POWER SYSTEM REVIEW

2009-10

March 2011

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Disclaimer

The Power System Review is prepared by the Utilities Commission in accordance with section 45 of the *Electricity Reform Act*.

The Review is prepared using information sourced from participants of the electricity supply industry, Northern Territory Government agencies, consultant reports, and publicly available information. The Commission understands this information to be current as at March 2011.

The Review contains predictions, estimates and statements that are based on the Commission's interpretation of data provided by electricity industry participants, and assumptions about the power system, including load growth forecasts and the affect of potential major developments in particular power systems. The Commission considers that the Review is an accurate report within the normal tolerance of economic forecasts.

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CHAPTER 1

Overview

1.1 The Commission's annual Power System Review reports on power system performance and capacity in the Northern Territory. The Review provides information and analysis of historical and forecast power system performance, focusing on the previous financial year, and on the upcoming 10 years.

1.2 This Review reports on actual system and network performance in 2009-10, and on forecast system performance in the period 2010-11 to 2019-20.

1.3 The Commission engaged a consultant to assist the Commission to prepare the 2009-10 Review by providing expert advice on power system and distribution planning, and reliability performance.

Key findings

1.4 Regular and comprehensive reporting on power system and distribution network performance and health is a feature of the electricity supply industry elsewhere in Australia.

1.5 The 2009-10 Review places an increased focus on electricity demand analysis. The purpose is to provide a robust assessment of the adequacy of the power system (i.e. generation) and the transmission and distribution networks (i.e. substations and lines).

1.6 The Commission is aware that electricity businesses operating elsewhere in Australia have taken some time to establish the systems and processes required to meet reporting requirements. Consequently, the Commission acknowledged from the outset that not all the information requested from electricity industry participants in the Territory, primarily the Power and Water Corporation (PWC), would be available for the 2009-10 Review.

1.7 The Commission expects PWC to provide a more comprehensive data set for the next Review. In particular, the Commission expects that PWC will have improved demand forecasts, with the PWC system (generation) demand forecasts available for the 2009-10 Review being too low for the purpose of assessing system adequacy. The PWC networks demand forecasts appear more reasonable. The Commission notes that the PWC is instituting information technology systems and business processes that are intended to provide more complete asset performance information, and improved electricity demand forecasting.

Generation adequacy

1.8 The generation supply-demand balance provides an assessment of generation adequacy relative to forecast electricity demand in the Darwin-Katherine, Alice Springs and Tennant Creek systems for the period 2010-11 to 2019-20.

1.9 Currently, a system is deemed to have adequate generation where there is sufficient capacity available to maintain supply despite the loss of the two largest units of generation plant, known as an N-2 event.

1.10 The Commission considers that further work is necessary to identify an optimum level of generation capacity for the Territory's power systems that recognises reliability performance and cost objectives. The Commission considers that probabilistic analysis of the adequacy of generation capacity is necessary. This is the approach most commonly used in Australia for identifying the potential for capacity constraints, and is a more useful measure for generation planning purposes than the N-X methodology.

Generation adequacy – Darwin-Katherine

- The Darwin-Katherine system is expected to have sufficient generation capacity to maintain supply under any credible electricity demand scenario despite the loss of the two largest generation units in the system (an N-2 event) from mid-2011 to 2019-20.
- There is a credible risk of generation capacity constraints and poor generation reliability during 2011, particularly prior to the commissioning of Channel Island power station sets 8 and 9 which PWC has advised is expected to occur during April 2011. There is potential for ongoing capacity constraints if the new Channel Island plant experiences commissioning problems or from forced outages of existing plant.
- The capacity being maintained in the Darwin-Katherine system for the period 2012 to 2016 may be greater than is reasonably necessary to maintain reliability of supply depending on factors such as plant condition, maintenance requirements and operating practices.
- The need for the planned level of generation capacity and reserves could be prompted by doubts about the condition and reliability of existing generation plant, particularly at Channel Island. There seems to be a perceived risk of these assets failing or not being available for extended periods due to extended maintenance, but this assumption is not explicitly recognised in PWC Generation planning. It should be reflected in planning assumptions for the timing and duration of planned outages or by de-rating of existing capacity.
- If the apparent, but not clearly documented, concerns about the reliability and availability of the older Channel Island sets prove warranted, the reported available capacity may be less for extended periods because plant is off-line for maintenance.

Generation adequacy – Alice Springs

- The Alice Springs system is expected to have sufficient generation capacity to meet forecast peak demand under any credible electricity demand growth scenario from mid-2011 to 2019-20.
- There is a credible risk of generation capacity constraints and poor generation reliability during 2011. The key risk period is prior to the commissioning of Owen Springs sets 1-3 which PWC has advised is expected to occur by March 2011. There is the potential for ongoing capacity constraints if the new Owen Springs plant experiences commissioning problems or from forced outages of existing plant.
- The level of the available capacity in the Alice Springs system is influenced by the timing of commissioning new capacity at Owen Springs and decommissioning of capacity at Ron Goodin. The Commission considers that PWC should keep the

timing of the installation of new plant under review to optimise the amount of plant installed or decommissioned on a yearly basis.

Generation adequacy – Tennant Creek

- The generation supply-demand balance in the Tennant Creek system is adequate for the period to 2019-20.
- New capacity is expected to be commissioned in mid-2011, providing sufficient capacity to meet an N-2 event for the period to 2019-20.
- Subject to industry standard operation and maintenance practices being followed, generation capacity is sufficient to meet forecast demand, with a significant reserve margin for the period January 2011 to June 2020.

Fuel supply

1.11 Natural gas is the main fuel for electricity generation in the Darwin-Katherine, Alice Springs and Tennant Creek systems. However, a number of generation sets are dual fuel, and able to use liquid fuels (i.e. diesel) as an alternative fuel source.

1.12 PWC has a range of contingency arrangements to maintain electricity supply in the event of the partial or complete loss of the primary gas supply from Blacktip, with a contingency supply arrangement with the Darwin liquid natural gas (LNG) plant, linepack gas and diesel stocks.

1.13 These alternate fuel sources should provide access to a continued fuel supply to power stations, even in the circumstances of partial or complete loss of gas from Blacktip due to production or processing equipment failure or cyclonic activity or a pipeline rupture.

Electricity networks adequacy

1.14 For the 2009-10 Review, the Commission requested PWC Networks (as owner/operator of the Darwin-Katherine, Alice Springs and Tennant Creek networks) to provide equivalent information to that routinely reported by transmission and distribution network operators in the national electricity market (NEM).

1.15 The Commission's intention was to identify potential network capacity constraints in the period 2010-11 to 2014-15:

- transmission/sub-transmission feeders that might exceed normal rating;
- bulk and zone substations that might exceed normal rating; and
- distribution feeders that might exceed normal rating.

1.16 Although routinely provided by network operators elsewhere in Australia, this is the first time that PWC Networks has been requested to provide equivalent information. In responding to the request, PWC Networks found that not all the information sought is yet available.

1.17 This is not unexpected given the experience of network operators elsewhere in Australia, and the Commission anticipates that PWC will take two or three years to develop the systems and practices to collate and report the requested data. The Commission expects to be able to provide a more comprehensive analysis of network capacity and constraints in future Reviews.

Transmission network adequacy – lines

1.18 Based on the information available, a high level assessment of capacity and constraints in the Darwin-Katherine system has been undertaken due to the criticality of the transmission/sub-transmission network to security of supply.

1.19 The analysis indicates a potential capacity constraint in the Palmerston sub-system, with potential overloading of the Hudson Creek-Palmerston and Hudson Creek-McMinn's 66 kV network under first contingency conditions (N-1) in 2012-13 and 2013-14. However, this constraint is expected to be relieved on the completion of Archer zone substation. The potential for overloading may also be managed by using the low voltage distribution network to transfer load.

1.20 The Commission cautions that the assessment relies on a number of simplifying assumptions and is presented to provide a high level indication of capacity and potential capacity constraints. The Commission expects to provide a more authoritative assessment in future Reviews as the necessary data becomes available.

Transmission network adequacy – substations

1.21 There are 28 bulk and zone substations across the Darwin-Katherine, Alice Springs and Tennant Creek systems, with an assessment of substation utilisation possible for 25 substations.

1.22 With all transformers in service, all zone substations should have sufficient capacity to meet forecast load for 2010-11. The Snell Street zone substation faces an emerging capacity constraint.

1.23 Under N-1 conditions (i.e. the loss of one transformer), five substations face capacity constraints in 2010-11 and 2013-14.

- Berrimah 66/11 kV, with 99 per cent utilisation in 2010-11 and 2013-14. PWC Networks is planning construction of a new East Arm substation (operating from circa 2015-16) to support the Berrimah substation;
- Centre Yard 66/11 kV, with 100 per cent utilisation in 2010-11 and 120 per cent utilisation in 2013-14. Centre Yard is a small (0.5 MVA) substation where PWC Networks is considering supplementing capacity by relocating spare transformers;
- Palmerston 66/11 kV, with 115 per cent utilisation in 2010-11 and 97.5 per cent utilisation in 2013-14. The Palmerston substation will be supported by the new Archer zone substation (expected to be operational in 2011) and load transfer through the low voltage distribution network;
- Katherine 132/22 kV, with 107 per cent utilisation in 2010-11 and 109 per cent utilisation in 2013-14. The Katherine substation is supported by Pine Creek and Katherine generation. Accounting for this generation should resolve the apparent constraint; and
- Snell Street 66/11 kV, with 106 per cent utilisation in 2010-11 and 116 per cent utilisation in 2013-14. Snell Street represents the most critical constraint due to its role supplying the Darwin CBD. PWC Networks intends construction of a replacement substation (operating from circa 2011-12).

1.24 The Commission notes that the poor condition of equipment at the City Zone and Snell Street substations makes a multiple contingency event a possibility which warrants a continued priority being given to the capital program associated with the development

of Frances Bay substation, upgrade of Snell Street substation and replacement of City Zone substation.

Distribution network adequacy

1.25 PWC Networks was not able to provide the load flow studies or measurements on the low voltage (11/22 kV) distribution network necessary for an assessment of loading and capacity. The Commission considers that availability of this data is important and anticipates that PWC Networks will provide such information for future Reviews.

Reliability

1.26 The Commission has examined reliability for 2005-06 to 2009-10 for:

- generation and network performance in the Darwin region and Katherine region (of the Darwin-Katherine system), Alice Springs and Tennant Creek systems, using a weighted total average of reliability outcomes for each system; and
- central business district (CBD), urban, short rural and long rural feeders (for 2009-10 only), using a weighted total average of feeder reliability for each system.

Generation performance trend

1.27 Territory customers experienced an average of 2.7 generation related outages a year (SAIFI) between 2005-06 and 2009-10. This is significantly more than observed in the NEM connected systems (e.g. for the 12 months ended 31 March 2010, Ergon Energy reported a SAIFI of 0.02).

1.28 The Commission expects generation reliability performance to improve in the coming years with the commissioning of new generation plant (especially Channel Island sets 8 and 9) and the planned major maintenance to existing generation plant.

Network performance trend – feeder performance

1.29 Examining feeder performance to identify network performance trend is the accepted approach in Australia. As 2009-10 is the first year this data has been reported, there is no time series data to compare reliability performance in the Territory over time.

1.30 The Commission has compared feeder performance in the Territory for 2009-10 with the minimum performance standards applicable to comparable network categories in Queensland.

1.31 Overall, the PWC feeder performance is reasonable when compared with the regulatory expectations in Queensland. However, the frequency of outages on long rural feeders is markedly higher than the minimum performance standard for the Queensland distributors. The Commission will report feeder performance in future Reviews to assess feeder performance achieved in the Territory over time.

Customer service performance

1.32 The customer service performance of PWC Networks and PWC Retail is measured using the following indicators:

- the time taken to complete reconnections and new connections;
- the number of complaints about quality of electricity supply;
- the time taken to answer telephone calls (after the customer has chosen to speak to an operator); and
- the number of complaints about PWC Networks and PWC Retail customer service.

Reconnections/connections

- the number of reconnections (i.e. those typically made when someone moves into a new residence) occurring within 24 hours is greater than 99 per cent.
- the number of connections to a property in a new subdivision in an urban area occurring within five working days is 92.1 per cent, continuing the improvement in the number occurring in time from a low point of 80.7 per cent in 2006-07.
- the number of connections to a property in a new subdivision in an urban area where minor works are required occurring within 10 weeks is 30.6 per cent, which is worse than in 2008-09 and the worst result in the five year period.

Quality of supply complaints

- The number of quality of supply complaints has increased substantially in Katherine and Tennant Creek from 2008-09. No reason has been given to the Commission.

Telephone call response times

- The reported percentage of telephone calls to PWC answered within 20 seconds of the customer choosing to speak to a human operator was 63 per cent in 2009-10. This represents an improvement from 2008-09, but is below the 76 per cent achieved in 2005-06.

Customer complaints

- PWC received 2477 electricity service related complaints during 2009-10, the highest number received since 2005-06 (2907).

CHAPTER 2

Introduction

2.1 The Commission's annual Power System Review reports on power system performance and capacity in the Northern Territory. The Review provides information and analysis of historical and forecast power system performance, focusing on the previous financial year, and on the upcoming 10 years.

2.2 The Review is prepared in accordance with the *Electricity Reform Act* [s45], which requires the Commission to:

- report forecasts of electricity load and generating capacity;
- report on the performance of the Territory's power systems;
- advise on matters relating to the future capacity and reliability of the Territory's power systems relative to forecast load;
- advise on other electricity supply industry and market policy matters; and
- review the prospective trends in the capacity and reliability of the Territory's power systems relative to projected load growth.

2.3 The Review relates only to the Darwin-Katherine, Alice Springs and Tennant Creek power systems (referred to as the market systems).[1]

2.4 The Review is prepared with the assistance and advice of participants in the electricity supply industry, other electricity industry stakeholders and consultant reports. The input of all those who have contributed is appreciated, but the views expressed in the Review are those of the Commission, and may not necessarily reflect those of the parties consulted.

Overview of 2009-10 Review

2.5 This Review reports on actual system and network performance in 2009-10, and on forecast system performance in the period 2010-11 to 2019-20.

2.6 The Commission engaged a consultant to assist the Commission to prepare the 2009-10 Review by providing expert advice on power system and distribution planning, and reliability performance.

Role of expert advisor

2.7 The Commission engaged Evans & Peck[2] to assist in development of the information request to electricity industry participants, collecting relevant information, and providing

1 The activities of electricity industry participants and customers in the market systems are regulated under the *Electricity Reform Act*, *Electricity Networks (Third Party Access) Act* and Code and associated legislation.

2 Evans & Peck <www.evanspeck.com> is an infrastructure focused advisory company with over 350 employees, and experience in economic regulation and pricing, and the planning, construction and operation of energy, water and resources projects and facilities. E&P is a subsidiary of the WorleyParsons Group.

an assessment of the performance and capacity of the Territory's power systems and distribution networks. The advice provided by Evans & Peck to the Commission covers four main areas:

- assessment of electricity demand and energy forecasts prepared by industry participants;
- assessment of future capacity and reliability of the power systems and distribution network;
- assessment of the performance of the Territory's power systems and distribution network; and
- advice on electricity supply industry practice.

2.8 In addition to the work of Evans & Peck, the 2009-10 Review draws on reports prepared for the Commission during 2010.

Availability of information

2.9 The Commission requested Evans & Peck to develop an information request template that detailed the information required from system participants for preparing the 2009-10 Review. The data specification was based on arrangements for reporting on system and distribution network health in place elsewhere in Australia.

2.10 Regular and comprehensive reporting on power system and distribution network performance and health is a feature of the electricity supply industry elsewhere in Australia.

2.11 The Australian Energy Market Regulator (AER) publishes an annual State of the Energy Market report to provide a high level overview of energy market activity in Australia, and supplement the AER's extensive technical reporting on the energy sector. The Australian Energy Market Operator (AEMO) publishes detailed reports on system planning and the operation of energy markets, notably the National Transmission Network Development Plan, Electricity Statement of Opportunities report and Power System Adequacy report. At the distribution network level, distribution network service providers are generally required under jurisdiction specific obligations to report on distribution planning and performance.

2.12 These reporting arrangements have developed over the past decade or more, during which time industry participants have built their capacity to provide relevant information.

2.13 The Commission is aware that electricity businesses operating elsewhere in Australia have taken some time to establish the systems and processes required to meet reporting requirements. Consequently, the Commission acknowledged from the outset that not all the information requested from electricity industry participants in the Territory, primarily the Power and Water Corporation (PWC), would be available for the 2009-10 Review.

2.14 The Commission expects PWC to provide a more comprehensive data set for the next Review. In particular, the Commission notes that the PWC is instituting information technology systems and business processes that are intended to provide more complete asset performance information.

Structure and scope of Review

2.15 The structure and scope of this Review is:

- Chapter Three provides some details of the Territory's electricity industry;
- Chapter Four provides an assessment of the adequacy of electricity generation supplies relative to forecast peak demand and an assessment of fuel supply adequacy for the medium term (next three years to 2012-13) and long-term (next 10 years to 2019-20);
- Chapter Five provides an assessment of the adequacy of the electricity transmission/sub-transmission and distribution networks capacity relative to forecast peak demand for the period to 2013-14; and
- Chapter Six reports on customer service performance and reliability of supply.

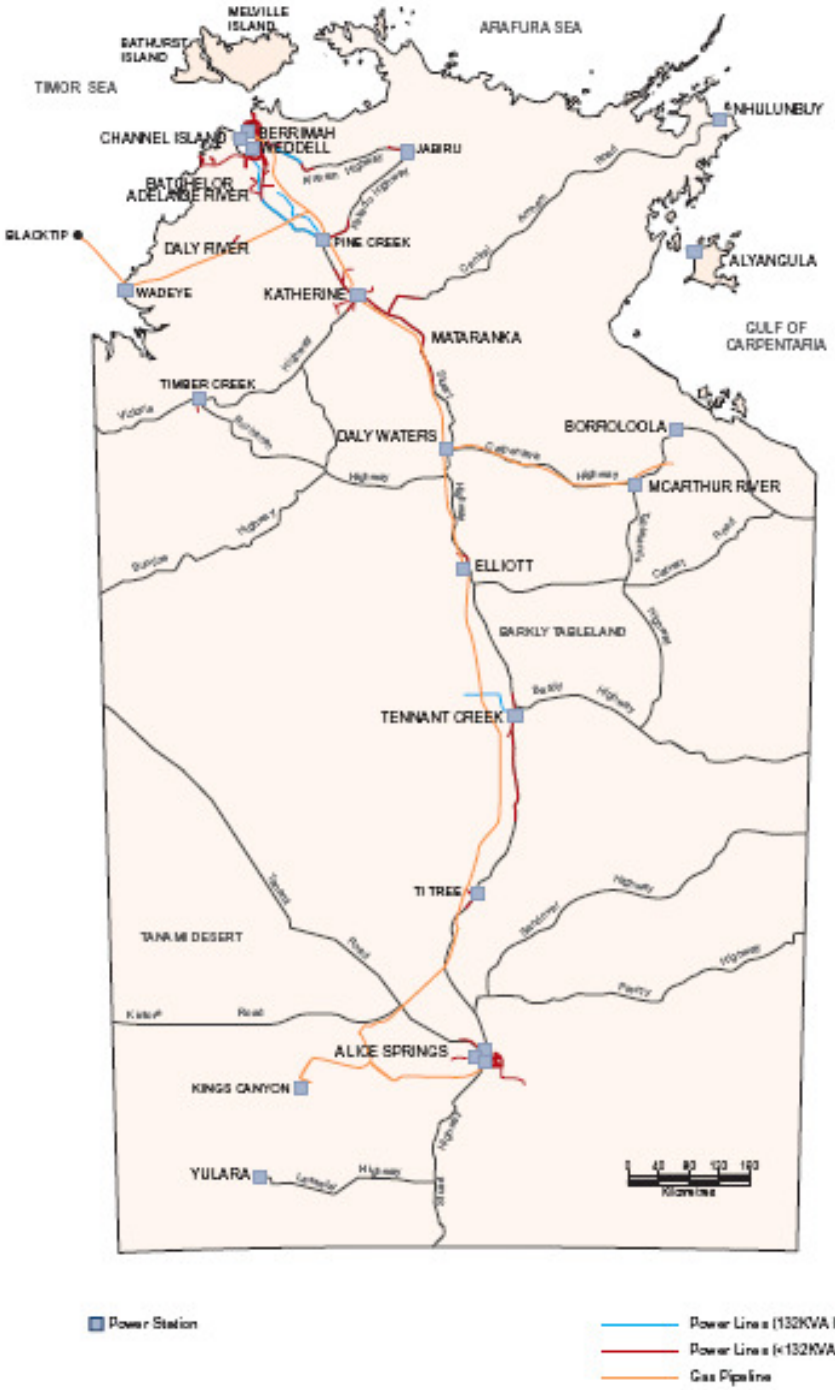
CHAPTER 3

Electricity supply in the Territory

Introduction

3.1 This chapter provides details of the Territory electricity industry, noteworthy industry developments and events in 2009-10.

Figure 3.1: Northern Territory energy supply infrastructure



Electricity industry participants

3.2 Electricity industry participants licensed to operate in the Darwin-Katherine, Alice Springs and Tennant Creek power systems at 30 June 2010 are listed in Table 3.1.

Table 3.1: Electricity licence holders at 30 June 2010

Licensees	Darwin-Katherine	Alice Springs	Tennant Creek
Generation	PWC Generation NGD (NT) P/L Cosmo Power P/L LMS Generation P/L	PWC Generation Central Energy Power	PWC Generation
Network	PWC Networks	PWC Networks	PWC Networks
Retail	PWC Retail	PWC Retail	PWC Retail

Source: Utilities Commission.

3.3 PWC generates most electricity for household and business use, operates the electricity distribution networks and provides retail services to all customers in the Darwin-Katherine, Alice Springs and Tennant Creek power systems.

3.4 PWC is a vertically integrated electricity supplier which also provides water supply and sewerage services. The PWC generation, network and retail units operate as separate businesses with internal transactions between units subject to oversight by the Commission. PWC is owned by the Territory Government and is subject to oversight by a shareholding Minister under the *Government Owned Corporations Act*.

3.5 The remaining industry participants are three generation businesses operating in the Darwin-Katherine system, and one generation business operating in the Alice Springs system. These four businesses generate electricity under power purchase agreements with PWC.

Market statistics

3.6 Table 3.2 provides some key market statistics for the Darwin-Katherine, Alice Springs and Tennant Creek power systems.

