the power system in the long term, and scope for transitional arrangements in the medium term.

Nevertheless, it is clear to the Commission that the situation is continuing to tighten with the passage of time."

10.26 From around January 2009, that is, within 36 months from the time of publication of this Review (depending when gas volumes under the existing Amadeus Basin contracts are exhausted), Power and Water will require secure supplies of approximately 21 to 22PJ of gas a year, rising to approximately 23 to 26PJ annually by 2014-15.

10.27 On 23 December 2005, Power and Water announced the signing of a Heads of Agreement with ENI Australia Limited to buy gas from the Blacktip field in the Bonaparte Gulf for up to 25 years.

10.28 The Commission recognises that this preliminary agreement is an important step, but that security of supply concerns will not be finally allayed until commercial arrangements for development of the Blacktip field are fully in place.

10.29 From the Commission's perspective there are two key conclusions to report:

- while the signing of the Heads of Agreement between Power and Water and ENI Australia Limited is an important step in the right direction, there is still some way to go before firm arrangements are in place for the supply of gas for electricity generation beyond the existing Amadeus Basin contracts, which, except for a small amount of Palm Valley gas, will cease sometime around January 2009; and

- given the lead times involved for field development and the construction of pipeline infrastructure, some uncertainty remains whether offshore gas from Blacktip or any other presently undeveloped field will be available in time to replace gas supplied under the existing Amadeus Basin contracts.

APPENDIX A

GLOSSARY

Capacity – The maximum output that a generating unit can provide under specific conditions for a given time period without exceeding temperature and stress limits.

Co-Generation – Involves the capture of exhaust heat (or other useful thermal energy such as steam) from a generating facility that produces electricity, for use in industrial, commercial, heating, or cooling processes.

Demand – The amount of electricity consumed by customers at any given time or over a period of time.

Demand Side Management – The planning, implementation, and monitoring of utility activities designed to encourage consumers to modify patterns of electricity usage, including the timing and level of electricity demand. It refers only to energy and load-shape modifying activities for the purpose of reducing peak load and the need for generating capacity at such times.

Forced Outage – The shutdown of a generating unit, transmission line or other system asset for either emergency reasons or unexpected breakdown.

Gigawatt-hour (GWh) – A measure of electricity consumption in gigawatts for a one-hour continuous period. One gigawatt hour equates to one million kilowatt hours.

Interruptible Load – Load that, in accordance with contractual arrangements, can be interrupted at times of peak load. Load can be disconnected, either manually or automatically, and usually involves commercial and industrial consumers.

Kilowatt-hour (kWh) – The total amount of energy used in one hour by a device that uses one kilowatt of power for continuous operation. Electric energy is commonly sold by the kilowatt-hour, which equates to 1000 watt-hours.

Line Pack – Refers to the gas that is in the pipeline at any given point in time for the purpose of maintaining minimum pipeline operating pressure. Line pack does not increase gas supply availability, but increases short-term deliverability by moving gas from one place on the pipeline to another.

LNG – An abbreviation for liquefied natural gas. LNG consists mainly of methane – the simplest hydrocarbon.

Load – The amount of electricity required to meet demand at any given time.

Load Duration – Indicates the proportion of time that particular levels of demand (expressed as a proportion of the maximum demand for a year) are exceeded.

Load Shedding – Occurs when there is inadequate generation to meet demand resulting in disconnected load. Load shedding protocols enable the System Controller to automatically

disconnect load in order to maintain frequency and voltage and prevent the possible collapse of the system.

Megawatt (MW) – One megawatt equates to one thousand kilowatts.

Megawatt-hour (MWh) – One megawatt-hour equates to one thousand kilowatt-hours. One MWh of electricity can power ten thousand 100-watt light bulbs for one hour.

Network – That part of the power system involved in the transmission and distribution of electricity from generation sources to end-use customers.

Operating Reserves – The generation arrangements required to maintain system security by handling short-term disturbances in the system.

Petajoules (PJ) – A measure of energy in petajoules. One petajoule equates to 1000 terajoules.

Planned Outage – Occurs when a network provider disconnects supply in order to undertake maintenance or capital works on a part of its network.

Planning Reserves – The generation reserves required to maintain system adequacy by meeting annual demand peaks.

Regulated Power System – A system for generating and supplying electricity that is based on an electricity network that is subject to regulation under the *Electricity Networks (Third Party Access) Act 2000*.

Reserve Margin – The reserve level associated with the point at which, given the current demand and supply capabilities of a power system, intervention in the market is required to ensure risks to supply are minimised.

Sent-out Energy – The amount of electricity measured leaving a generator at its connection point to the transmission or distribution network, and therefore does not reflect network losses.

System Adequacy – The power system's ability to supply the aggregate energy requirements of end-use customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements.

System Security – The power system's ability to withstand sudden disturbances such as electric short circuits or unanticipated loss of system elements.

TCF – A measure of the size of a resource in trillion cubic feet. One TCF equates to 930PJ.

Terajoules (TJ) – A measure of energy in terajoules.