Table 3.2: Key market statistics at 30 June 2010

	Darwin-Katherine	Alice Springs	Tennant Creek
Customers (connections)	59 355	11 876	1485
Generation capacity (MW)	404	72	17
Peak demand (MW)	273	55	7
Electricity sent out (GWh)	1516	229	30
Network length (km)	4829	607	385

Source: Power and Water Corporation. Figures rounded to nearest whole number.

Industry developments and key events

3.7 Industry developments and key events for 2009-10 are detailed below.

Priority work program

3.8 In August 2009, the Northern Territory Government requested the Commission undertake a priority work program to increase the efficiency of PWC, improve customer standards of service and reliability, and where possible, align the Territory electricity industry with national electricity market practice.

3.9 The work program required the Commission to undertake a series of reviews under terms of reference approved by the Treasurer. At the time of writing, four reviews are complete, one is underway and one is yet to start:

- A Review of Full Retail Contestability for Northern Territory Electricity Customers was started in August 2009. The final report for this Review was provided to the Treasurer in December 2009 and released publicly in February 2010.
- A Review of Options for Implementation of a Customer Service Incentive Scheme for Electricity Customers was started in March 2010. The final report was provided to the Treasurer in July 2010 and released publicly in August 2010.
- A Review of Options for the Development of a Retail Price Monitoring Regime for Contestable Electricity Customers started in March 2010. The final report was sent to the Treasurer in October 2010, and released publicly in October 2010.
- A Review of Electricity Standards of Service was started in May 2010. The final report sent to the Treasurer in November 2010, and released publicly in December 2010.
- A Review of System Planning, Monitoring and Reporting started in December 2010. The final report is to be provided to the Treasurer in mid 2011.
- A Review of Electricity System Planning and Market Operation Roles and Structures is to start in April 2011. A final report is to be provided to the Treasurer in mid 2011.

3.10 Each review has involved extensive analysis and consultation with electricity industry participants, consumers and interest groups.

Natural gas supply

3.11 Natural gas from the Blacktip field in the Bonaparte Gulf was to be used for electricity generation in the Territory from January 2009. However, construction delays attributed to difficulties sourcing components and bad weather meant that gas was not available until late 2009. Full specification gas was available from mid January 2010 in sufficient quantities to meet electricity generation requirements.

Darwin-Katherine system black on 30 January 2010

3.12 On 30 January 2010, a lightning strike to the 132 kV transmission lines linking the Channel Island power station and Hudson Creek zone substation led to a black out of the entire Darwin-Katherine power system – a system black.

3.13 A system black is the most significant and disruptive event that can affect a power system, and warrants a detailed analysis of the causes and response to identify implications for system reliability and security.

3.14 The system black was investigated by the System Controller. The Commission subsequently provided a separate report to industry participants and the Territory Government, with an independent assessment of the event.

3.15 The Commission's main observations about the event and the subsequent response are:

- the system black was initiated by a lightning strike, but the customer related impacts were made significantly worse by avoidable errors, such as equipment failure, inadequate operating procedures and switching errors;
- the event resulted in all customers in the Darwin-Katherine system losing power. Power was restored in Katherine within 30 minutes, with the rest of the system gradually restored within 10 hours. The average customer interruption was about five hours;
- if not for switching errors, Katherine and Pine Creek customers would probably not have lost power, and Darwin customers would probably have been without power for a much shorter period; and
- PWC is addressing the issues identified through the incident investigation, including improving operating procedures and training.

Generation investment program

3.16 PWC Generation announced a major generation investment program in March 2010, involving the installation at Channel Island power station of two 45 MW dual fuel turbines. The new generation plant was to provide additional capacity to meet increasing peak demand and to provide additional reserve capacity to allow major maintenance on existing generation plant.[3]

3.17 The new generation plant was initially planned to be operating for the 2010-11 wet season, but is now expected to be operating from April 2011.

Subsequent developments

3.18 The Commission notes that subsequent developments since July 2010 that will be addressed in more detail in the 2010-11 Review:

- QEnergy Pty Ltd was granted an Electricity Retail Licence in February 2011. QEnergy is a retailer in the National Electricity Market (NEM) with customers in Queensland. The entry of QEnergy into the Territory's electricity retail market provides customers with a choice of retailer for the first time since 2002; and
- Alice Springs system black on 7 October 2010 when a generation related outage caused all Alice Springs customers to lose power. The System Controller provided the Commission with an investigation report on the incident.

[3] Power and Water Corporation, media release, 31 March 2010, <www.powerwater.com.au>, http://www.powerwater.com.au/newsroom/news_item/2010/rolls_royce_power_for_channel_island.

CHAPTER 4

Electricity generation

4.1 This chapter examines the capacity and adequacy of electricity generation in the Darwin-Katherine, Alice Springs and Tennant Creek systems, and reports:

- generation capacity at 30 June 2010;
- system demand forecasts for the medium term (to 2012-13) and long term (to 2019-20);
- the supply-demand balance for the system to 2012-13 and to 2019-20 (a projected assessment of system adequacy), and actual and potential system constraints related to generation capacity;
- the adequacy of generation capacity and the reserve margin to 2012-13 and potential capacity to 2019-20, based on available, committed and proposed generating capacity; and
- the adequacy of fuel supplies for electricity generation.

Generation capacity

4.2 Electricity supplied in the Darwin-Katherine, Alice Springs and Tennant Creek systems is generated by PWC Generation and four other licensed generation suppliers with agreements to supply PWC Generation.

4.3 Table 4.1 presents generation capacity figures as at 30 June 2010. The capacity reported is the sustainable installed capacity figure for generation plant (i.e. the capacity available under normal operating conditions).

Table 4.1: Generation capacity in the Darwin-Katherine, Alice Springs and Tennant Creek systems

Darwin Katherine	**Operator**	**Capacity (MW)**	**Fuel**
Channel Island	PWC	232	Natural gas/liquid fuel
Weddell	PWC	86	Natural gas
Berrimah	PWC	30	Liquid fuel
Katherine	PWC	21	Natural gas/liquid fuel
Pine Creek	NGD(NT) Cosmo Power	34	Natural gas/liquid fuel
LMS Shoal Bay	LMS Generation	1	Landfill gas
Total		**404**	

Alice Springs	Operator	Capacity (MW)	Fuel
Ron Goodin	PWC	59	Natural gas/liquid fuel
Owen Springs	PWC	4	Natural gas/liquid fuel
Brewer	Central Energy Power	9	Natural gas/liquid fuel
Total		**72**	

Tennant Creek	Operator	Capacity (MW)	Fuel
Tennant Creek	PWC	17	Natural gas/liquid fuel
Total		**17**	

Source: Power and Water Corporation. Figures are rounded to the nearest whole number.

Darwin-Katherine – 2009-10

4.4 Just over 82 per cent of total generation capacity is located in the Darwin-Katherine system, with over 47 per cent at the Channel Island power station. The next most significant power station in the market systems is the Weddell power station (also in the Darwin-Katherine system), with about 17 per cent of capacity. About 15 per cent of total generation capacity is located in the Alice Springs system and 3 per cent in the Tennant Creek system.

4.5 The Channel Island power station has five dual fuel (gas and diesel) combustion turbines (sets 1-5) with a capacity of 31.6 MW each, one gas fuelled combustion turbine (set 7) with a capacity of 42 MW, and one steam turbine (set 6) which operates as part of a combined cycle block, using the waste heat from sets 4 and 5, to provide 32 MW capacity.

4.6 Each of the sets at Channel Island represents almost 8 per cent of capacity in the Darwin-Katherine system. The combined cycle block formed by sets 4, 5 and 6 can produce 95 MW, representing about 23 per cent of capacity in the system.

4.7 Weddell power station has a capacity of 86 MW, comprising two gas fuelled turbines, each with a capacity of 43 MW. Each set represents about 9 per cent of total capacity in the Darwin-Katherine system.

4.8 Pine Creek power station, operated by NGD (NT) Pty Ltd and Cosmo Power Pty Ltd (subsidiaries of Energy Developments Ltd), has 34 MW from three gas fuelled combustion turbines and three dual fuel combustion turbines. The Pine Creek power station supplies electricity to PWC Generation under a power purchase agreement.

4.9 Also supplying PWC Generation with electricity under a power purchase agreement in the Darwin-Katherine system is LMS Generation Pty Ltd, which operates a 1.1 MW land fill gas generation facility at the Darwin City Council Shoal Bay rubbish dump.

Alice Springs – 2009-10

4.10 Ron Goodin power station in Alice Springs has a capacity of 72 MW comprising three diesel engines (sets 1, 2 and J) with a combined capacity of 4.7 MW, six dual fuel engines (sets 3-8) with a combined capacity of 29.1 MW and four gas turbines (sets 9, 10, F and G) with a combined capacity of 25.8 MW.

4.11 There was a minor change to generation capacity in the Alice Springs system in 2009-10. Capacity at the Ron Goodin power station increased from 58.7 MW to 59.6 MW with the commissioning of a 0.9 MW diesel fuelled engine (set J).

4.12 Owen Springs power station in Alice Springs has a capacity of 3.9 MW, being a dual fuel combustion turbine that was relocated from Ron Goodin in June 2009. Three dual fuel combustion turbines, each with 10.9 MW of capacity were installed at the Owen Springs power station during 2010, and are expected to begin supplying electricity in the first quarter of 2011.

4.13 Once operating, the Owen Springs power station is intended to replace Ron Goodin power station, where generating units will be retired gradually over the period to 2018-19.[4]

4.14 Brewer power station, operated by Central Energy Power Pty Ltd, has 8.5 MW from four spark fired reciprocating engines. Brewer operates under a power purchase agreement with PWC Generation.

4.15 Not mentioned in the 2008-09 Review, generation capacity in Alice Springs increased in 2009 with a 0.3 MW photovoltaic system installed at the Crowne Plaza Alice Springs as part of the Alice Springs Solar Cities program.[5]

4.16 This PV system is not included in calculations of system capacity because the electricity is generated for use on site only. During optimal operating conditions, the Crowne Plaza system is expected to reduce total system load by about 0.5 per cent.

Tennant Creek – 2009-10

4.17 The Tennant Creek power station has a capacity of 16.7 MW, comprising seven diesel engines (sets 1-5 and 16) with a combined capacity of 8 MW, five gas engines (sets 10-14) with a combined capacity of 4.8 MW and a dual fuel turbine (set 15) with a capacity of 3.9 MW.

Power purchase agreements

4.18 PWC Generation was supplied electricity during 2009-10 by four businesses licensed to operate as independent power producers:

- in the Darwin-Katherine system, NGD (NT) Pty Ltd and Cosmo Power Pty Ltd (subsidiaries of Energy Developments Ltd) operate Pine Creek power station;
- in the Darwin-Katherine system, LMS Generation Pty Ltd operates a land fill gas generation facility at the Darwin City Council Shoal Bay rubbish dump; and
- in the Alice Springs system, Central Energy Power Pty Ltd operates Brewer Estate power station.

4.19 These four firms currently operate generation equipment with a total capacity of about 44 MW, or potentially about 9 per cent of total generation capacity of the market systems.

[4] Power and Water Corporation website <www.powerwater.com.au>, viewed 10 February 2011, http://www.powerwater.com.au/about_us/major_projects/owen_springs_power_station.

[5] Alice Solar City website <www.alicesolarcity.com.au>, viewed 2 March 2011, http://www.alicesolarcity.com.au/iconic-projects.

Generation supply-demand balance

4.20 The generation supply-demand balance is an assessment of whether available generation capacity is adequate to meet forecast electricity demand. To make this assessment the Commission has used:

- generation capacity projections for 2010-11 to 2012-13, and advice of generation investment plans for 2013-14 to 2019-20; and
- electricity demand forecast scenarios for 2010-11 to 2019-20.

Projected available generation capacity

4.21 Generation capacity projections for the Darwin-Katherine, Alice Springs and Tennant Creek systems for 2010-11 to 2012-13 are provided in the tables below.

4.22 The capacity projections are based on advice by industry participants to the Commission of available capacity, planned generation additions and retirements in the period 2010-11 to 2019-20. Capacity projections for the period 2013-14 to 2019-20 are not reported due to uncertainty about outcomes versus plans. The Commission cautions that the timing of additions and retirements of capacity may vary in response to commercial priorities of electricity industry participants, construction or commissioning delays and changing electricity peak demand forecasts.

4.23 The Commission will be seeking more specific estimates of generation commitments and future generation capacity for the next Review. The information available for the 2009-10 Review on the timing of new capacity was generally limited to the estimated year of commissioning. This is not sufficient to allow an informed assessment of the within year supply-demand balance. Consequently, the Commission has made assumptions about the likely month that new capacity will become available based on available information and good industry practice.

Darwin-Katherine system

4.24 Table 4.2 provides the Commission's assessment of generation capacity in the Darwin-Katherine system for 2010-11 to 2012-13. The starting capacity of the Darwin-Katherine system for 2010-11 is 404 MW.

Table 4.2: Darwin-Katherine capacity projections (MW) 2010-11 to 2012-13

Year (30 June)	Retirements	New capacity	Total Capacity	Comment
2010-11	37.5	86	452.5	Less Berrimah Less Pine Creek B Plus Channel Island sets 8&9
2011-12	-	54.1	506.6	Plus Weddell set 3 Plus Katherine set 4
2012-13	-	-	506.6	

Source: Power and Water Corporation and Utilities Commission.

4.25 PWC has advised that Berrimah power station will be removed from regular service in 2010-11, reducing the system capacity by 30 MW. The Commission has excluded Berrimah power station from the calculation of available generation capacity for 2010-11 on the understanding that the equipment is aged, in poor condition and may

not be available for service, even in an emergency situation. PWC advises that the expiry of the Pine Creek B power purchase agreement in April 2011 will reduce available capacity by a further 7.5 MW.

4.26 New capacity of 86 MW is expected to become available during 2010-11 with the planned commissioning of Channel Island power station sets 8 and 9 from April 2011 with each providing 43 MW of capacity. The new plant was initially to be commissioned by October 2010.[6] PWC advises the Commission that the plant is to be commissioned from April 2011.

4.27 New capacity of 54.1 MW is expected to become available in 2011-12 with the commissioning of:

- Katherine power station set 4 in September 2011, adding 12 MW of capacity. This timeframe is a Commission estimate. PWC advises that this set is to be relocated from Ron Goodin power station (where it is currently designated as set 10) during 2011, but has not advised the timing of the set being decommissioned at Ron Goodin or recommissioned at Katherine. The Commission has assumed the set will be decommissioned once new capacity is available from Owen Springs power station (March 2011), and that the relocation and upgrading will take four months; and
- Weddell power station set 3 (42 MW) in early 2012. No definite advice is available from PWC on the month of commissioning. The Commission has assumed set 3 will be available from January 2012.

Alice Springs system

4.28 The starting capacity of the Alice Springs system for 2010-11 is 72 MW.

Table 4.3: Alice Springs capacity projection (MW) 2010-11 to 2012-13

Year (30 June)	Retirements	New capacity	Total Capacity	Comment
2010-11	14.1	33.7	91.6	Plus Owen Springs sets 1,2&3 Plus Uterne solar power station Less Ron Goodin sets 10, F&G
2011-12	-	-	91.6	
2012-13	4.2	-	87.3	Less Ron Goodin set 3

Source: Power and Water Corporation and Utilities Commission.

4.29 New capacity of 32.7 MW is expected to become available in 2010-11 with the commissioning of Owen Springs power station sets 1, 2 and 3 from March 2011, each with 10.9 MW of capacity. PWC advises that electricity should be available from this new plant in the first quarter 2011.[7]

4.30 As part of the Alice Springs Solar Cities program a 0.96 MW solar power station is scheduled to be operating in Alice Springs from May 2011. The facility is owned by

[6] Power and Water Corporation website, viewed 17 February 2011, http://www.powerwater.com.au/newsroom/news_item/2010/rolls_royce_power_for_channel_island.

[7] Power and Water Corporation website, viewed 17 February 2011, http://www.powerwater.com.au/about_us/major_projects/owen_springs_power_station.

Uterne Power Plant Pty Ltd, and all production is to be sold to PWC Generation under a power purchase agreement.[8]

4.31 Also as part of the Solar Cities program a 0.2 MW photovoltaic system at the Alice Springs Airport was commissioned in September 2010. This PV system is not included in calculations of system capacity because the electricity is generated for use on site only. Under optimal operating conditions the Alice Springs Airport system is estimated to supply about 25 per cent of the airport electricity demand. [9]

4.32 The new capacity becoming available in 2011 will offset a 14.1 MW reduction in capacity from the planned retirement of Ron Goodin power station sets F (2 MW) and G (2 MW), and the planned relocation of Ron Goodin power station set 10 (10 MW) to the Katherine power station from April 2011. PWC has advised that the plant at Ron Goodin will be decommissioned in 2010-11, but has not advised the month of decommissioning. The Commission has assumed the set will be decommissioned once new capacity is available from Owen Springs power station.

4.33 PWC advises that Ron Goodin set 3 (4.2 MW) is to be retired in 2012-13. The Commission has assumed that the set will be decommissioned in January 2013. All generation at Ron Goodin is to be gradually removed from service between 2010-11 and 2018-19.

Tennant Creek system

4.34 The reported starting capacity of the Tennant Creek system for 2010-11 is 16.7 MW.

Table 4.4: Tennant Creek capacity projection (MW) 2010-11 to 2012-13

Year (30 June)	Retirements	New capacity	Total Capacity	Comment
2010-11	-	-	16.7	
2011-12	-	1.5	18.2	Plus set 17
2012-13	-	-	18.2	

Source: Power and Water Corporation and Utilities Commission.

4.35 PWC advises that 1.5 MW of new capacity will be commissioned at the Tennant Creek power station from July 2011.

System demand forecasts

4.36 Electricity system demand is the generation capacity (in megawatts) required to meet the electricity consumption (in megawatt hours) of customers at a point in time.

4.37 System demand is determined by household, business and industrial electricity consumption patterns, which are influenced by weather, population growth and household formation, economic growth and the development of energy intensive industrial projects.

[8] Alice Solar City website <www.alicesolarcity.com.au>, viewed 17 February 2011, http://www.alicesolarcity.com.au/sites/default/files/Media%20Release%20-%20Uterne%20Solar%20Power%20Station%20announcement%2015%20Dec%202010.pdf.

[9] Alice Solar City website <www.alicesolarcity.com.au>, viewed 17 February 2011, http://www.alicesolarcity.com.au/iconic-projects.

4.38 The focus of a system demand forecast is the expectation of maximum or 'peak' demand. Forecasts of peak demand are used to inform decisions about the supply-demand balance and the management of the electricity system to ensure a reliable and secure electricity supply:

- the system operator (the System Controller in the Territory) will use peak demand forecasts to determine the generation capacity operating and in reserve that must be available in the short term (e.g. in the next half hour and over the day) to meet customer energy use; and
- system participants will use peak demand forecasts to develop their maintenance program and to identify potential generation investment opportunities in the longer term (e.g. in three years time).

Development of system demand forecast scenarios

4.39 System demand forecasts for Territory power systems are produced by:

- PWC, through its System Controller role, will develop demand forecasts to use to ensure there is sufficient generation capacity available to meet demand as part of the day to day operation of the power systems; and
- the Commission, which is required under the *Electricity Reform Act* [s45(1)(a)] to develop forecasts of overall electricity load and generating capacity in consultation with participants in the electricity supply industry.

4.40 PWC Generation, PWC Networks and PWC Retail (and any other generator and retailer operating in the Territory) would also require system demand forecasts to schedule maintenance, to identify potential generation investment opportunities, potential network constraints and to inform estimates of energy sales.

4.41 PWC has been the sole market generator and sole retailer operating in the Territory, which puts it in a unique situation for Australia of having access to comprehensive information on historical and prospective peak demand and energy consumption.

4.42 For example, a new customer wanting to establish an energy intensive business activity would necessarily approach PWC Retail to negotiate an electricity supply contract. These negotiations would in some way involve PWC Generation and PWC Networks, informing their understanding and expectations of future peak demand and energy consumption in the power system, and decisions about the timing and location of new generation investment.

4.43 In contrast, there is no longer any vertically integrated electricity business in the NEM or the Western Australia south west interconnected system (SWIS). In these systems, the independent market and system operator is responsible for developing a coordinated and independent system demand forecast, based on information from all market participants.[10]

[10] The Australian Energy Market Operator prepares the Electricity Statement of Opportunities and Power System Adequacy documents for the NEM, available from <www.aemo.com.au>. The Independent Market Operator prepares an Electricity Statement of Opportunities document for the Western Australian SWIS, available from <www.imowa.com.au >.

PWC system demand forecasts

4.44 For the 2009-10 Review, the Commission started with PWC system demand forecast scenarios for the period 2010-11 to 2019-20 (prepared in late 2010) to develop forecasts of demand for the period 2010-11 to 2019-20 for the Darwin-Katherine, Alice Springs and Tennant Creek systems.

4.45 A range of quantitative and qualitative data was reviewed to determine if the PWC forecasts represent credible system demand scenarios. The Commission has identified a number of areas for continuous improvement, but notes that PWC is taking steps to address some of the deficiencies in the forecasting process. The findings include:

- the information underpinning the system demand forecasts was not of the standard that could be expected in support of the associated infrastructure investment program;
- inconsistencies between top down and bottom up forecasts – that is, the overall system demand forecast and the localised zone substation forecast;
- the forecasting process was poorly documented with the assumptions underpinning forecasts not always apparent or specified; and
- the forecasting process lacked key elements considered routine according to good industry practice, particularly weather correction of data and use of econometric modelling.

4.46 Evans & Peck found that the PWC system demand forecasts for the purposes of testing system adequacy for the period 2010-11 to 2019-20 are probably too low. However, a conclusive opinion of system demand growth over the period requires a comprehensive analysis using the elements common to the preparation of robust demand forecasts.

4.47 The Commission expects that PWC will in the future develop a consolidated system demand forecast that is sufficiently robust for the purposes of accurately assessing the supply-demand balance, including by adopting forecasts that are management sanctioned and confirmed by external review.

Forecast system demand scenarios

4.48 The Commission is adopting the Evans & Peck Medium system demand growth scenario for assessing system adequacy in the Darwin-Katherine, Alice Springs and Tennant Creek systems for the period 2010-11 to 2019-20. Table 4.5 compares the Evans & Peck Medium scenario with the PWC Medium and High scenarios for the period to 2010-11 to 2019-20.

Table 4.5: System demand growth scenarios for 2010-11 to 2019-20

Forecast demand growth (% per annum)	**Medium (E&P)**	**Medium (PWC)**	**High (PWC)**
Darwin-Katherine	2.8	2.2	2.6
Alice Springs	1.7	1.2	1.6
Tennant Creek	2.0	0.6	1.1

Source: Evans & Peck and Power and Water Corporation.

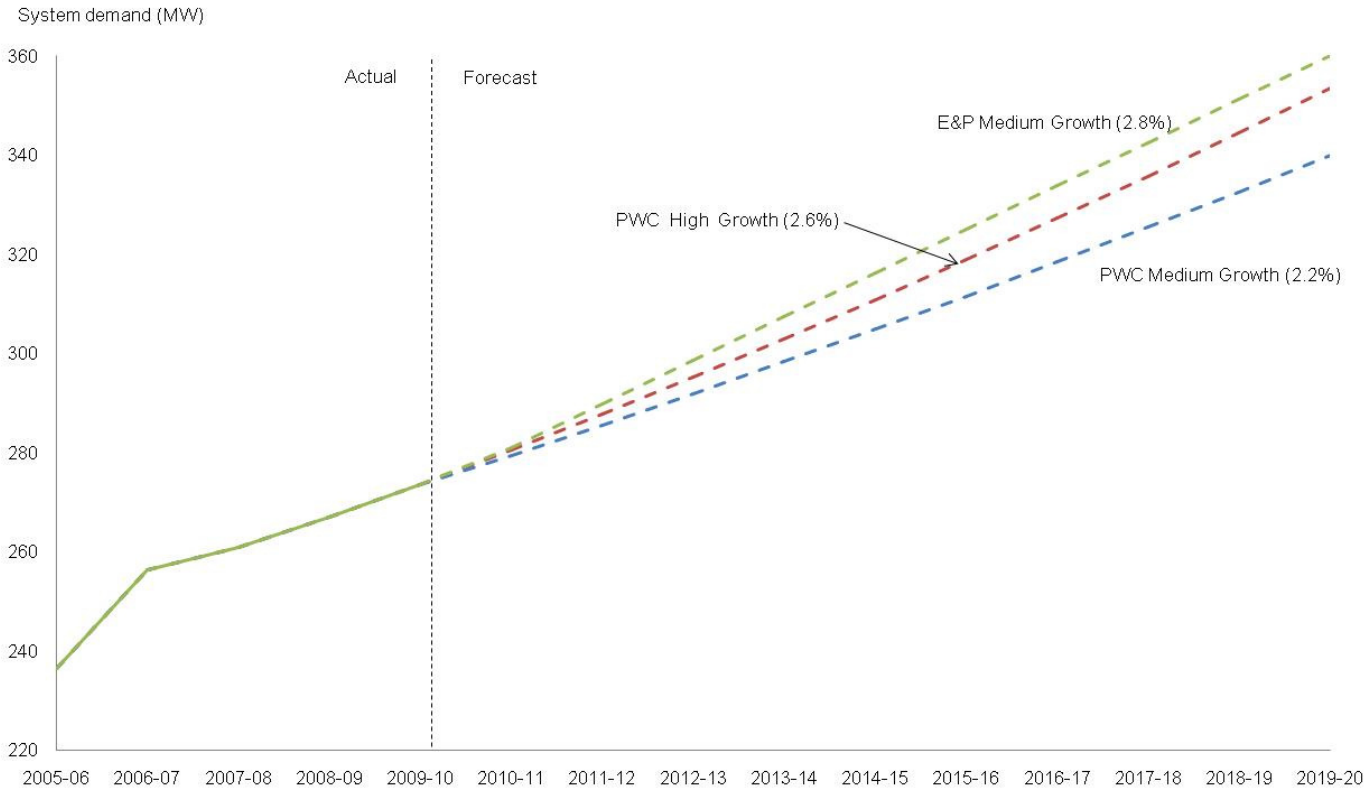
4.49 The Commission considers that the PWC demand forecast scenarios may be too low for the purposes of assessing system adequacy, particularly for the period from

2015-16. However, the period 2015-16 to 2019-20 is outside the critical period for identifying a shortfall in the supply-demand balance, and there remains sufficient time to reconsider potential peak demand for that period and for system participants to adjust future generation investment programs.

4.50 The Commission is aware that PWC is developing more effective forecasting techniques and capability to improve the reliability of longer term demand forecasts.

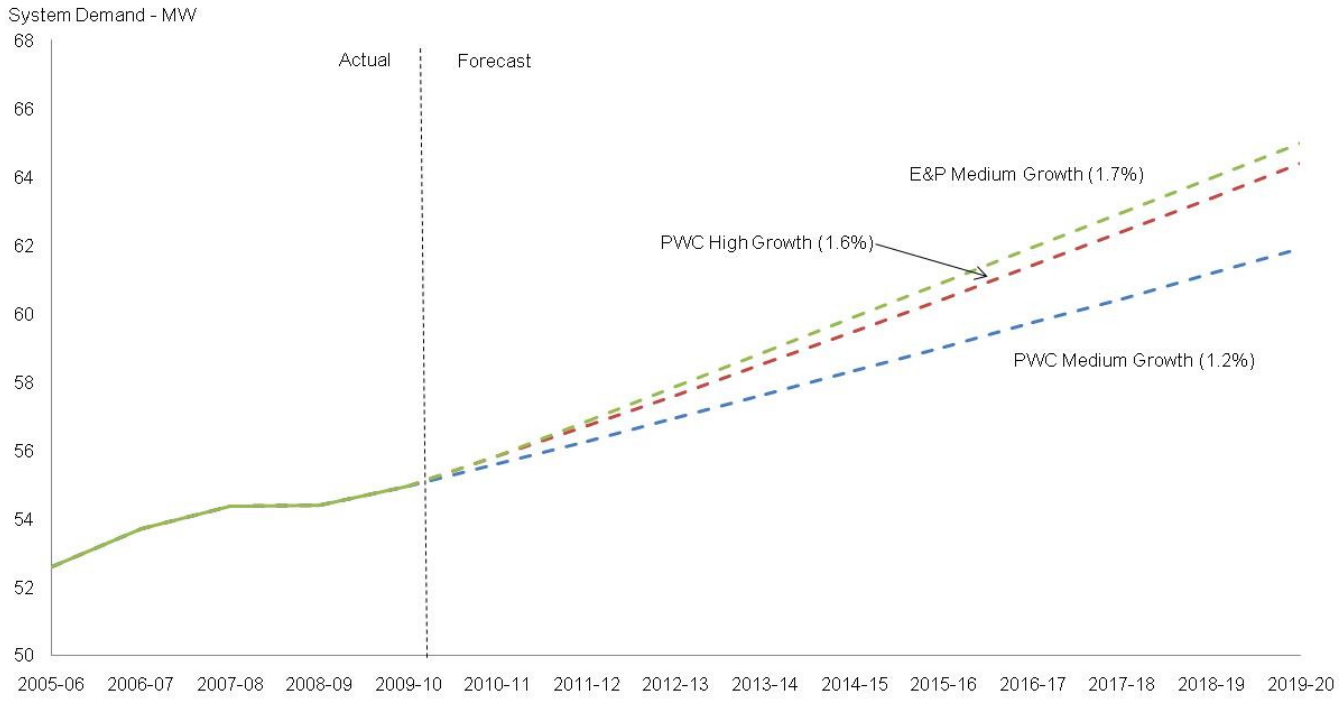
4.51 The Evans & Peck Medium (the Commission's baseline scenario), PWC Medium and PWC High forecast system demand scenarios for the Darwin-Katherine, Tennant Creek and Alice Springs systems are presented in charts 4.2, 4.3 and 4.4. Tables A.1, A.2 and A.3 in Appendix A provide the forecast maximum demand for 2010-11 to 2019-20.

Chart 4.2: Forecast Darwin-Katherine annual maximum system demand 2010-11 to 2019-2020



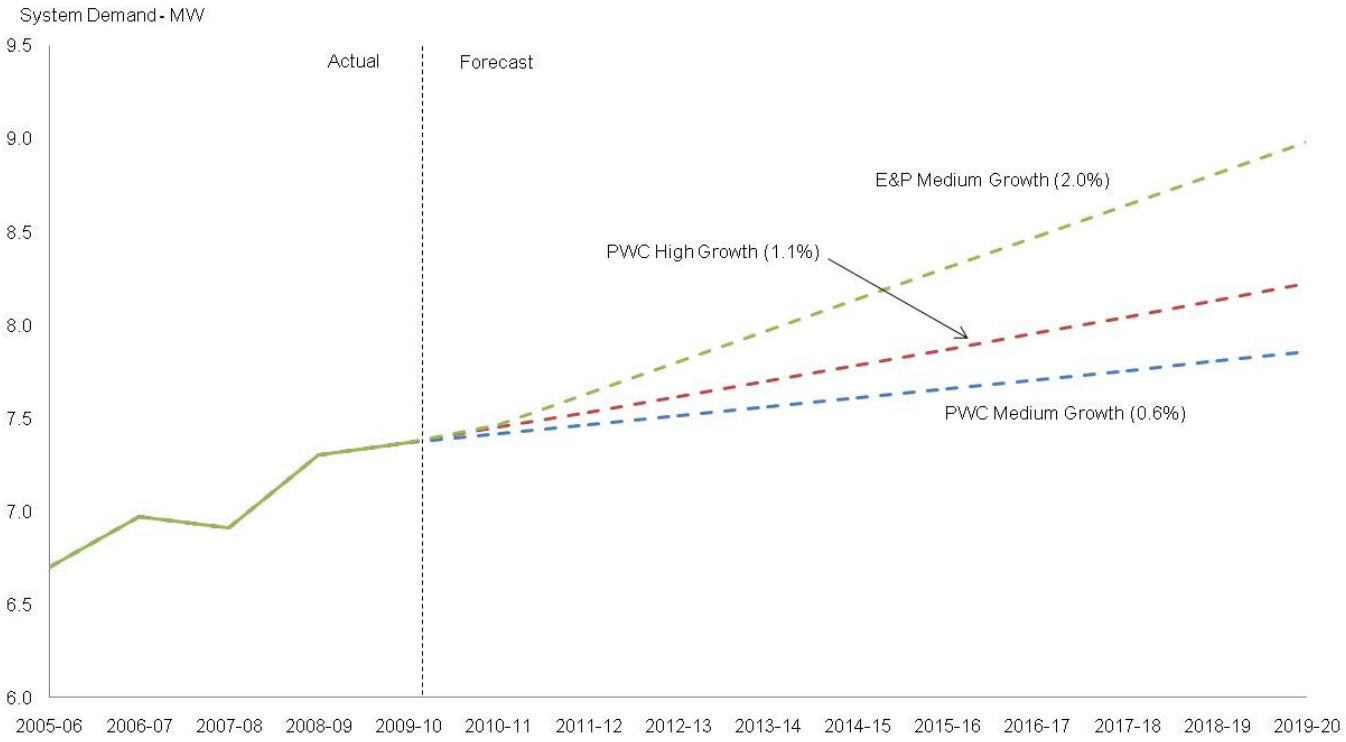
Source: Evans & Peck and Power and Water Corporation.

Chart 4.3: Forecast Alice Springs annual maximum system demand for 2010-11 to 2019-20



Source: Evans & Peck and Power and Water Corporation.

Chart 4.4: Forecast Tennant Creek annual maximum system demand for 2010-11 to 2019-20



Source: Evans & Peck and Power and Water Corporation.

4.52 The Evans & Peck Medium system demand growth scenario for Tennant Creek is signficantly higher than the PWC High scenario. A reason could be that Evans & Peck

does not have forward looking information about factors that might influence demand growth in the small Tennant Creek system, such as building approvals and local industry development. The Commission notes that the Evans & Peck projection is in line with average annual demand growth for 2005-06 to 2009-10.

Major projects

4.53 Consistent with the methodology adopted by PWC, the Commission considers that major energy using projects should be excluded from the forecasting process and treated on a case by case 'contingent' project basis. The Commission considers that:

- major projects have varying impacts on energy infrastructure, depending on energy intensity, onshore or offshore locations and the multiplier effects in the local community;
- the Territory's electricity system and distribution networks are relatively small, and a major project can represent a significant percentage of generation capacity;
- these projects may have their own generation capacity, and may not require electricity from the system; and
- there is considerable uncertainty about the timing of projects, due to factors such as global markets, availability of finance and timing of local and national approvals processes.

4.54 No major projects are factored into the PWC demand forecast scenarios for 2010-11 to 2012-13.

Generation supply-demand balance

4.55 The generation supply-demand balance provides an assessment of generation adequacy relative to forecast electricity demand in the Darwin-Katherine, Alice Springs and Tennant Creek systems for:

- the short to medium term – 2010-11 to 2012-13; and
- the medium to long term – 2014-15 to 2019-20.

4.56 The Commission has used two techniques to assess the generation supply-demand balance:

- an N-X analysis of generation adequacy, which tests whether generation capacity is adequate to meet peak system demand under the medium growth scenario at N-X. This is the approach adopted by the Commission for previous Power System Reviews; and
- for the Darwin-Katherine system only, a probabilistic analysis, which establishes a loss of load probability (LOLP) to identify the likelihood of generation constraints occurring over the assessment period. This is the approach most commonly adopted for generation planning purposes in Australia.

N-X analysis of generation adequacy

4.57 An N-X analysis of generation adequacy involves progressively subtracting the largest unit of capacity from total installed capacity. For example:

- N is the system capacity regarded as available for service;
- N-1 is the system capacity minus the largest unit of generation in the system; and
- N-2 is the system capacity minus the two largest units in the system.

4.58 The N-X approach is a straightforward method for assessing the level of reserve capacity and identifying actual or potential generation constraints at a point in time at a given level of demand.

4.59 The Commission notes that the PWC Statement of Corporate Intent (SCI), which is a contract between the shareholding Minister and PWC about technical and financial performance, has used the N-2 criterion to establish the level of reserve capacity required for each power system.

4.60 The Commission has identified the N-X capacity for the Darwin-Katherine, Alice Springs and Tennant Creek systems for the period 2010-11 to 2019-20, based on advice from system participants about future generation capacity. Table 4.6 provides the capacity available in each system at N-1 and N-2 as at 31 December 2010.

Table 4.6: N-X capacity for 2010-11

N-X capacity (MW)	N	N-1	N-2
Darwin-Katherine	374.0	326.4	278.8
Alice Springs	71.1	59.4	49.3
Tennant Creek	16.7	12.8	11.3

Source: Utilities Commission. Note: the N-X capacities change over time as generation sets are added and replaced.

4.61 In the Darwin-Katherine system:

- N-1 is 47.6 MW, which represents the loss of 50 per cent of the capacity of the combined cycle block at Channel Island power station (i.e. the loss of one dual fuel turbine and 50 per cent of the steam turbine); and
- N-2 is 95.2 MW, which represents the loss of the combined cycle block at Channel Island power station.

4.62 In the Alice Springs system:

- N-1 is 11.7 MW, which represents the loss of set 9 at Ron Goodin power station; and
- N-2 is 21.8 MW, which represents the loss of set 9, and set 10 (10.1 MW) at Ron Goodin power station.

4.63 In the Tennant Creek system:

- N-1 is 3.9 MW, which represents the loss of set 15 at Tennant Creek power station; and
- N-2 is 5.4 MW, which represents the loss of sets 15 and 16 (1.5 MW) at Tennant Creek power station.

Loss of load probability

4.64 The LOLP is an indicator of generation reliability commonly used in Australia for assessing system adequacy and generation planning purposes. The LOLP indicates the probability that generation capacity will be insufficient to meet demand at some point over some specific period. It is considered a more useful measure for planning purposes than the N-X methodology.

4.65 A probabilistic analysis of the adequacy of generation capacity, such as the LOLP, has not been previously applied by the Commission. PWC Generation does not currently undertake any probabilistic analysis.

Generation supply-demand balance – Darwin-Katherine system

4.66 The Darwin-Katherine system is expected to have sufficient generation capacity to meet forecast peak demand under any credible demand growth scenario in the medium and long term.

4.67 In the short term, there is a credible risk of generation capacity constraints and poor generation reliability during 2011. The key risk period is prior to April 2011 and the commissioning of Channel Island sets 8 and 9. There is the potential for ongoing capacity constraints the expected commissioning date if the new Channel Island plant experiences teething problems or from forced outages of existing plant.

4.68 For the period 2012 to 2019-20, there appears to be sufficient generation capacity available to provide an estimated average reserve margin of 60 per cent. In the period, January 2012 to April 2016, the average reserve plant margin is estimated at 73 per cent. The minimum reserve plant margin in the period is 57 per cent in late 2015 when forecast peak demand reaches 323 MW against capacity of 508 MW (representing reserve capacity of 185 MW). This comfortably exceeds the N-2 criterion of 95.2 MW.

4.69 The supply-demand balance and generation adequacy is influenced by the current maintenance program for 2010 to 2016 for generation plant in the Darwin-Katherine system.[11]

4.70 Accounting for planned maintenance in the period January 2012 to April 2016 the average reserve plant margin is estimated at 61 per cent. The minimum reserve plant margin experienced in the period is 43 per cent in November 2015 when forecast peak demand reaches 323 MW against available capacity of 461 MW (representing reserve capacity of 138 MW). This exceeds the N-2 criterion of 95.2 MW.

4.71 The reserve plant margin being maintained in the Darwin-Katherine system for the period 2012 to 2016 may be greater than what is reasonably necessary to maintain reliability of supply depending on factors such as plant condition, maintenance requirements and operating practices. The Commission considers that further work is necessary to identify an optimum level of generation capacity to balance reliability performance and cost objectives.

4.72 For example, if the Weddell set 3 (42 MW) planned for commissioning in early 2012 is excluded from the supply-demand balance calculation (including accounting for planned maintenance), the average reserve plant margin for January 2012 to April 2016 is estimated at 47 per cent, with a minimum reserve plant margin of 30 per cent in late 2015 (representing reserve capacity of 96 MW). This just exceeds the N-2 criterion of 95.2 MW.

4.73 The need for the planned level of generation capacity and reserves could be prompted by doubts about the condition and reliability of existing generation plant, particularly at Channel Island. If so, the Commission considers that these doubts should be reflected in the generation maintenance program to recognise the availability and reliability of generation plant and to support the generation capital investment program.

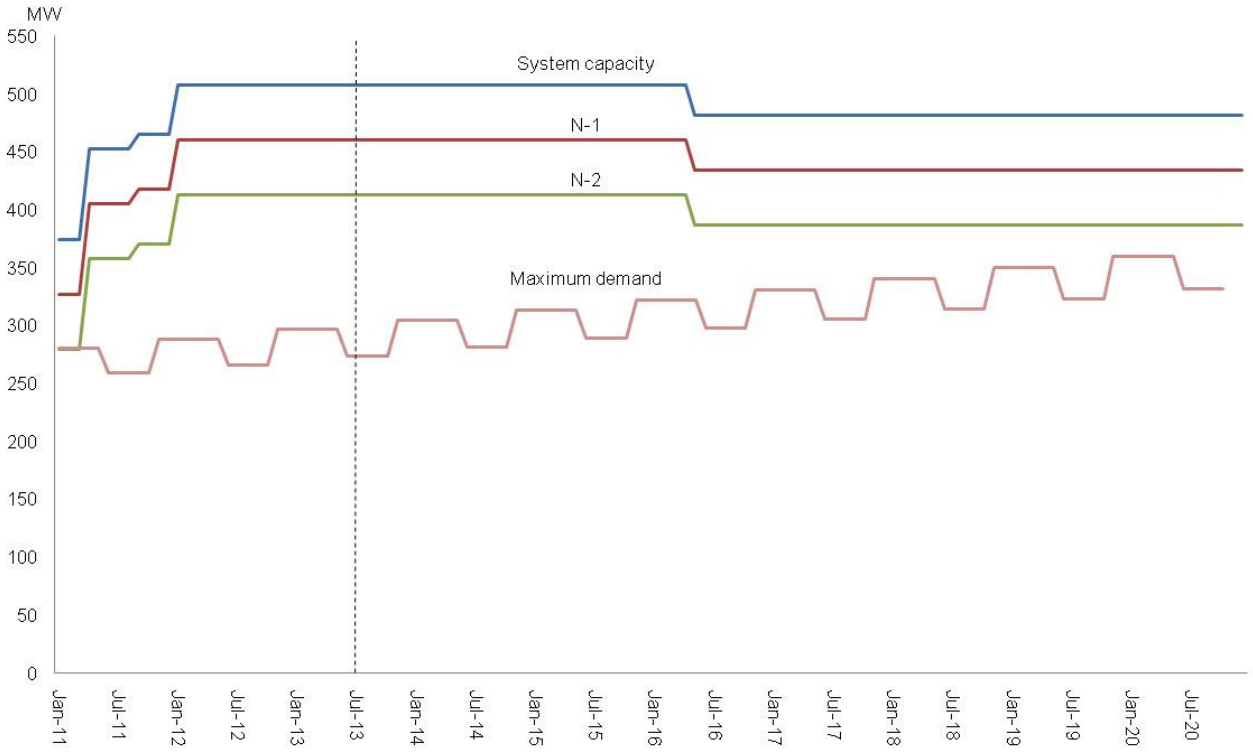
[11] The PWC Generation, Generation North Five Year Maintenance Program for 2010-2016 was provided to Evans & Peck.

N-X analysis – Darwin-Katherine

4.74 An N-X analysis of the supply-demand balance for the Darwin-Katherine system is presented in Chart 4.5. The analysis assumes that peak demand increases according to the Evans & Peck Medium scenario (2.8 per cent a year),[12] that all capacity is available (i.e. without accounting for planned maintenance), and that no capacity additions are made after 30 June 2013. The key points are:

- there is sufficient capacity to meet an N-2 event only until April 2011;
- the commissioning of Channel Island sets 8 and 9 from April 2011 provides sufficient capacity to meet in excess of an N-2 event until 2019-20; and
- the commissioning of Weddell set 3 from January 2012 provides sufficient capacity to meet in excess of an N-2 event (between January 2012 to April 2016) or the loss of 181.2 MW.

Chart 4.5: Darwin-Katherine system supply-demand balance for 2010-11 to 2019-20



Source: Evans & Peck and Utilities Commission.

4.75 The potential for capacity constraints to cause adverse reliability outcomes during 2011 will remain a concern until the successful commissioning of sets 8 and 9, including resolving any commissioning problems that may occur with new plant. The effect on reliability associated with new plant is exampled by the reliability problems experienced when PWC generation was bringing Weddell power station into service in 2008-09.

[12] The Commission performed a sensitivity test of the implications for the supply-demand balance of demand growth of 3.5 per cent a year, finding that the higher demand growth scenario had no appreciable adverse affect on generation adequacy relative to the chosen demand growth scenario until about 2016.

4.76 Subject to industry standard operation and maintenance practices being followed, generation capacity should be sufficient to provide spare capacity above the N-2 criterion from January 2012 to 2019-20 under credible demand forecast scenarios.

Reserve plant margin

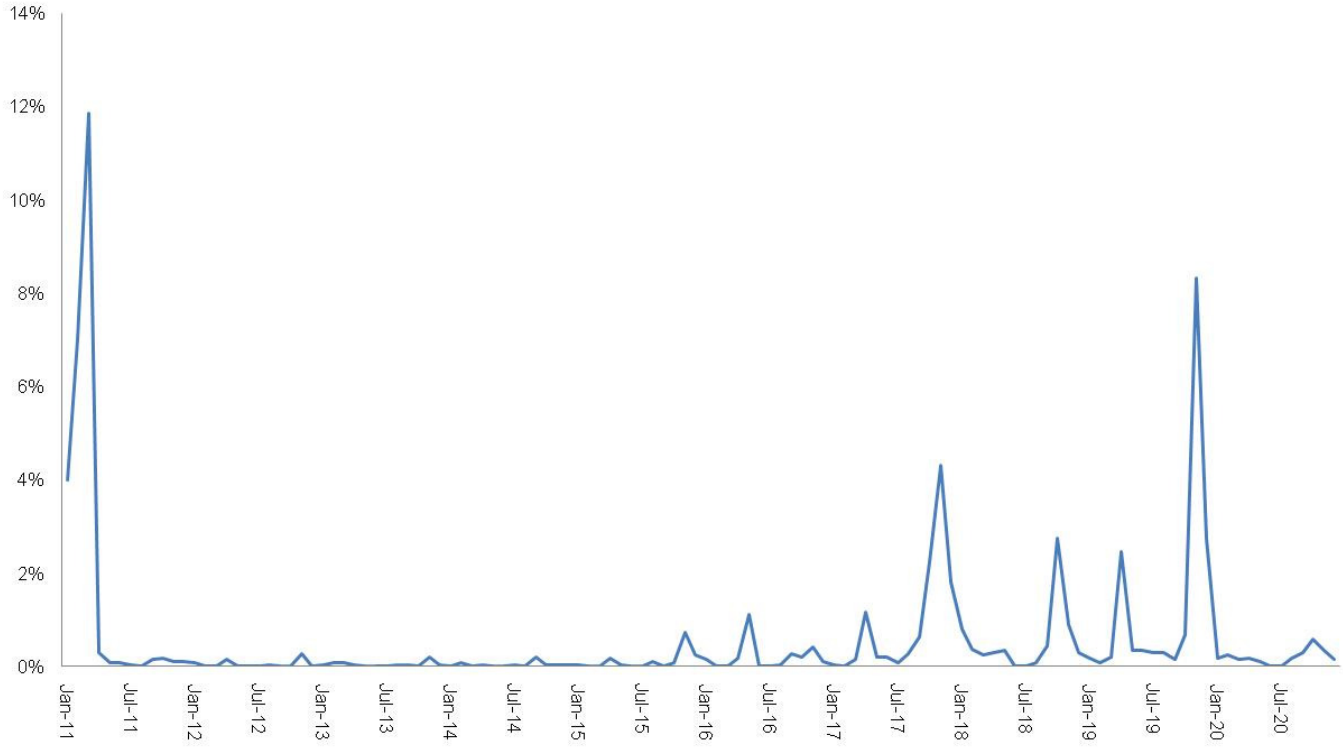
4.77 An alternative indicator of system adequacy is the reserve plant margin, which is calculated as the total system capacity available less the actual maximum demand for electricity in a particular year, expressed as a percentage of maximum demand.

4.78 The Commission does not yet have a view on an appropriate benchmark reserve plant margin for each Territory power system. Evans & Peck advised that a starting point benchmark for a small power system is upwards of 20 per cent, subject to factors including the size of individual plant relative to total system load.

4.79 The Darwin-Katherine system (accounting for planned outages) has an estimated average reserve plant margin of 65 per cent for the period July 2011 to June 2013, and of 50 per cent for the period July 2011 to June 2020. The reserve plant margin reaches a minimum of 21 per cent in late 2019, and is above 50 per cent until July 2011 to March 2015.

4.80 Chart 4.6 presents the estimated probability of the Darwin-Katherine reserve plant margin falling below 20 per cent in the period 2010-11 to 2019-20.

Chart 4.6: Probability of a Darwin-Katherine system reserve plant margin of below 20 per cent 2010-11 to 2019-20



Source: Evans & Peck.

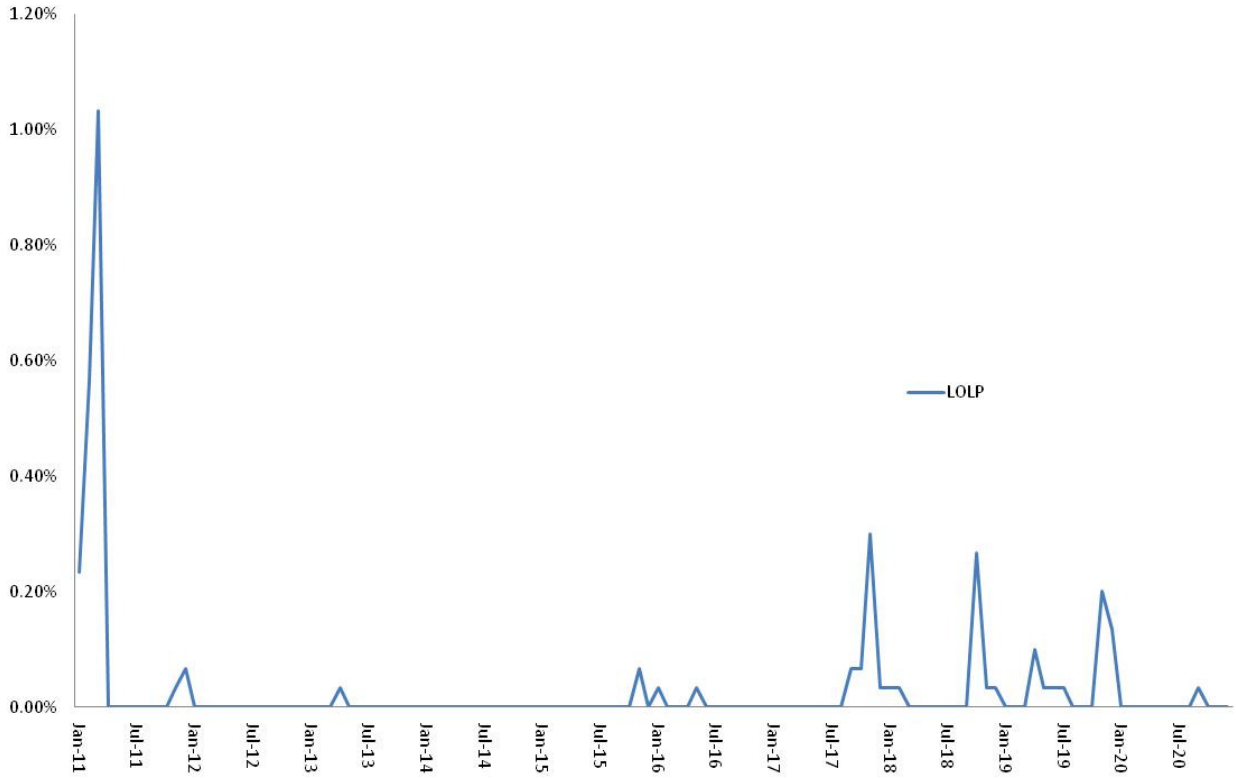
Darwin-Katherine system LOLP

4.81 To supplement the N-X analysis of adequacy in the Darwin-Katherine system, the Commission has assessed the LOLP, using a LOLP of a one day loss in 10 years (or 0.027 per cent) as the benchmark of a reliable system. A LOLP greater than 0.027 per cent is indicative of an unreliable system.

4.82 Evans & Peck developed a simple probabilistic model for the Darwin-Katherine system to complement the N-X analysis of generation adequacy. The Commission stresses that this LOLP assessment has limitations, with additional information required to reflect good industry practice, and provide a robust planning tool. However, the Commission seeks to encourage participants in the Territory's electricity sector to use probabilistic analysis as the primary tool for assessing system adequacy and generation planning purposes.

4.83 Chart 4.6 shows that the LOLP for the Darwin-Katherine system for the period 2010-11 to 2019-20 is generally at an acceptable level, except for the period to July 2011 prior to Channel Island sets 8 and 9 entering service, and towards 2020 as load growth erodes the reserve plant margin.

Chart 4.7: Darwin-Katherine system loss of load probability (LOLP) 2010-11 to 2019-20



Source: Evans & Peck.

4.84 The annual average LOLP are presented in Table 4.7. Years where the average is greater than the benchmark of 0.027 per cent are shaded.

Table 4.7: Darwin-Katherine system average annual LOLP for 2010-11 to 2019-20

Period	LOLP (%)	Period	LOLP (%)
2011	0.15	2016	0.00
2012	0.00	2017	0.04
2013	0.00	2018	0.025
2014	0.00	2019	0.06
2015	0.00	2020	0.008

Source: Evans & Peck.

4.85 Table 4.7 (with charts 4.6 and 4.7) highlight that the most critical period for potential poor generation reliability in the Darwin-Katherine system is the first three months of 2011 or until Channel Island sets 8 and 9 are operating, and then from 2017.

Implications of generation plant condition and the maintenance program

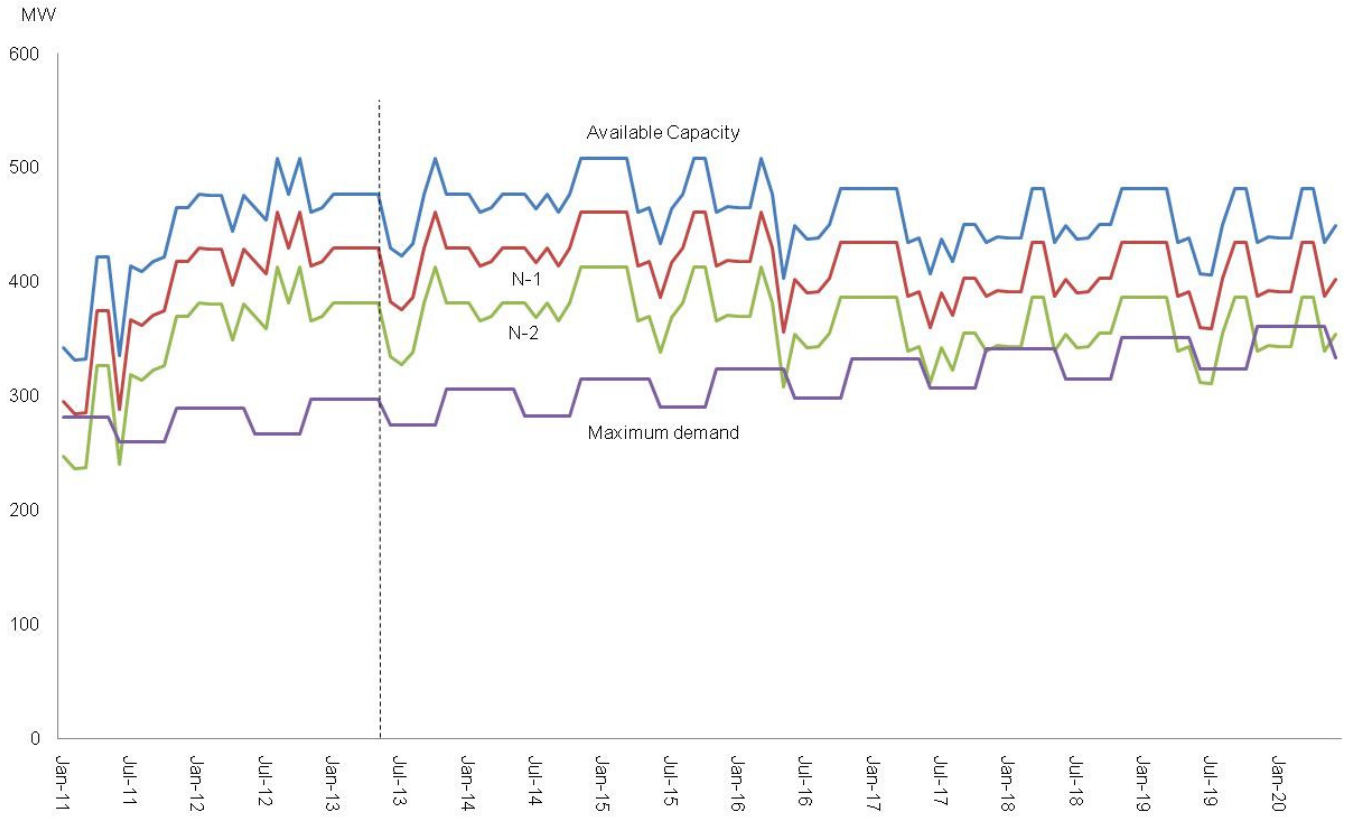
4.86 Planned and unplanned outages could have a significant influence on the incidence of generation constraints and poor reliability performance until Channel Island sets 8 and 9 are in service.

4.87 Historical generation reliability performance suggests that maintaining a reliable system under N-2 conditions is not guaranteed. As noted in the PWC 2010-11 Statement of Corporate Intent:[13]

…ongoing investigations have found that the previous estimates of the residual life of many assets may have been optimistic and that additional urgent refurbishment or replacement of key assets is needed….Because of increasing reliability issues with generation assets, a revised Generation capital investment strategy was developed and approved in February 2010.

4.88 Chart 4.8 presents the generation supply-demand balance for the Darwin-Katherine system, with capacity adjusted to exclude generation plant not available due to scheduled maintenance.

Chart 4.8: Darwin-Katherine supply-demand balance for 2010-11 to 2019-20 (with planned maintenance)



Source: Evans & Peck and Utilities Commission.

[13] Power and Water Corporation, 2010-11 Statement of Corporate Intent, page 24.

4.89 The maintenance schedule used by Evans & Peck to determine available capacity in each month was provided by PWC Generation. The Commission cannot comment on the detail of the maintenance program, but notes that variation to the timing and duration of planned maintenance could have implications for generation constraints and reliability performance, particularly during 2011.

4.90 Similarly, unplanned outages due to plant failure could have adverse implications for generation reliability performance during 2011. The Commission notes that new plant can experience initial teething problems in construction or commissioning, which could delay the new capacity (Channel Island sets 8 and 9, Weddell set 3) becoming available for service. Consequently, the Commission considers there is an ongoing credible risk of generation capacity constraints during 2011, and potentially into 2012.

Concluding comments – Darwin-Katherine system adequacy

4.91 A central concern of the Commission is that the generation capital and maintenance programs may not be aligned. It is understood that the capital program is intended to provide additional capacity to meet increasing demand, but also in case of higher failure rates and extended outages for maintenance due to the not completely known (but expected to be poor) condition of generation plant at Channel Island.

4.92 There seems to be a perceived risk of these assets failing or not being available for extended periods due to extended maintenance, but this assumption is not explicitly recognised in PWC Generation planning. It should be reflected in planning assumptions for the timing and duration of planned outages or by de-rating of existing capacity. If the apparent, but not clearly documented, concerns about the reliability and availability of the older Channel Island sets prove warranted, the reserve margin may be less for extended periods because plant is off-line for maintenance.

Generation supply demand balance – Alice Springs

4.93 The Alice Springs system is expected to have sufficient generation capacity in the medium and long term to meet forecast peak demand under any reasonable demand growth scenario.

4.94 In the short term there is a credible risk of generation capacity constraints and poor generation reliability during 2011. The key risk period is prior to the commissioning of Owen Springs sets 1-3, expected in March 2011. There is the potential for ongoing capacity constraints after March 2011 if the new Owen Springs plant experiences teething problems from forced outages of existing plant.

4.95 For the period 2012 to 2019-20 there appears to be sufficient generation capacity available to provide an estimated average reserve plant margin of 77 per cent, with a minimum reserve plant margin of 42 per cent in late 2017 when forecast peak demand reaches 63 MW against capacity of 90 MW (representing reserve capacity of 27 MW). This exceeds the N-2 criterion of 22.6 MW.

4.96 The level of the reserve plant margin for the Alice Springs system is influenced by the timing of commissioning new capacity at Owen Springs and decommissioning of capacity at Ron Goodin. PWC Generation has not provided a clear timetable (month and year) for commissioning/decommissioning of plant. The timing of the installation of new plant should be kept under review to optimise the amount of plant installed on a yearly basis.

4.97 PWC Generation has not provided the Commission with a maintenance program for generation plant in the Alice Springs system. The number and duration of planned

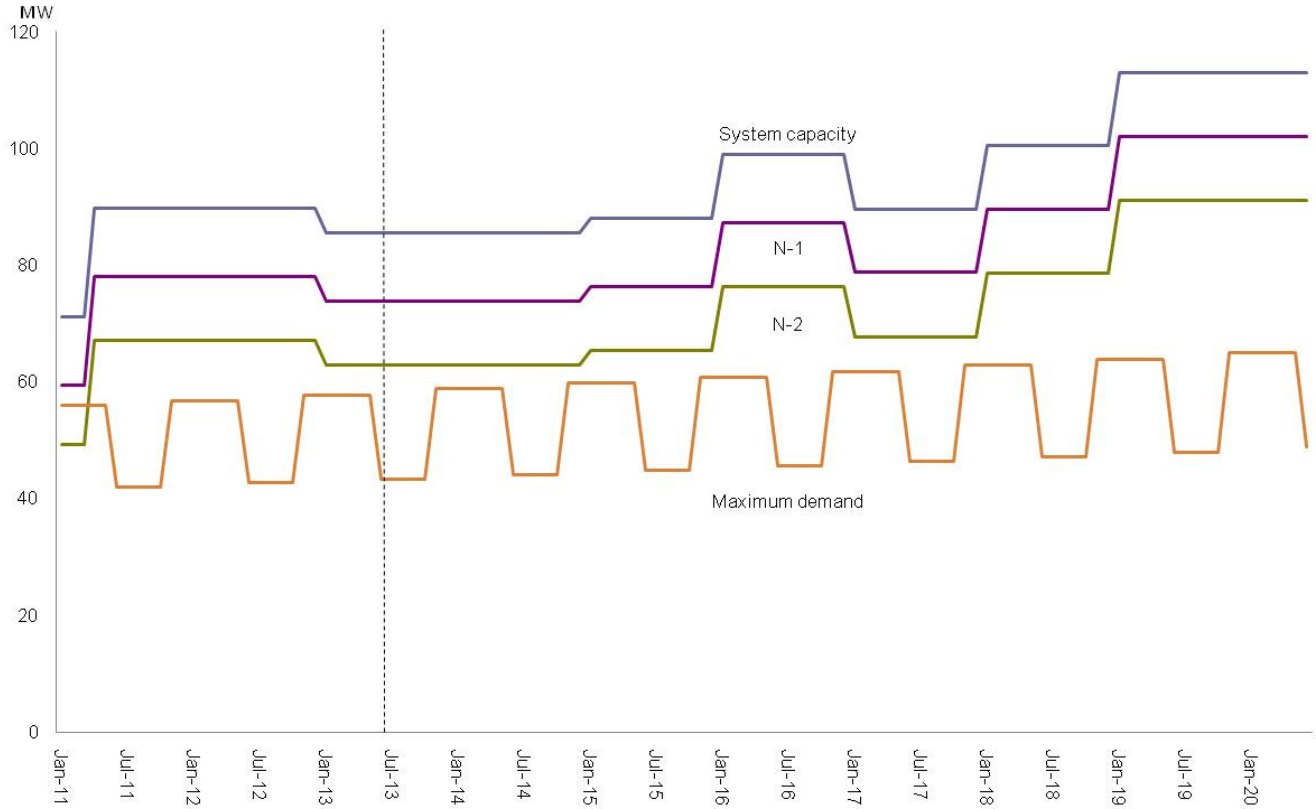
outages may have an effect on the supply-demand balance and the assessment of generation adequacy.

N-X analysis – Alice Springs system

4.98 An N-X analysis of the supply-demand balance for the Alice Springs system is presented in Chart 4.9. The analysis assumes that peak demand increases according to the Evans & Peck Medium demand growth scenario (1.7 per cent a year) and that all capacity is available (i.e. without accounting for planned maintenance). The key points are:

- there is sufficient capacity to meet an N-1 event only until March 2011; and
- after the commissioning of Owen Springs sets 1-3 from March 2011, there is sufficient capacity to meet an N-2 event until 2019-20, subject to the timing of commissioning/decommissioning of plant.

Chart 4.9: Alice Springs system supply-demand balance for 2010-11 to 2019-20



Source: Evans & Peck and Utilities Commission.

4.99 The average reserve plant margin for the Alice Springs system for July 2011 to December 2020 is 77 per cent. The average reserve plant margin for July 2011 to June 2013 is 78 per cent. The estimated minimum reserve plant margin is 27 per cent in the January to March 2011, and then 42 per cent in late 2017.

Concluding comments – Alice Springs system adequacy

4.100 There is a potential for capacity constraints and adverse generation reliability during 2011, especially if the new plant at Owen Springs experiences teething problems.

4.101 The period 2012-2013 to 2015-16 requires monitoring to ensure that generation constraints do not occur. Such constraints, if they appear likely, could be managed

through maintaining plant in service at Ron Goodin, or advancing commissioning of plant at Owen Springs.

4.102 The supply-demand balance for the period 2010-11 to 2019-20 is subject to the scheduled commissioning/decommissioning program for plant at Owen Springs and Ron Goodin, and the generation plant maintenance program. The Commission requires more detailed information about these programs to confidently comment on generation adequacy over the review period.

Generation supply demand balance – Tennant Creek

4.103 The generation supply-demand balance in the Tennant Creek system is adequate for the period to 2019-20.

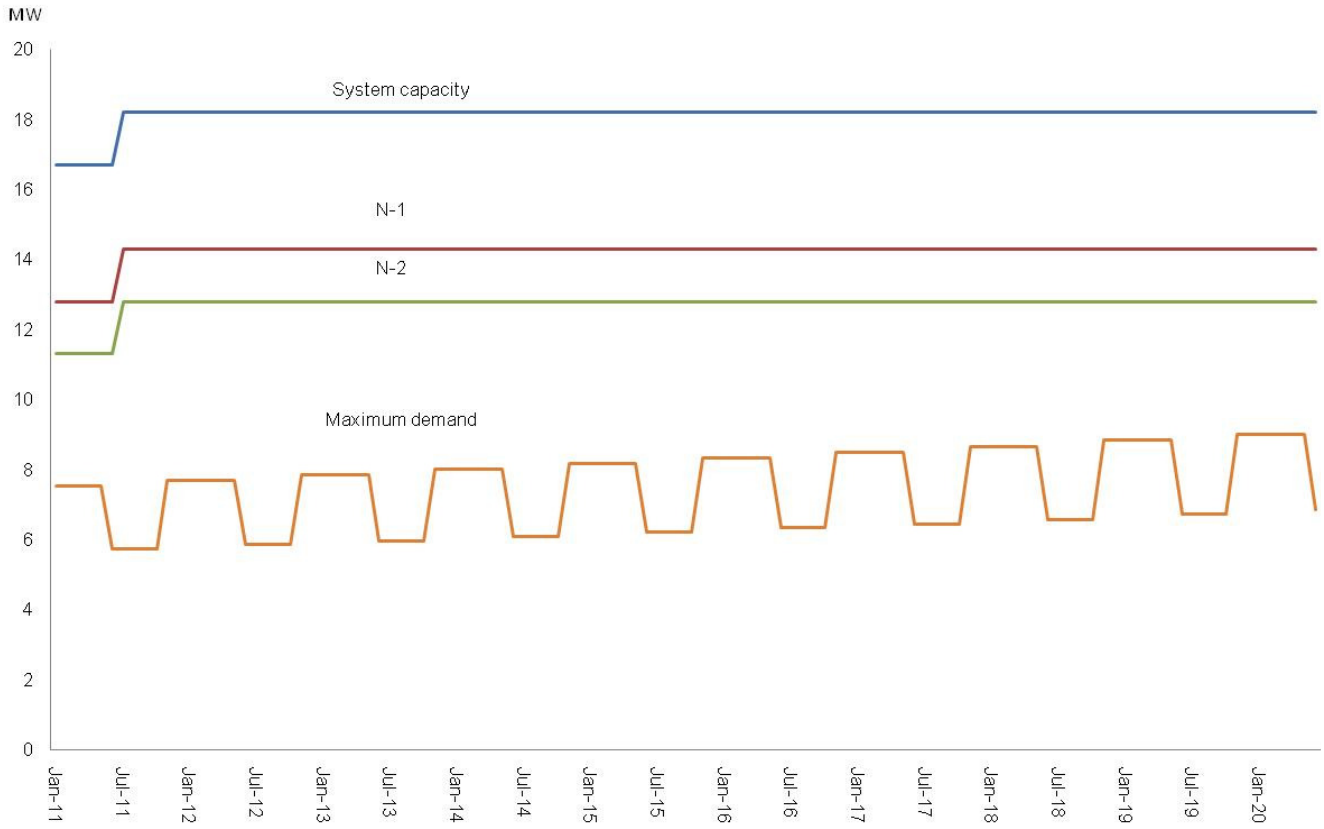
N-X analysis – Tennant Creek system

4.104 An N-X analysis of the supply-demand balance for the Tennant Creek system is presented in Chart 4.10. The analysis assumes that peak demand increases according to the Evans & Peck Medium demand growth scenario (2.0 per cent a year) and that all capacity is available (i.e. without accounting for planned maintenance).

4.105 The key points are:

- new capacity of 1.5 MW is expected to be commissioned in mid 2011; and
- there is sufficient capacity to meet an N-2 situation for the period 2010-11 to 2019-20.

Chart 4.10: Tennant Creek system supply-demand balance for 2010-11 to 2019-20



Source: Evans & Peck and Utilities Commission.

4.106 The estimated average reserve plant margin for the Tennant Creek system for the period January 2011 to June 2013 is 161 per cent, with an estimated minimum reserve margin of 122 per cent in the period January to May 2011.

4.107 The estimated average reserve plant margin for the period January 2011 to June 2020 is 149 per cent, with a minimum of 102 per cent in early 2020.

Concluding comments – Tennant Creek system adequacy

4.108 Subject to industry standard operation and maintenance practices being followed, generation capacity is sufficient to meet forecast demand, with a significant reserve margin for the period January 2011 to June 2020.

Fuel supplies

4.109 Natural gas is the main fuel for electricity generation in the Darwin-Katherine, Alice Springs and Tennant Creek systems. However, a number of generation sets are dual fuel, and able to use liquid fuels (i.e. diesel) as an alternative fuel source.

Natural gas supply

Amadeus Basin gas fields

4.110 Natural gas originally from the Palm Valley field and subsequently from the Mereenie field in the Amadeus Basin in central Australia has been the main fuel for electricity generation in the Territory for many years, starting with Alice Springs in 1983. Gas has been used for electricity generation in the Darwin-Katherine and Tennant Creek systems since 1987 following the commissioning of the Amadeus Basin to Darwin gas pipeline (now termed the Amadeus gas pipeline or AGP) in December 1986.

4.111 The Palm Valley and Mereenie fields have declining reserves, and have not been able to supply sufficient gas since late 2008 for all electricity generation requirements in the Darwin-Katherine system in addition to supplying the smaller Alice Springs and Tennant Creek systems.

4.112 The Palm Valley field is operated by Magellan Petroleum Australia Ltd and the Mereenie field by Santos Ltd. Together these companies own both fields outright.

4.113 Under gas supply contracts between Magellan and Santos, and PWC (through Gasgo Pty Ltd, a PWC subsidiary), supply from the Mereenie field ceased generation from December 2009, while supply from the Palm Valley field will cease in January 2012.

Blacktip gas field

4.114 The Blacktip gas field is located in the Bonaparte Gulf about 100 km west of Wadeye, and is owned and operated by Eni Australia B.V. (Eni). The field has been developed to supply gas to PWC for electricity generation to replace the Amadeus Basin fields. PWC and Eni entered a 25 year gas supply arrangement in 2006 for the supply of 740 petajoules of gas from Blacktip field plus additional gas if required and available.

4.115 The first gas from Blacktip was supplied in October 2009. The gas comes onshore to Eni's gas processing plant near Wadeye, and is transported by APA Group's 286 km Bonaparte gas pipeline (BGP) to join the AGP at Ban Ban Springs.

4.116 For the period to 2019-20, the volumes of gas available under the PWC/Eni gas supply contracts are considered sufficient to meet forecast electricity demand.

Alternative fuel sources

4.117 Leaving aside any remaining uncontracted reserves in the Amadeus Basin fields, there are two alternative fuel sources for electricity generation – natural gas from the Darwin

liquefied natural gas (DLNG) facility at Wickham Point on Darwin harbour and liquid fuels (i.e. diesel).

Contingency gas supply

4.118 PWC agreed a contingency gas supply arrangement with DLNG in 2009 involving the supply of a quantity of gas from the DLNG plant to the Darwin city gate gas hub in certain defined circumstances. This arrangement operated successfully in 2009-10 to assist PWC Generation to make up some of the shortfall in gas supply from the declining Amadeus Basin fields.

4.119 The DLNG plant and Blacktip production and processing systems are geographically separate, thereby reducing the risk of both supply sources being impacted simultaneously by cyclonic activity or other natural disaster.

Contingency diesel supply

4.120 PWC Generation maintains a portfolio of generation plant able to use diesel as a last resort contingency if gas is not available, and has significant diesel storage facilities at Channel Island, Katherine and Tennant Creek power stations, and in Alice Springs.

4.121 Based on advice from PWC Generation, the diesel only capacity of each system is:

- 211.3 MW for the Darwin-Katherine system, against a peak demand of 273.4 MW in 2009-10;
- 63.5 MW for the Alice Springs system, against a peak demand of 54.9 MW in 2009-10; and
- 11.9 MW for the Tennant Creek system, against a peak demand of 7.4 MW in 2009-10.

4.122 PWC Generation advises that the diesel stocks at Channel Island are sufficient to meet two days of diesel only operation. Diesel stocks in Alice Springs and Tennant Creek are sufficient to meet four days of diesel only operation.

Adequacy of fuel supplies

4.123 PWC has advised the Commission that its maximum daily requirement for 2009-10 was about 79 terajoules (TJ), compared to an average daily requirement of 61 TJ (which translates into approximately 22 PJ a year).[14] The annual quantity of gas to be supplied from the Blacktip field over the 25 year term of the contract ranges from 23 PJ to 37 PJ per year.[15]

4.124 The gas volumes available from the Blacktip field are projected to be sufficient to meet gas demand to well beyond the review period to 2019-20.

4.125 In particular, the commissioning of more efficient generation plant in the Darwin-Katherine and Alice Springs systems should result in significant improvements in thermal efficiency and a decrease in the quantity of fuel consumed per unit of electrical output. PWC expects the average heat rate to decrease by 16 per cent for Darwin-Katherine and 24 per cent for Alice Springs between 2009-10 and 2014-15. This should offset any increase in gas demand resulting from increased electricity

[14] 1000 terajoules equal 1 petajoule.

[15] Press article, Blacktip gas feed in pipeline soon, Northern Territory News, 18 August 2008.

demand in the period to 2014-15, and provide a continuing fuel efficiency benefit to 2019-20.

Adequacy of contingency arrangements

4.126 PWC has a range of contingency arrangements to maintain electricity supply in the event of the partial or complete loss of the primary gas supply from Blacktip:

- DLNG gas. The DLNG contingency gas supply arrangement does not represent a complete replacement supply to Blacktip. However, the DLNG gas would provide a second gas supply in the event of pipeline rupture or temporary production/processing problems that should reduce or eliminate the need to use diesel for electricity generation;
- linepack gas, which is gas stored in the pipeline. Linepack gas may be sufficient to provide a short term (i.e. possibly a few days) source of supply if there is a disruption to the primary supply, particularly if there is forewarning so the pipeline can be brought to its maximum operating pressure. The Commission understands that the volume of linepack that can be made available from the AGP is being assessed by the pipeline operator; and
- diesel stocks held by PWC provide a last resort fuel source for dual fuel or diesel burning sets.

4.127 These alternate fuel sources should provide access to a continued fuel supply to power stations, even in the circumstances of partial or complete loss of gas from Blacktip due to production or processing equipment failure or cyclonic activity or a pipeline rupture.

4.128 The critical risk to the adequacy of fuel supplies is an extended gas outage due to a pipeline rupture or production problems requiring PWC to rely solely on diesel. In this situation, transport and storage constraints (at power stations, bulk fuel terminals in the Territory and available road tankers) could lead to a gradual decline in diesel stocks as they may not be able to be replenished at the same rate as they are used.

4.129 However, the availability of Blacktip, DLNG gas and linepack gas are considered to provide sufficient diversity of supply to ensure adequate fuel supplies are available to avoid prolonged use of diesel.

4.130 Under the extreme and unlikely scenario of a double event, the rupture of the Amadeus Basin-Darwin pipeline close to the Channel Island power station cutting off gas supply to the generation plant and supply from Blacktip being unavailable, gas should be available from DLNG to Weddell, Katherine and Pine Creek power stations. In such a case, gas fired capacity would be about 140 MW (increasing to 180 MW with the proposed additional unit at Weddell in 2011-12). From April 2011, the Channel Island power station will have 235 MW of dual fuel (diesel) capacity at N-1 contingency and 280 MW at full capacity.

4.131 The most disruptive (and quite unlikely) event for Alice Springs and Tennant Creek would be a rupture of the supply pipeline near the power stations. It is expected that the four day diesel fuel stocks would in almost all circumstances be sufficient to cover the duration of repairs to the pipeline. Moreover, diesel fuel supply could be supplemented by road from local terminals.

Pipeline transportation

4.132 Firm gas transportation entitlements in both the AGP, the spur pipeline from DLNG and BGP are understood to match the PWC gas purchase entitlements, which exceed current and projected peak flow rates for the period of this review.

CHAPTER 5

Electricity networks

5.1 This chapter examines the capacity and adequacy of the Darwin-Katherine, Alice Springs and Tennant Creek transmission and distribution networks:

- network capacity (firm delivery capacity and demand) at 30 June 2010;
- network demand forecasts for 2010-11 to 2014-15, and forecast capacity and firm delivery capacity at the sub-transmission and zone substation level;
- the supply-demand balance and supply-demand outlook at the sub-transmission and zone substation level to 2013-14, and actual and potential constraints related to sub-transmission assets and zone substations; and
- feeders that have exceeded in 2009-10, or are expected to exceed in 2010-11, their normal operating conditions.

Scope of assessment and availability of data

5.2 For the 2009-10 Review, the Commission has expanded the scope of the assessment of the network by requesting PWC Networks business unit (as owner/operator of the Darwin-Katherine, Alice Springs and Tennant Creek networks) to provide equivalent information to that routinely reported by transmission and distribution network operators in the NEM.

5.3 Although routinely provided by network operators elsewhere in Australia, this is the first time that PWC Networks has been requested to provide equivalent information. In responding to the request, PWC Networks found that not all the information sought is yet available.

5.4 This is not unexpected given the experience of network operators elsewhere in Australia, and the Commission anticipates that PWC Networks will take two or three years to establish the systems and processes necessary to routinely record the relevant information.

5.5 The Commission expects that the implementation across each PWC business unit in 2011 of new information technology systems and business processes through the PWC Asset Management Capability project will expedite the availability of the comprehensive and detailed network asset information required for an effective assessment of network capacity and adequacy.

Transmission and distribution networks in the Territory

5.6 The Darwin-Katherine, Alice Springs and Tennant Creek networks are subject to the third party access regime established by the Territory's *Electricity Networks (Third*

Party Access) Act and Code, which provides a framework for setting the conditions of service and charges for transporting electricity over the network.[16]

5.7 The Commission is responsible for determining the network conditions and charges, and monitoring and enforcing compliance with the determination. The arrangements for the period 1 July 2009 to 30 June 2014 were determined in March 2009.[17]

Network infrastructure

5.8 The PWC Networks business unit operates the Darwin-Katherine, Alice Springs and Tennant Creek transmission and distribution networks, which comprise the poles, wires, substations, transformers, switching, monitoring and signalling equipment involved in transporting electricity from the generator to the customer.

5.9 The transmission and distribution network control function is undertaken by the System Controller, and the PWC System Control business unit which is a part of PWC Networks. The System Controller has statutory responsibilities for monitoring and controlling the operation of the system and network to ensure a reliable, safe and secure electricity supply.[18]

5.10 Table 5.1 provides some key details of the Territory's transmission and distribution network infrastructure, and operating characteristics.

Table 5.1: Transmission and distribution network characteristics

System/network	Darwin-Katherine	Alice Springs	Tennant Creek
Connections (customers at 30 June 2010)			
Household	50 589	9956	1193
Government	471	95	27
Business	8295	1825	265
Energy use (GWh for 2009-10)	1516	229	30
Transmission/sub-transmission network (km at 30 June 2010)	666	0	0
Distribution network (km at 30 June 2010)	4164	607	385
Zone substations (number at 30 June 2010)	24	3	1
Distribution substations (number at 30 June 2010)	4037		

Source: Power and Water Corporation. Note: the transmission/sub-transmission network is defined as 66 kV and above.

[16] The Territory's regional and remote networks are not subject to the third party access framework and the Commission has no role in setting conditions of service and charges. These networks transport electricity to customers in the 72 communities and 82 outstations where essential services are provided through the Territory Government Indigenous Essential Services program; eight remote townships and three mining townships.

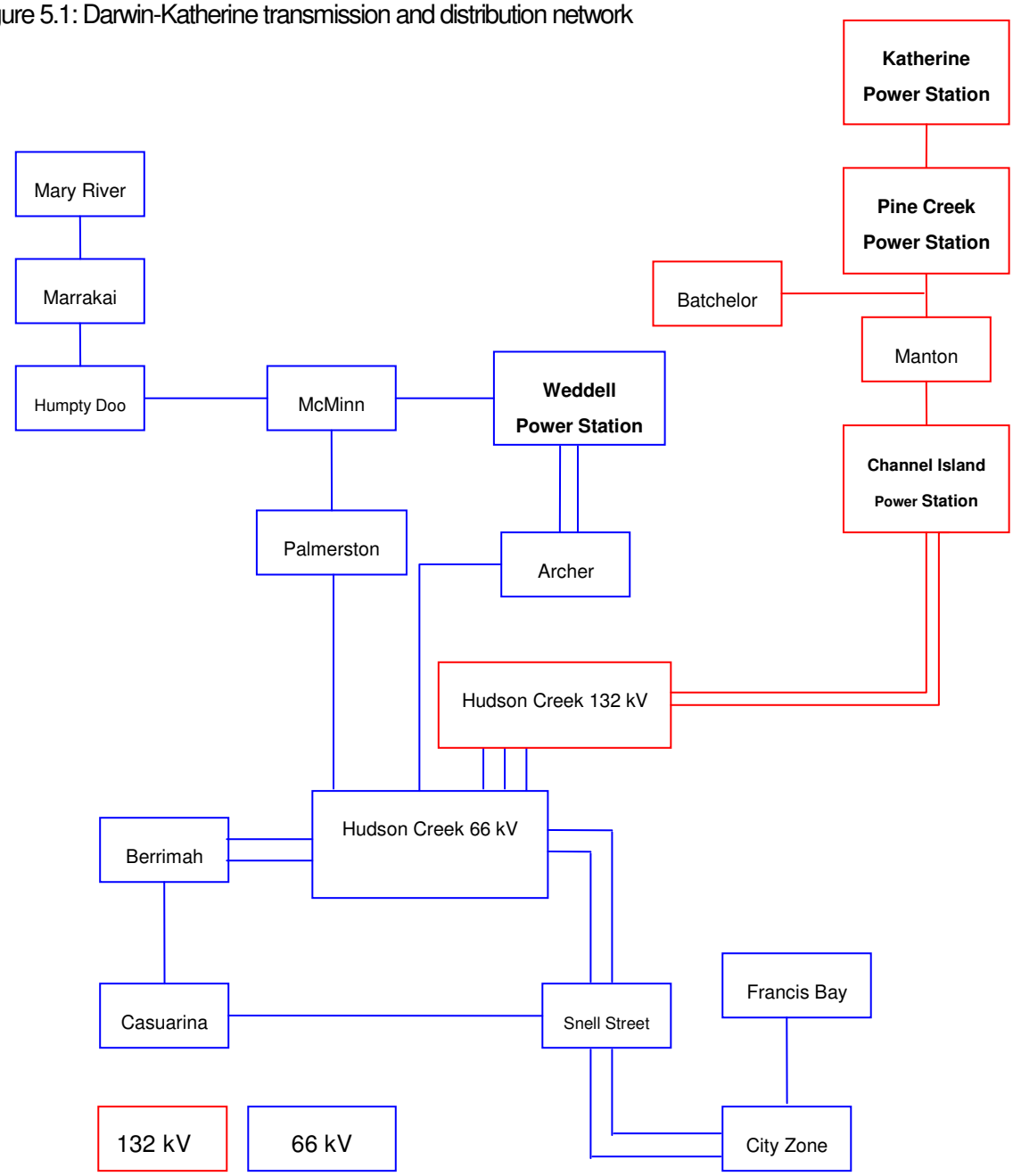
[17] Utilities Commission, March 2009, Final Determination Networks Pricing: 2009 Regulatory Reset.

[18] *Electricity Reform Act*, s38. The functions and duties of the System Controller are detailed in the System Control Technical Code and Network Connection Technical Code.

5.11 A transmission/sub-transmission network overlay exists in the Darwin region to transport electricity produced at three power station locations (Channel Island, Weddell and Berrimah) to primary load centres via two 132 kV transmission lines and seven 66 kV zone substations. This transmission network is also connected with power stations and loads at Pine Creek and Katherine via a 132 kV line from the Channel Island power station.

5.12 A schematic of the Darwin-Katherine transmission and distribution network is presented in Figure 5.1.

Figure 5.1: Darwin-Katherine transmission and distribution network

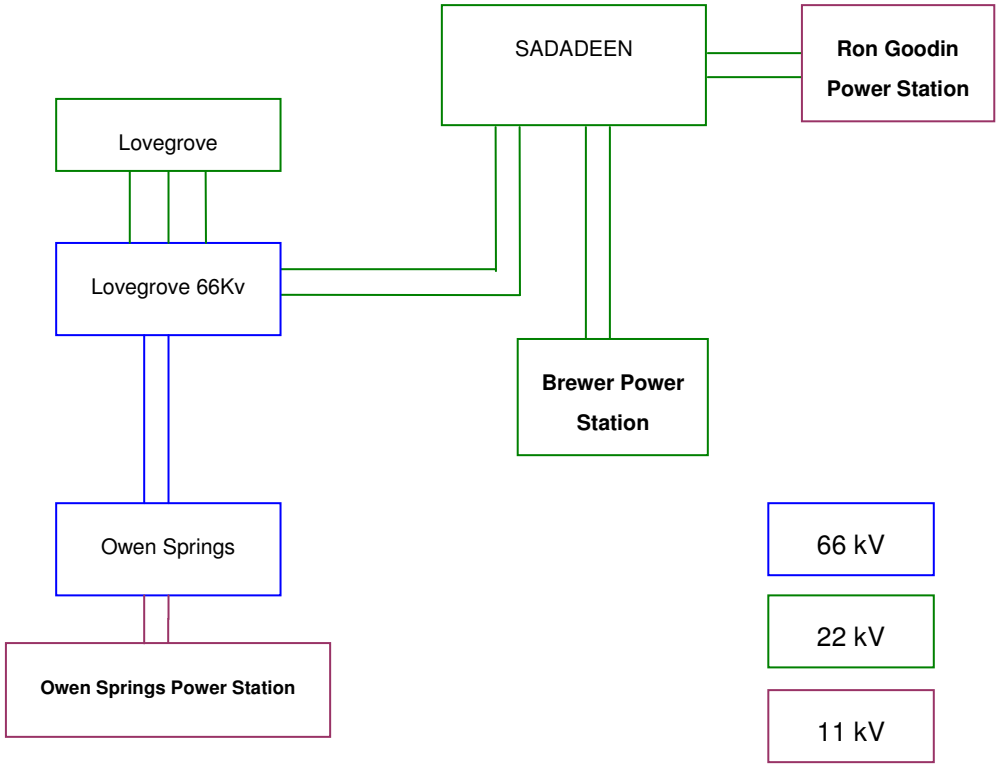


Source: Utilities Commission and Power and Water Corporation.

5.13 Electricity generated in the Alice Springs and Tennant Creek systems has been supplied directly into the distribution network. However, a transmission network overlay is being developed in Alice Springs, with electricity produced at the Owen Springs power station to be supplied into the distribution network via a 66 kV transmission line and two 66 kV zone substations (Owen Springs and Lovegrove).

5.14 A schematic of the Alice Springs transmission and distribution network is presented in Figure 5.2.

Figure 5.2: Alice Springs transmission and distribution network



Source: Utilities Commission and Power and Water Corporation.

Network capacity and constraints

5.15 The Commission sought advice from PWC Networks on forecast network peak demand and the capacity of transmission/sub-transmission feeders, distribution feeders, and substations. The Commission's intention was to identify potential network capacity constraints in the period 2010-11 to 2014-15:

- transmission/sub-transmission feeders that might exceed normal rating. Identifying potential feeder constraints requires rating and loading data. No loading data was available for transmission/sub-transmission feeders;
- bulk and zone substations that might exceed normal rating. Identifying potential substation constraints requires rating and loading data. This information was available for bulk and zone substations; and
- distribution feeders that might exceed normal rating. Identifying potential feeder constraints requires rating and loading data. No rating or loading data was available for distribution feeders.

5.16 PWC Networks was not able to provide all the information necessary to identify potential transmission/sub-transmission or distribution feeder constraints, but is expected to have the capability to do so in future. As such, the Commission expects to be able to provide a more comprehensive analysis of network capacity and constraints in future Reviews.

Network peak demand forecasts

5.17 Network demand forecasts are influenced by energy consumption patterns in the substation service area. Therefore, a whole of network demand forecast is the aggregate of forecast loading/demand for individual substations, which is determined by factors including household and business energy use patterns, and residential and commercial developments.

5.18 Appendix B presents information from PWC Networks on actual and forecast zone substation demand and capacity for 2007-08 to 2015-16.

5.19 The aggregate Darwin-Katherine network demand growth for 2011-12 to 2014-15 is presented in Table 5.2.

Table 5.2: Annual average network peak demand for the Darwin-Katherine system

Aggregate substation load	2011-12	2012-13	2013-14	2014-15
MVA	335.8	346.6	358.1	369.9
Maximum demand growth (%)	3.29	3.22	3.30	3.30

Source: Evans & Peck.

5.20 This forecast of network demand growth for the Darwin-Katherine system was derived from the demand forecasts developed by PWC Networks for each bulk and zone substation. A forecast is not presented for 2010-11 due to some uncertainty about the transfer of demand between substations.

5.21 A network demand forecast could not be developed for the Alice Springs and Tennant Creek networks as loading information for the Sadadeen, Ron Goodin and Tennant Creek substations was not available. The loading of these substations depends on generation dispatch patterns. The Commission expects that loading information for these substations will be available for future Reviews.

Energy use forecasts and load factor

5.22 The energy use forecasts developed by PWC Generation have been used to determine the load factor for each network. The load factor is the ratio of average demand over a year to maximum demand and represents the rate of change in energy use relative to maximum demand. The load factor indicates if maximum demand is likely to be more or less “peaky”. The load factors for the Darwin-Katherine, Alice Springs and Tennant Creek networks indicate:

- energy use is forecast to increase at a marginally higher rate than maximum demand in the Darwin-Katherine system; and
- energy use is forecast to increase at a lower rate than maximum demand in the Alice Springs and Tennant Creek systems.

5.23 The implication is that peak demand in the Alice Springs and Tennant Creek networks will increase at a faster rate than energy use, raising the prospect of network constraints in the medium term. Energy use in the Darwin-Katherine network is not considered likely to present as great an influence on peak demand in the medium term.

Transmission/sub-transmission network capacity and constraints

5.24 The Commission considers that the transmission/sub-transmission network comprises:

- all 66 kV and above feeders;

- bulk and zone substations with a highest voltage of 66kV or above; and
- distribution substations (e.g. with a voltage of 11/22kV) that perform a sub-transmission role.

5.25 The Commission acknowledges that transmission/sub-transmission assets are not currently specifically identified as such, but considers that these assets play a critical role in network reliability and security due to the radial design of the network and limited number of alternative flow paths. Hence, the Commission will continue to place a specific focus on the components of the transmission/sub-transmission network.

Feeders

5.26 PWC Networks was not able to provide loading information for the transmission/sub-transmission feeders, preventing a complete assessment of feeder utilisation and adequacy (i.e. the ratio of maximum demand to the allocated rated capacity of the equipment).

5.27 However, a high level assessment of capacity and constraints in the Darwin-Katherine system has been undertaken due to the criticality of the transmission/sub-transmission network to security of supply. The assessment was undertaken by Evans & Peck by inferring feeder loadings under peak demand conditions using zone substation loading data for the following sub-systems of the Darwin-Katherine system:

- the Berrimah sub-system, consisting of the Hudson Creek-Berrimah-Hudson Creek loop;
- the City sub-system, consisting of City Zone, Snell Street, Casuarina, Frances Bay and Leanyer substation service areas;
- the Palmerston sub-system, consisting of Archer, Weddell, Palmerston, McMinn's, Humpty Doo, Marrakai and Mary River substation service areas; and
- the Manton sub-system, consisting of Manton, Batchelor, Pine Creek, Katherine, Edith River, Cosmo, Brock's Creek and Union Reef substation service areas.

5.28 The analysis indicates a potential capacity constraint in the Palmerston sub-system, with potential overloading of the Hudson Creek-Palmerston and Hudson Creek-McMinn's 66 kV network under first contingency conditions (N-1) in 2012-13 and 2013-14. However, this constraint is expected to be relieved on the completion of Archer zone substation in early 2011. The potential for overloading may also be managed by using the low voltage distribution network to transfer load.

5.29 The Commission cautions that the assessment relies on a number of simplifying assumptions and is presented to provide a high level indication of capacity and potential capacity constraints. The Commission expects to provide a more authoritative assessment in future Reviews as the necessary data becomes available.

Bulk and zone substations

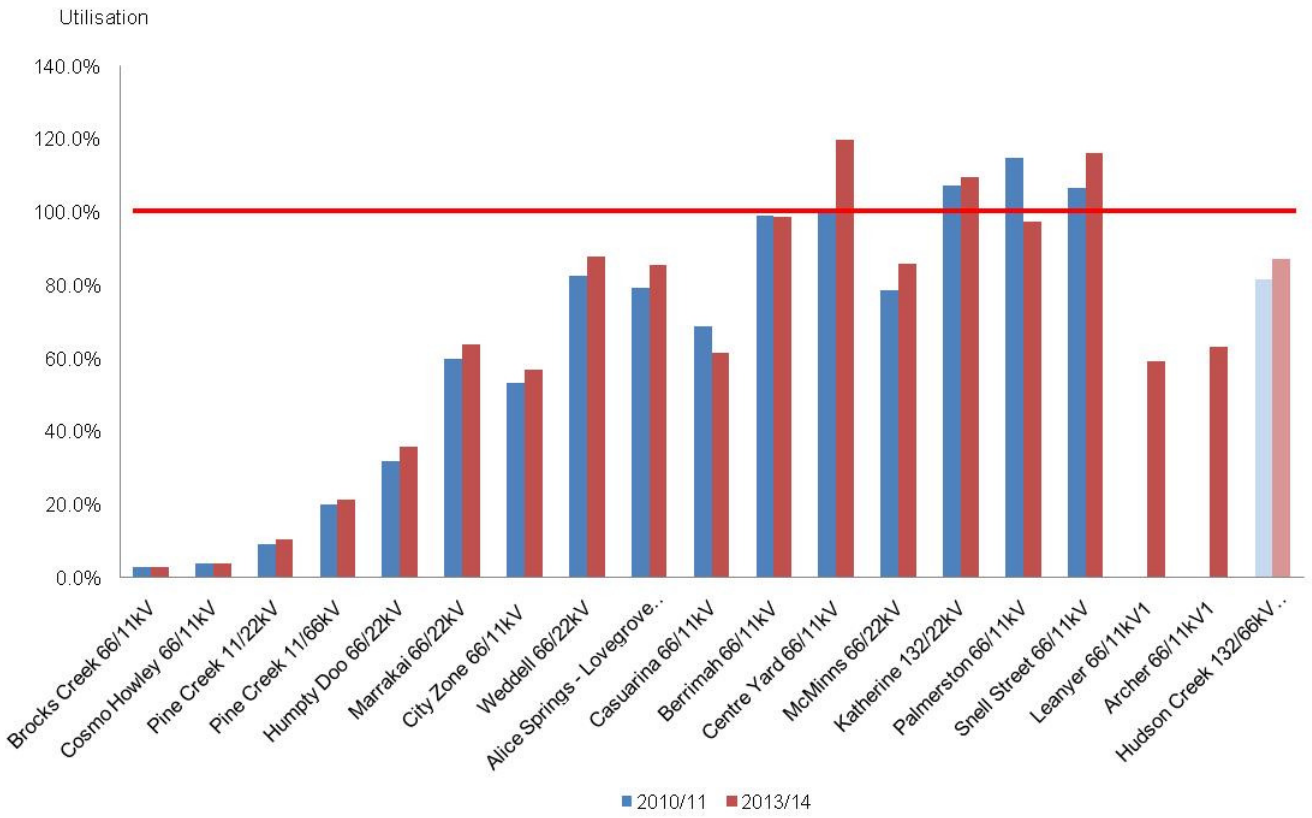
5.30 There are 28 bulk and zone substations across the Darwin-Katherine, Alice Springs and Tennant Creek systems, with an assessment of substation utilisation possible for 25 substations.[19] Substation capacity and potential constraints have been measured by examining the substation utilisation:

- with all network elements (i.e. transformers) in service (an N rating); and
- with one network element out of service (an N-1 rating).

5.31 With all transformers in service, all zone substations should have sufficient capacity to meet forecast load for 2010-11 except for the Snell Street zone substation which faces an emerging capacity constraint.

5.32 Chart 5.1 presents zone substation utilisation under N-1 conditions (one transformer out of service) in 2010-11 and 2013-14, based on forecast loads and system configuration in 2010-11 and 2013-14.

Chart 5.1: Projected substation utilisation in 2010-11 and 2013-14 (N-1 conditions)



Source: Evans & Peck.

5.33 Under N-1 conditions, five substations face capacity constraints in 2010-11 and 2013-14:

- Berrimah 66/11 kV, with 99 per cent utilisation in 2010-11 and 2013-14. PWC Networks is planning construction of a new East Arm substation (operating from circa 2015-16) to support the Berrimah substation;

[19] Loading information is not available for the Sadadeen, Ron Goodin and Tennant Creek zone substations.

- Centre Yard 66/11 kV, with 100 per cent utilisation in 2010-11 and 120 per cent utilisation in 2013-14. Centre Yard is a small (0.5 MVA) substation where PWC Networks is considering supplementing capacity by relocating spare transformers;
- Palmerston 66/11 kV, with 115 per cent utilisation in 2010-11 and 97.5 per cent utilisation in 2013-14. The Palmerston substation will be supported by the new Archer zone substation (expected to be operational in 2011) and load transfer through the low voltage distribution network;
- Katherine 132/22 kV, with 107 per cent utilisation in 2010-11 and 109.6 per cent utilisation in 2013-14. The Katherine substation is supported by Pine Creek and Katherine generation. Accounting for this generation should resolve the apparent constraint; and
- Snell Street 66/11 kV, with 106.6 per cent utilisation in 2010-11 and 116.4 per cent utilisation in 2013-14. Snell Street represents the most critical constraint due to its role supplying the Darwin CBD. PWC Networks intends a replacement substation to be operating from circa 2011-12.

5.34 Based on the information available to the Commission the PWC Networks network planning policy requires only Berrimah, Katherine and Snell Street substations to meet an N-1 event.

5.35 Additionally, under N-1 conditions, the Weddell, McMinns and Lovegrove substations utilisation rates exceed 80 per cent in 2013-14 (88 per cent, 86 per cent and 82 per cent respectively), indicating the potential for capacity constraints in the future.

5.36 Although industry practice for assessing potential network constraints focuses on the implications of the first contingency event (i.e. an N-1 event), Evans & Peck advised the Commission that the poor condition of network infrastructure[20] means that there is a credible risk that multiple contingency events could arise.

5.37 In particular, the Commission notes that the poor condition of equipment at the City Zone and Snell Street substations makes a multiple contingency event a possibility which warrants a continued priority being given to the capital program associated with the development of Frances Bay substation, upgrade of Snell Street substation and replacement of City Zone substation.

Distribution network capacity and constraints

5.38 PWC Networks was not able to provide the load flow studies or measurements on the low voltage (11/22 kV) distribution network necessary for an assessment of loading and capacity.

5.39 Similarly, PWC Networks was not able to provide loading or capacity information for distribution substations. Consequently, the Commission is unable to identify if there are any actual or potential constraints in the distribution network.

[20] As identified through the Independent Enquiry into Casuarina Substation Events and Substation Maintenance Across Darwin (the Davies Enquiry) and being addressed through the PWC Remedial Asset Management Program.

5.40 Monitoring of distribution substation loading and capacity is currently based on the incidence of voltage complaints or overloads which activate protection schemes. This has been a common approach across the industry, but emerging industry practice is to:

- integrate information technology into distribution substations to record and report loading, quality of supply, status and fault indication data in real time; and
- integrate geographic information systems with network topology and customer billing information to determine the energy use through individual assets, which can then be combined with standard load profiles to determine substation utilisation.

CHAPTER 6

Customer service and reliability performance

6.1 This chapter reports on customer service performance and reliability of supply outcomes in 2009-10 in the Darwin-Katherine, Alice Springs and Tennant Creek systems.

6.2 Customer service performance and reliability of supply information is reported by PWC Generation, PWC Networks and PWC Retail as a requirement of the Territory's Electricity Standards of Service Code. The 2009-10 Standards of Service: Key Service Performance Indicators Report covers:

- network and generation reliability performance, and network feeder performance; and
- customer service performance, such as network reconnections/new connections, the time taken to answer telephone calls, and customer complaints about quality of supply and service (e.g. billing).

Reliability performance

6.3 Reliability performance is measured by calculating:

- the system average interruption duration index (SAIDI), which indicates the average duration of network and generation related outages experienced by a customer; and
- the system average interruption frequency index (SAIFI), which indicates the average number of network and generation related outages experienced by a customer.

6.4 The Commission has examined reliability performance for:

- generation and network performance in the Darwin region and Katherine region (of the Darwin-Katherine system), Alice Springs and Tennant Creek systems for 2005-06 to 2009-10, using a weighted total average of reliability outcomes for each system; and
- central business district (CBD), urban, short rural and long rural feeders for 2009-10 only, using a weighted total average of feeder reliability for each system.

Overall reliability performance

6.5 Chart 6.1 shows the average total minutes off supply for a customer in the Darwin, Katherine, Alice Springs and Tennant Creek (combined) systems for 2005-06 to 2009-10.

6.6 The key points highlighted by chart 6.1 are:

- the lack of clear trend in the underlying network reliability performance (SAIDI) over the five year period 2005-06 to 2009-10; and
- the significant contribution of "exclusions" to the weighted total average minutes off supply for 2007-08, 2008-09 and 2009-10.

Chart 6.1: PWC Networks weighted total average minutes off supply (SAIDI) for 2005-06 to 2009-10

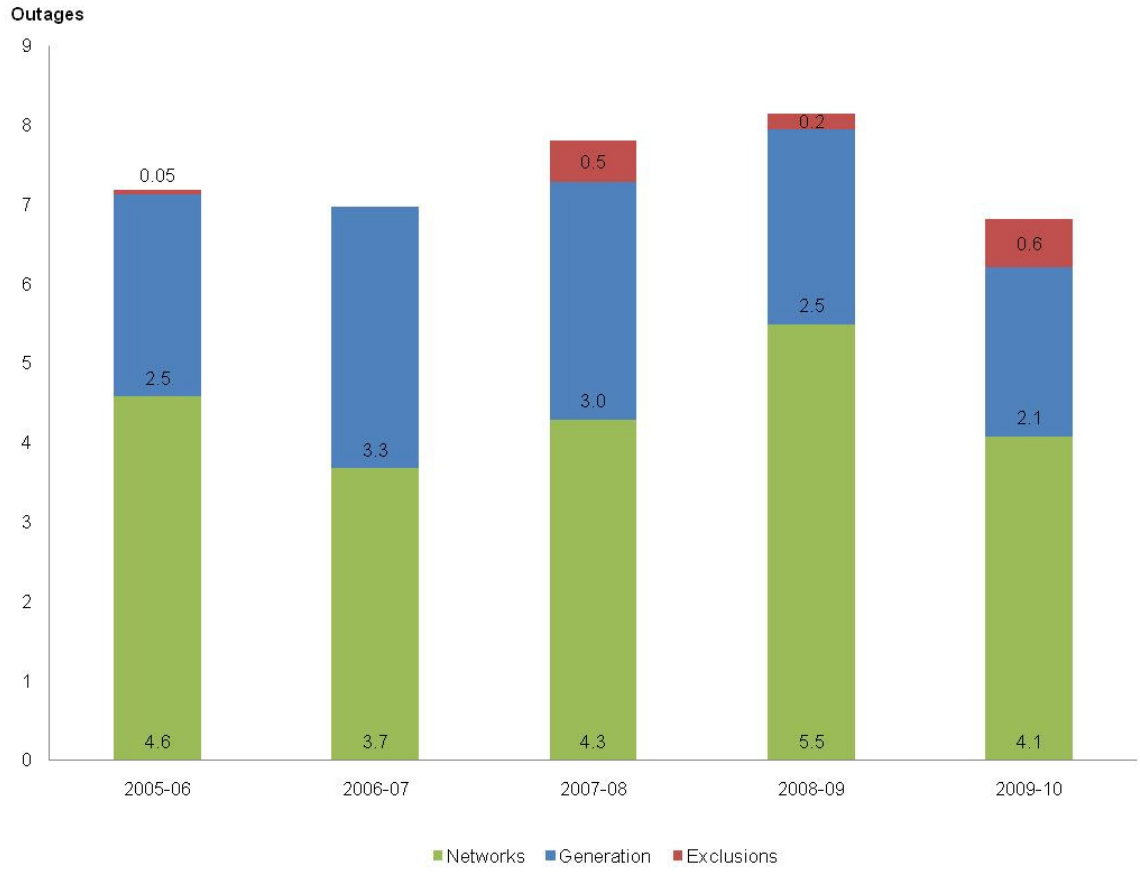
Source: Utilities Commission and Power and Water Corporation.

6.7 Chart 6.2 shows the average total frequency of outages for a customer (SAIFI) in the Darwin, Katherine, Alice Springs and Tennant Creek (combined) systems for 2005-06 to 2009-10.

6.8 The key points highlighted by chart 6.2 are:

- the high frequency of generation related outages compared to the experience of customers elsewhere in Australia;
- the lack of a clear trend in the underlying network reliability performance (SAIFI) over the five year period 2005-06 to 2009-10;
- a smaller contribution of “exclusions’ to the weighted total average frequency of outages than for SAIDI, indicating a small number of events with a large impact.

Chart 6.2: PWC Networks weighted total average frequency of outages (SAIFI) for 2005-06 to 2009-10



Source: Utilities Commission and Power and Water Corporation.

Generation performance trend

6.9 Territory customers experienced an average of 2.7 generation related outages a year (SAIFI) between 2005-06 and 2009-10. This is significantly more than observed in the NEM connected systems (e.g. for the 12 months ended 31 March 2010, Ergon Energy reported a SAIFI of 0.02).

6.10 So as to develop an improved understanding of generation reliability performance, Evans & Peck examined under frequency loss of supply (UFLS) events for the period 2005-06 to 2009-10 (to 28 November 2010). For the Darwin-Katherine system:

- there was an average of 28 UFLS events over the five year period, which represents an average of over one UFLS event each fortnight;
- the number of UFLS events peaked in 2008 with 49 events, but has fallen to 20 in 2010.

6.11 The analysis identified a number of possible causes for the high number of generation related outages, but could not identify the specific cause(s) from the range of possibilities, including operating practice, spinning reserve policy and asset condition and maintenance. The Commission expects generation reliability performance to improve in the coming years with the commissioning of new generation plant (especially Channel Island sets 8 and 9) and the major maintenance to existing generation plant.

6.12 The Commission will continue to monitor generation performance through regular performance reporting and an incident reporting framework now being finalised. The Commission will report on progress in future Reviews.

Network performance trend

6.13 There is no clear trend in network reliability performance in the SAIDI and SAIFI outcomes for 2005-06 to 2009-10.

6.14 The Commission requested PWC Networks to report reliability performance for 2009-10 based on feeder type, consistent with the approach adopted across Australia:[21]

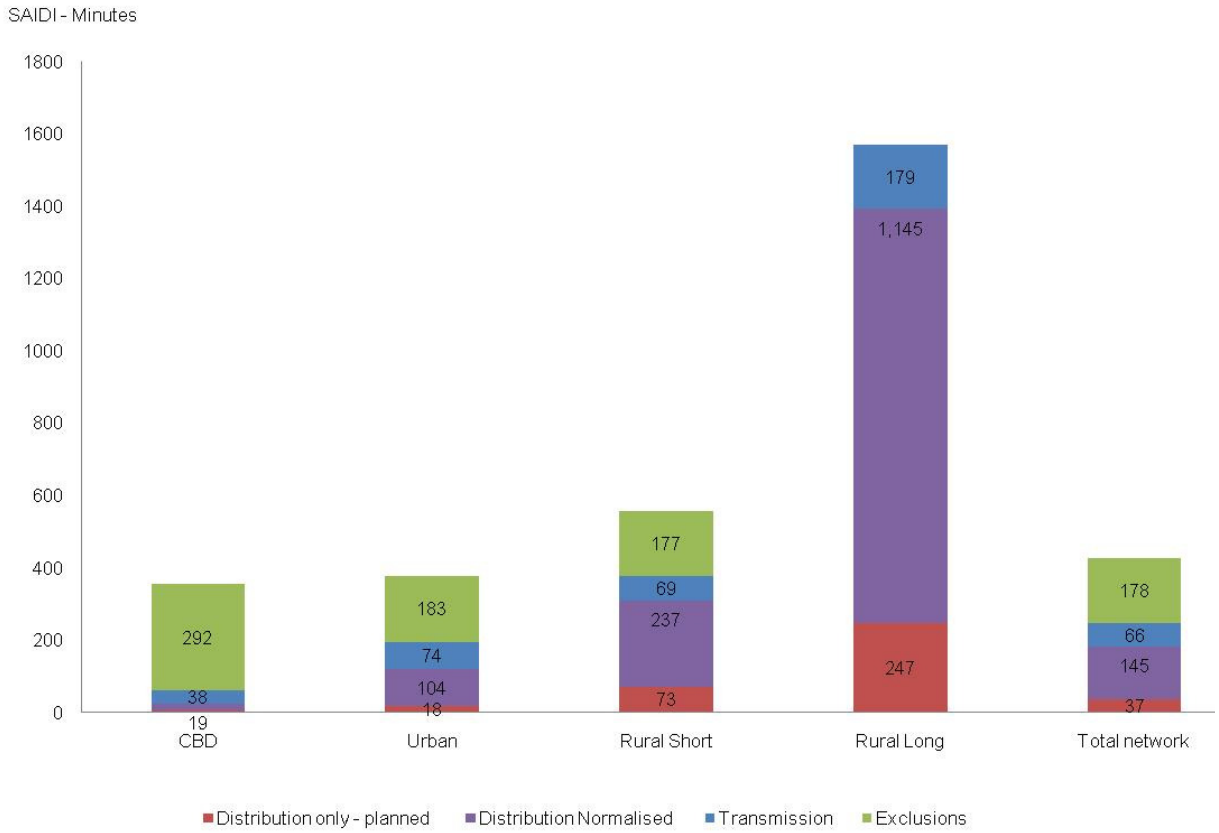
- CBD – a feeder predominantly supplying commercial, high-rise buildings, supplied by a predominantly underground distribution network containing significant interconnection and redundancy when compared to urban areas. PWC Networks had 34 CBD feeders at 30 June 2010;
- Urban – a feeder, which is not a CBD feeder, with actual maximum demand over the reporting period per total feeder route length greater than 0.3 MVA/km. PWC Networks had 30 urban feeders at 30 June 2010;
- Short Rural – a feeder which is not a CBD or urban feeder, with a total feeder route length less than 200km. Rural short feeders may include feeders in urban areas with low load densities. PWC Networks had 105 short rural feeders at 30 June 2010; and
- Long Rural – a feeder which is not a CBD or urban feeder with a total feeder route length greater than 200km. PWC Networks had 2 rural long feeders at 30 June 2010.

6.15 Examining feeder performance to identify network performance trend is the accepted approach in Australia. As 2009-10 is the first year this data has been reported for the Territory, there is no time series data to compare reliability performance in the Territory over time. The Commission will report reliability performance by feeder type in future Reviews.

6.16 Charts 6.3 and 6.4 present the relative performance of each feeder category for the (combined) Darwin-Katherine, Alice Springs and Tennant Creek systems for 2009-10.

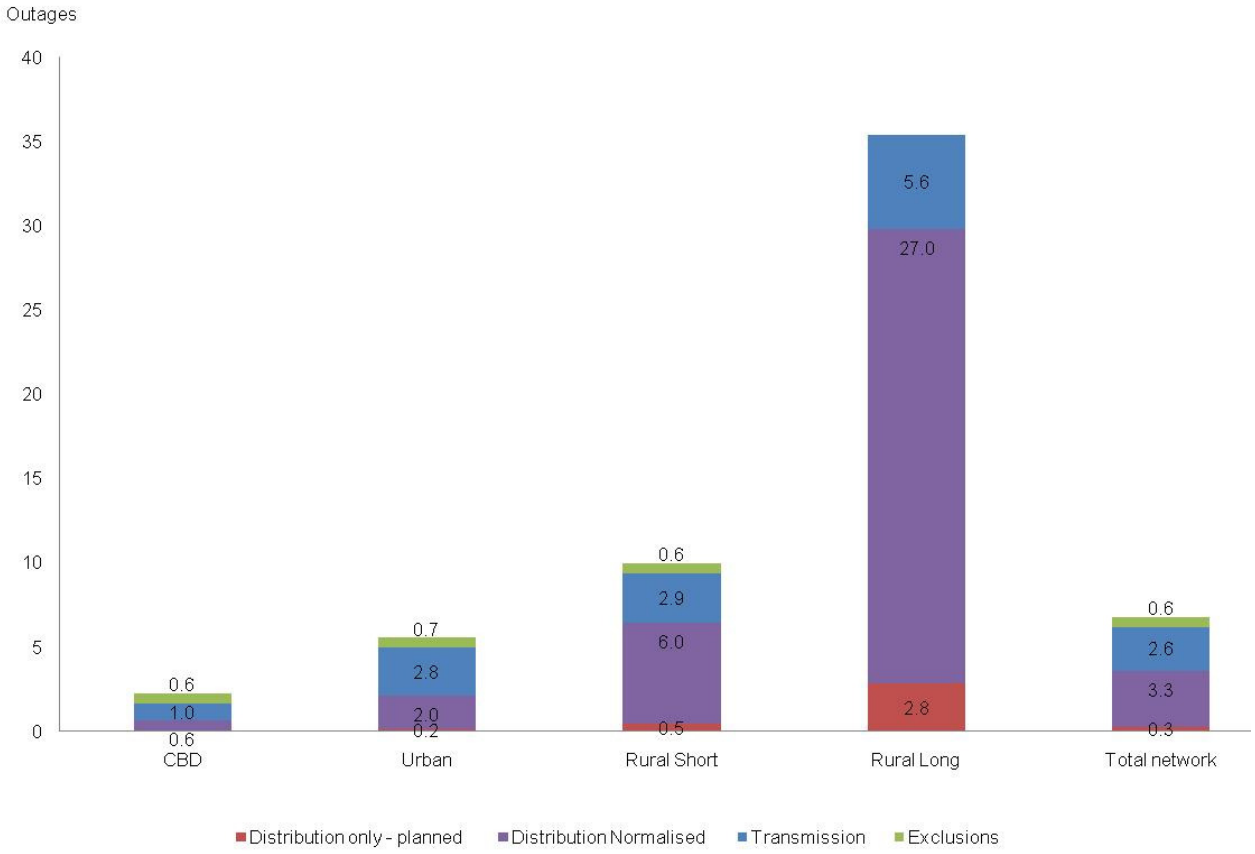
[21] Feeder performance is most commonly reported based on feeder type. The approach is documented in the Utility Regulator's Forum, 2002, National Regulatory Reporting for Electricity Distribution and Retailing Businesses.

Chart 6.3: PWC Networks average outage duration (SAIDI) by feeder category for 2009-10



Source: Evans & Peck.

Chart 6.4: PWC Networks average frequency of outages (SAIFI) by feeder category for 2009-10

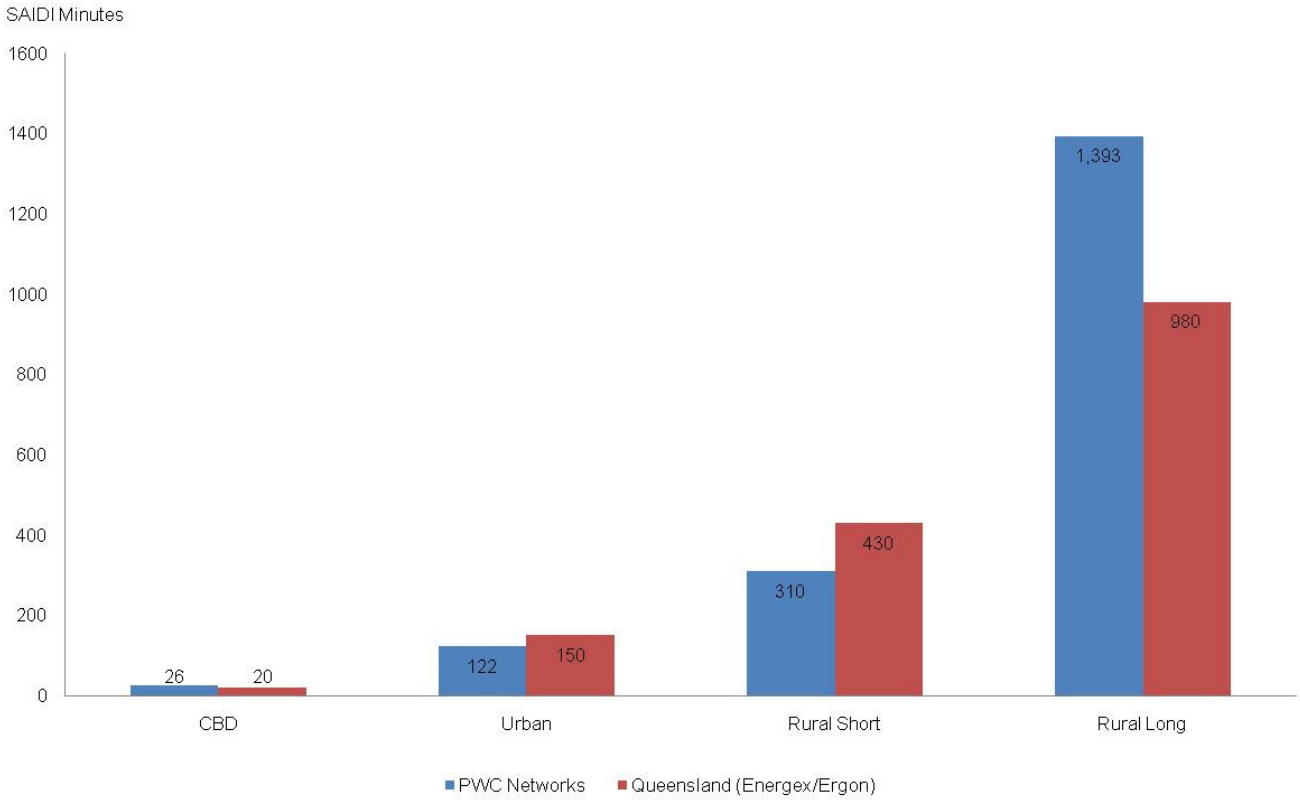


Source: Evans & Peck.

6.17 To assess relative performance of PWC Networks with regulatory expectations elsewhere in Australia, the Commission has compared PWC Network "normalised"[22] performance with the minimum service standards applicable in Queensland. The Commission considers the two Queensland electricity networks to provide a reasonable point of comparison to PWC Networks (particularly Ergon Energy).

6.18 Charts 6.5 and 6.6 present a comparison of feeder performance in the Territory with the Queensland minimum service standards.[23]

Chart 6.5: Feeder performance (SAIDI) 2009-10 – PWC Networks (actual) and Queensland (minimum service standard



Source: Evans & Peck

6.19 The Commission has the following observations about the comparison of SAIDI performance:

- the PWC Networks CBD feeder performance is marginally worse than the Energex CBD minimum standard (Energex CBD performance for 2009-10 was 1.2 SAIDI minutes). CBD feeder performance is variable across Australia and volatile between years. A single event can have a significant influence on performance.

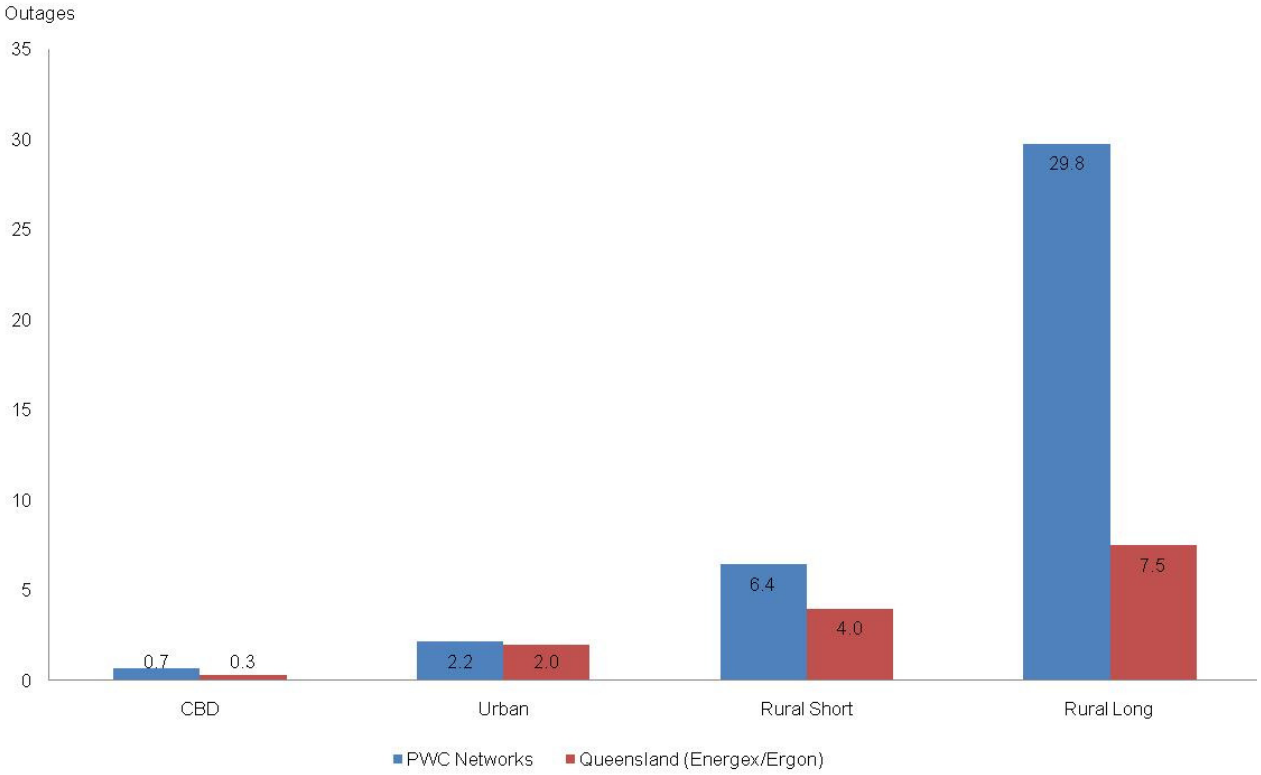
[22] Normalised means planned and unplanned outages excluding major event days.

[23] 2009-10 Ergon Energy urban, short rural and long rural standards and the Energex CBD standard (Ergon Energy has no CBD feeders). Refer Queensland Competition Authority, October 2010, Report on performance against minimum service standards and compliance with guaranteed service levels by Energex and Ergon Energy for the 2009-10 financial year.

The PWC Network CBD feeder performance is considered to be consistent with outcomes Australia wide;

- PWC Networks urban and short rural performance is better than the Ergon Energy minimum standards (Ergon performance for 2009-10 was 221.7 SAIDI minutes for urban and 542.9 SAIDI minutes for short rural); and
- PWC Network long rural performance is worse than the Ergon Energy minimum standard (Ergon performance for 2009-10 was 995.2 SAIDI minutes). However, the small number of long rural feeders in the Territory could cause high statistical variation. The individual feeder performances should be judged on relative length and technical configuration.

Chart 6.6: Feeder performance (SAIFI) 2009-10 – PWC Networks (actual) and Queensland (minimum service standards



Source: Evans & Peck

6.20 The Commission has the following observations about the comparison of SAIFI performance:

- PWC Networks CBD, urban and short rural SAIFI performance is marginally worse than the Energex/Ergon Energy minimum standards (Energex performance for 2009-10 was 0.08 outages for CBD, and Ergon performance for 2009-10 was 2.3 outages for urban and 4.6 outages for short rural). This is considered generally consistent with regulatory expectations across Australia; and
- PWC Networks long rural SAIFI performance is much worse than the Ergon Energy standard (Ergon performance for 2009-10 was 7.2 outages).

6.21 In future Reviews the Commission intends to compare feeder performance in the Territory over time and with that of like network service providers elsewhere in Australia.

Exclusions

6.22 Exclusions are events that have been identified using the 2.5 Beta method, which is a methodology developed by the Institute of Electrical and Electronic Engineers (IEEE) to statistically identify reliability events that may not represent business as usual and distort the underlying reliability trend. This is the method commonly used in Australia.

6.23 Notwithstanding that the terminology used is "exclusions" or excluded events, this does not mean that the cause or consequences of the event should be ignored. Each excluded event should be the subject of a review so as to provide a detailed understanding of the event.

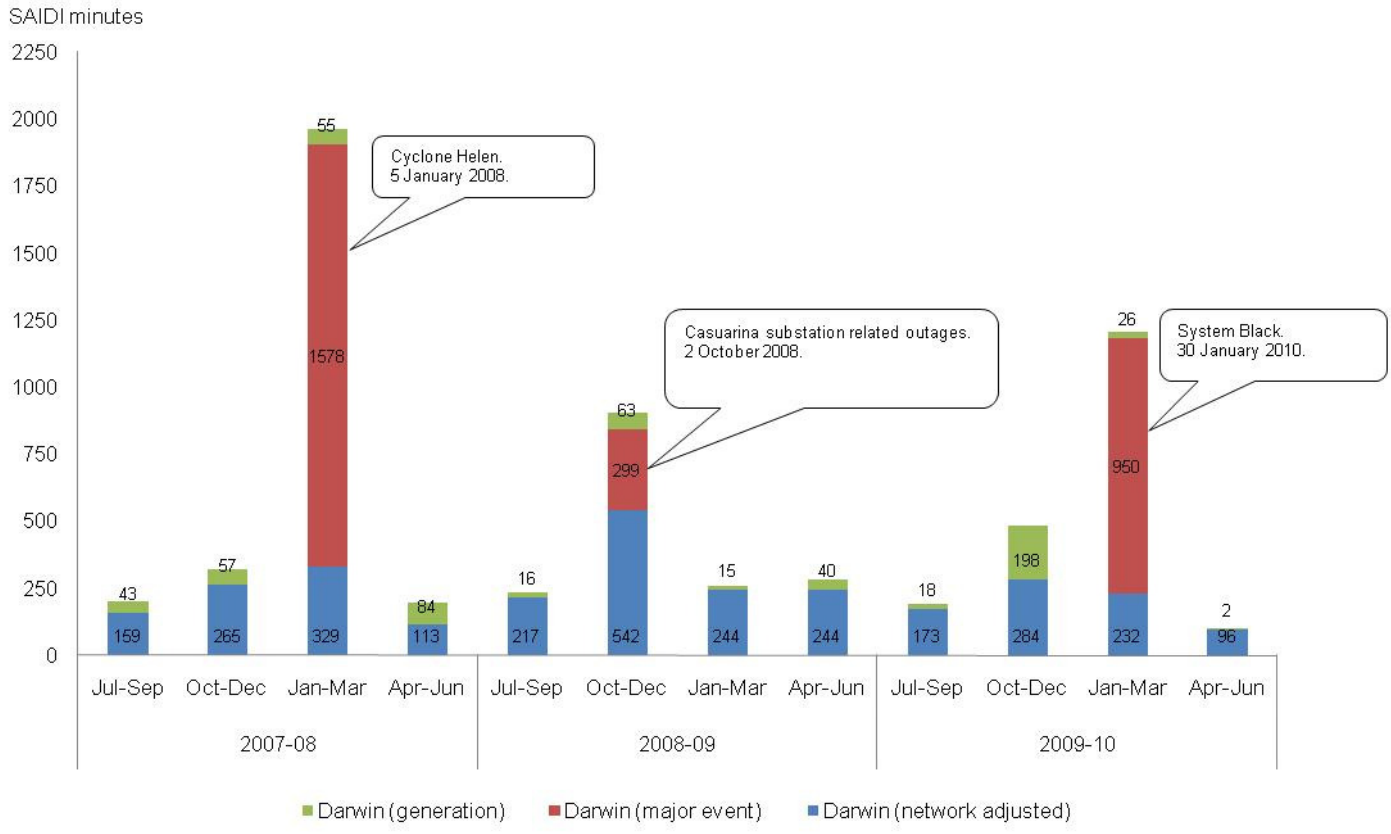
6.24 Although the 2.5 Beta method removes some statistical variability, reliability performance is still probabilistic and influenced by weather, equipment failure, actions by third parties and animals. However, a review of trends gives some insight as to whether reliability performance is stable, improving or deteriorating.

Darwin region reliability performance

6.25 Darwin region reliability performance for each quarter for 2007-08 to 2009-10 is presented in Charts 6.7 and 6.8.

6.26 The SAIDI performance in 2009-10 was 494.9 minutes off supply, comprising 61.2 minutes due to generation, 196.2 minutes due to networks and 237.6 minutes due to a major event (when a lightning strike to the two transmission lines from the Channel Island power station on 30 January 2010 led to the Darwin-Katherine system black).

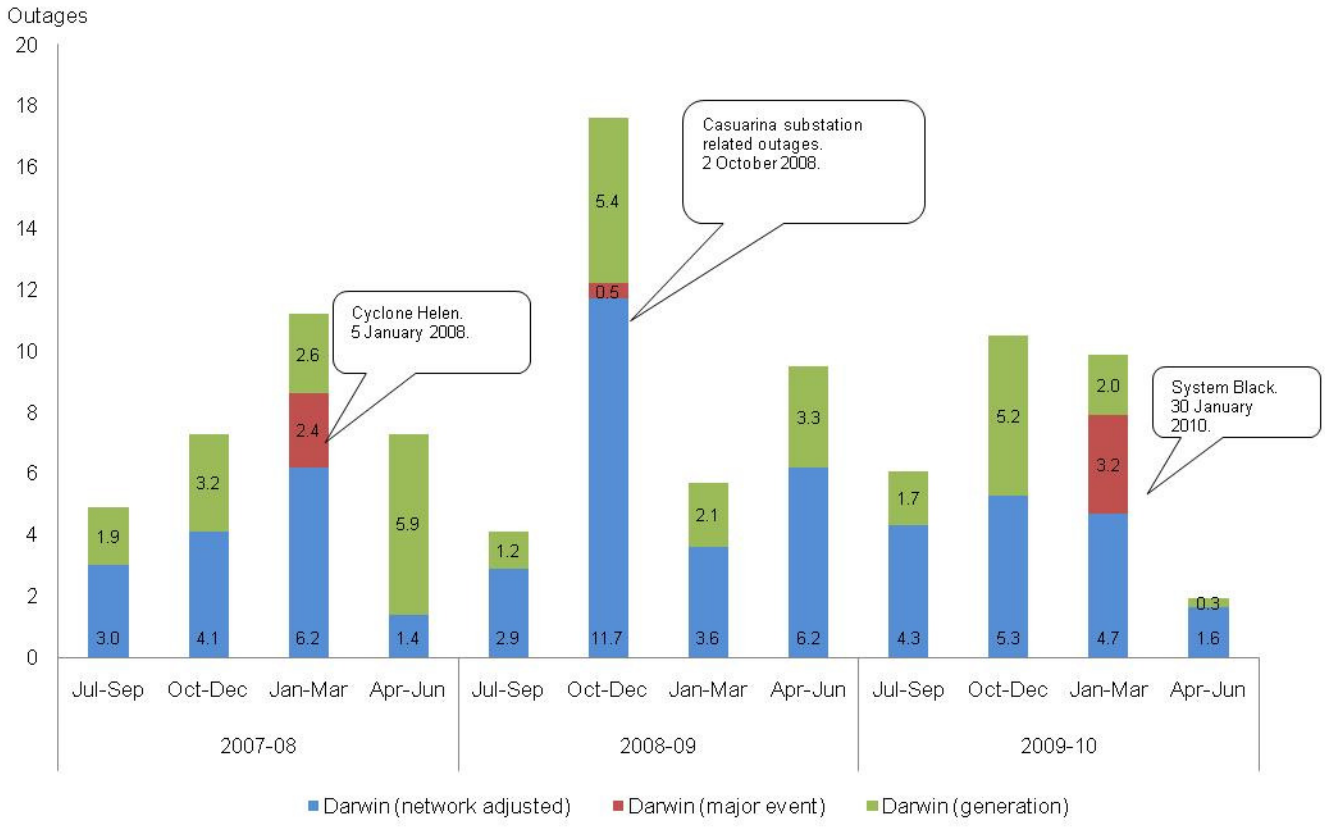
Chart 6.7: Average outage duration for a Darwin customer 2007-08 to 2009-10 (quarterly)



Source: Utilities Commission.

6.27 The average frequency of outages experienced by a customer (SAIFI performance) in 2009-10 was 7.1, comprising 2.3 outages due to generation, 4.0 outages due to networks and 0.8 outages due to the system black.

Chart 6.8: Average frequency of outages for a Darwin customer 2007-08 to 2009-10 (quarterly)



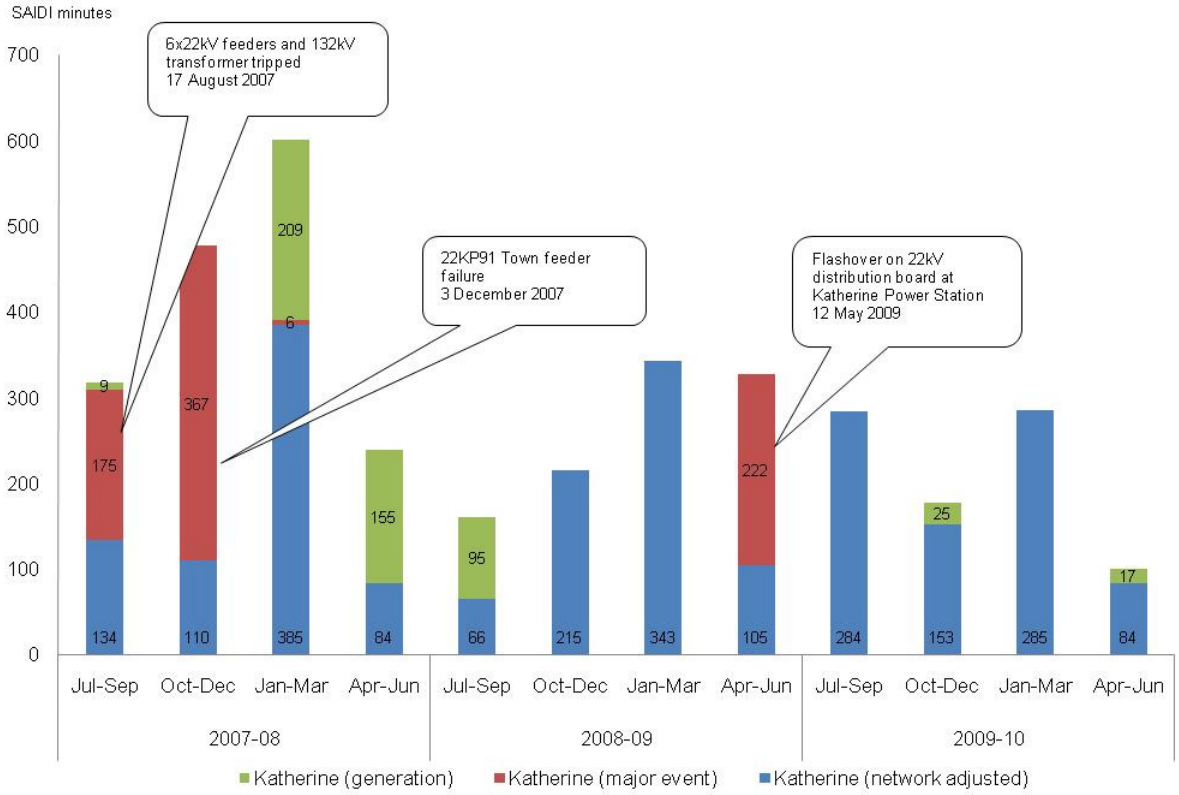
Source: Utilities Commission.

Katherine region reliability performance

6.28 Katherine region reliability performance for each quarter for 2007-08 to 2009-10 is presented in Charts 6.9 and 6.10.

6.29 SAIDI performance in 2009-10 was 211.9, comprising 10.4 minutes due to generation and 201.5 minutes due to networks.

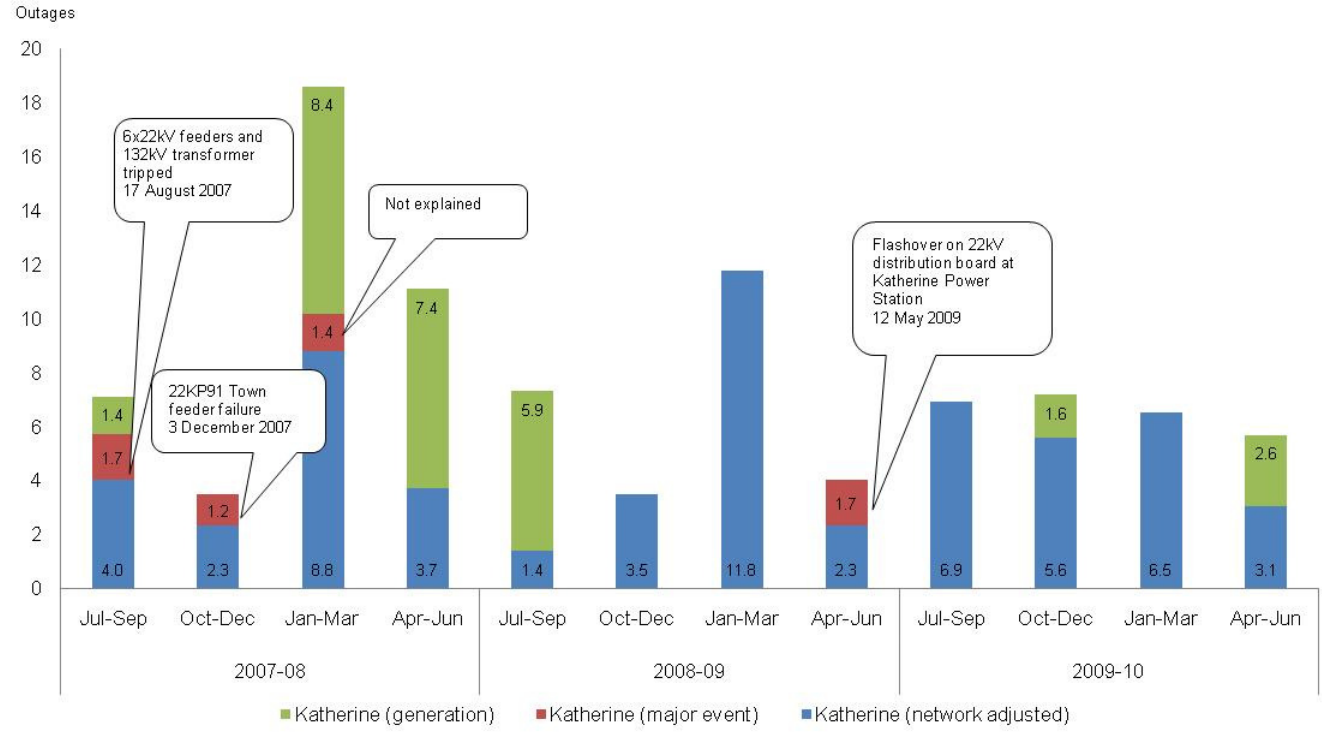
Chart 6.9: Average outage duration for a Katherine customer 2007-08 to 2009-10 (quarterly)



Source: Utilities Commission.

6.30 SAIFI performance in 2009-10 was 6.6, with 1.0 outage due to generation and 5.5 outages due to networks.

Chart 6.10: Average frequency of outages for a Katherine customer 2007-08 to 2009-10 (quarterly)



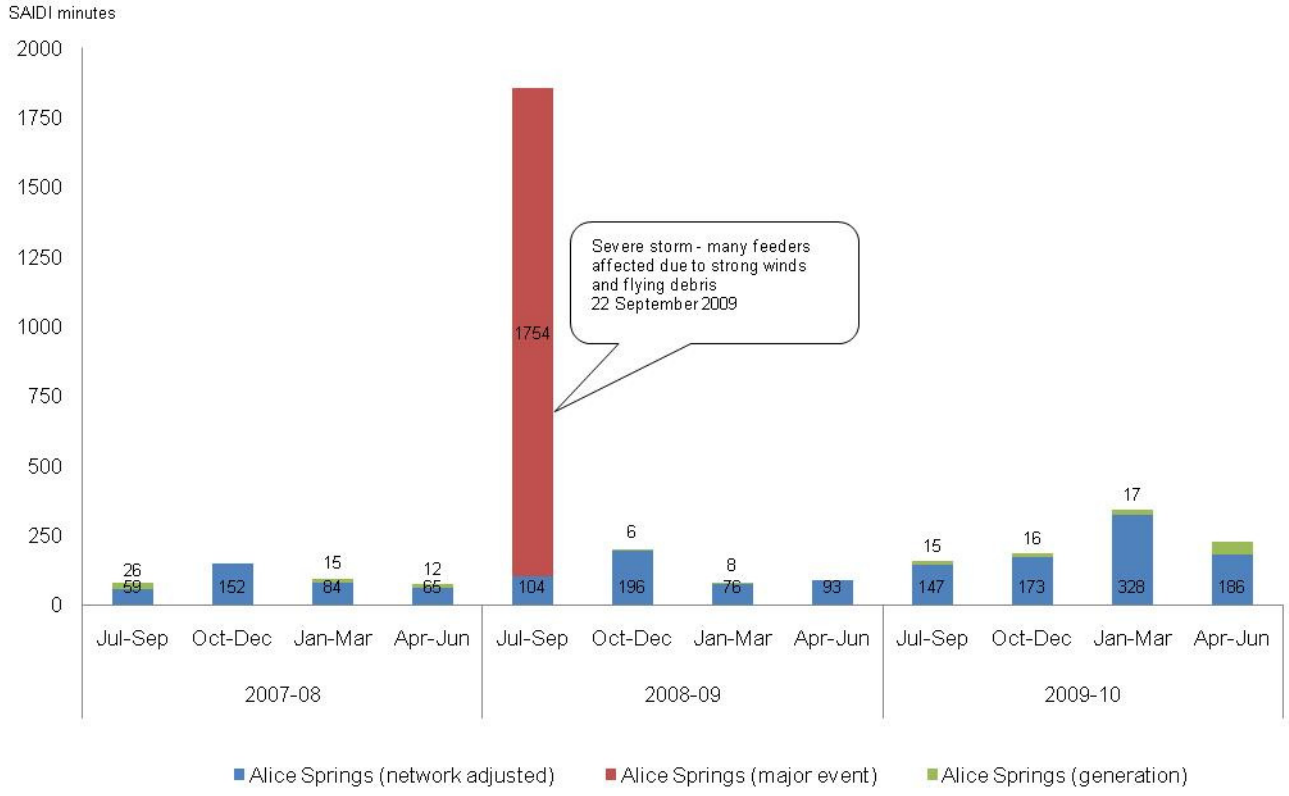
Source: Utilities Commission.

Alice Springs region reliability performance

6.31 Alice Springs reliability performance for each quarter for 2007-08 to 2009-10 is presented in Charts 6.11 and 6.12.

6.32 SAIDI performance in 2009-10 was 231.9, with 23.4 minutes due to generation and 208.5 minutes due to networks.

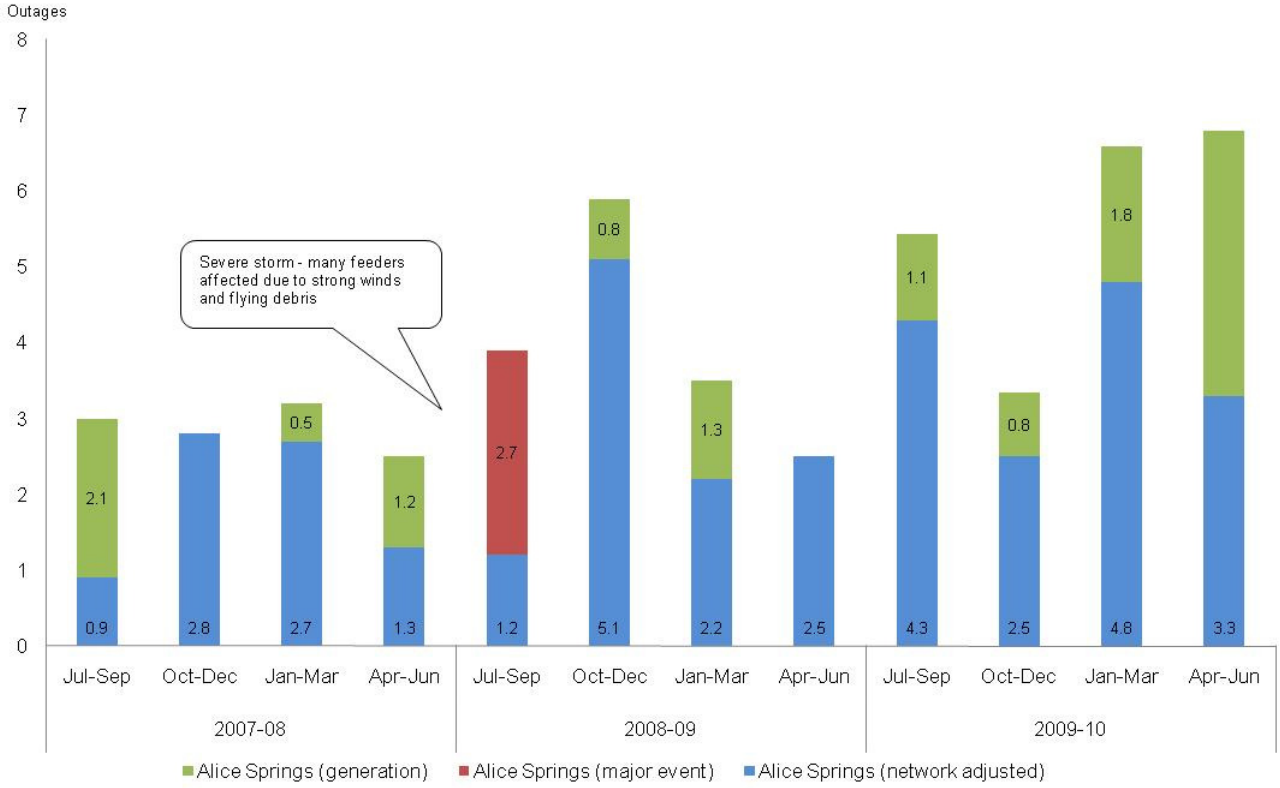
Chart 6.11: Average frequency of outages for an Alice Springs customer 2007-08 to 2009-10 (quarterly)



Source: Utilities Commission.

6.33 SAIFI performance in 2009-10 was 5.5, with 1.8 outages due to generation and 3.7 outages due to networks.

Chart 6.12: Average frequency of outages for an Alice Springs customer 2007-08 to 2009-10 (quarterly)



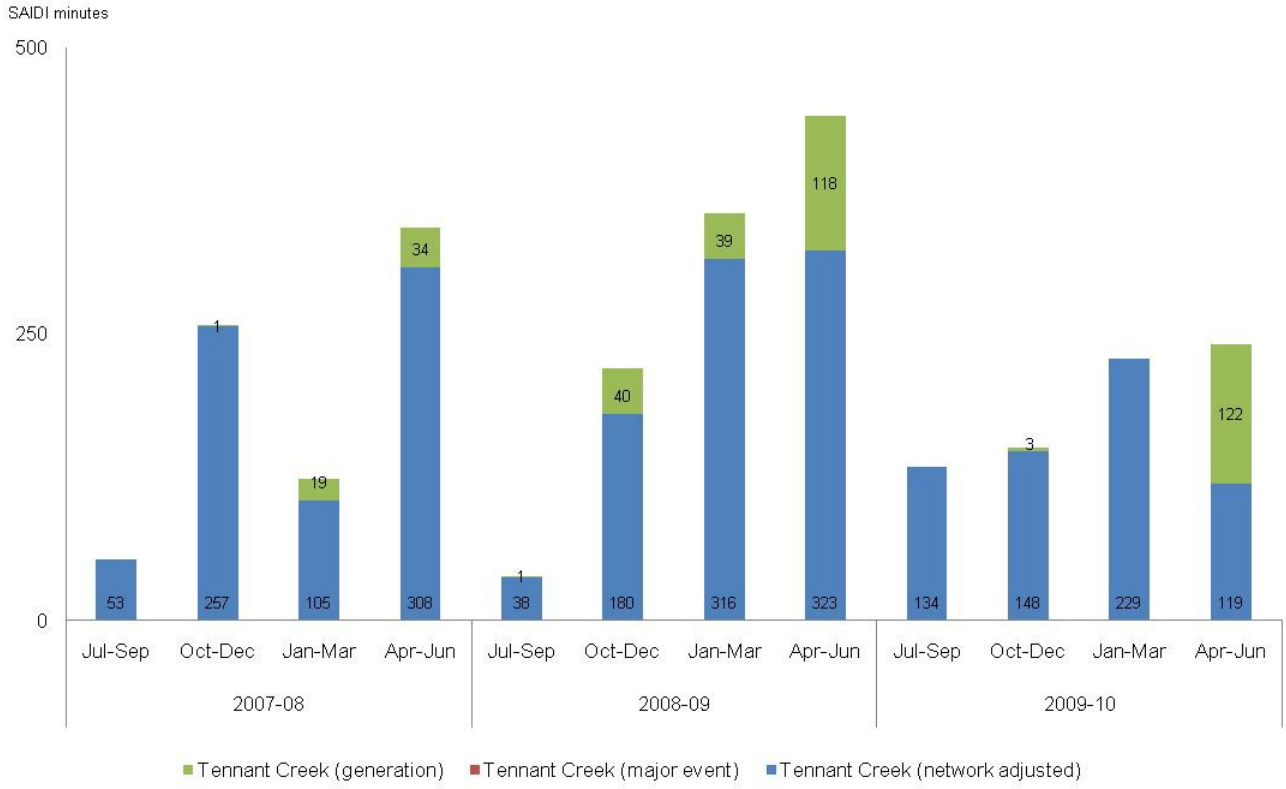
Source: Utilities Commission.

Tennant Creek reliability performance

6.34 Tennant Creek reliability performance for each quarter for 2007-08 to 2009-10 is presented in Charts 6.12 and 6.13.

6.35 SAIDI performance in 2009-10 was 188.7, with 31.2 minutes due to generation and 157.5 minutes due to networks.

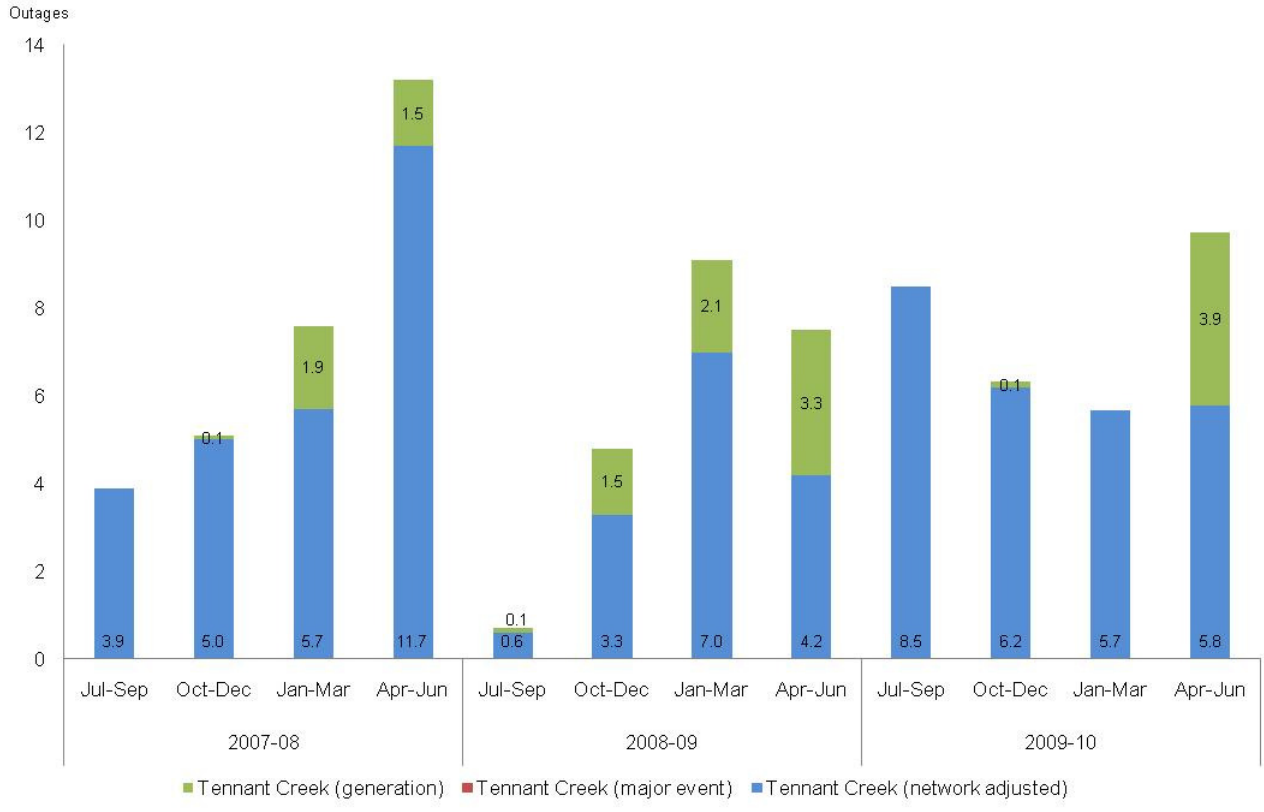
Chart 6.12: Average frequency of outages for a Tennant Creek customer 2007-08 to 2009-10 (quarterly)



Source: Utilities Commission.

6.36 SAIFI performance in 2009-10 was 7.5, with 1.0 outage due to generation and 6.5 outages due to networks.

Chart 6.13: Average frequency of outages for a Tennant Creek customer 2007-08 to 2009-10 (quarterly)



Source: Utilities Commission.

Customer service performance

6.37 The customer service performance of PWC Networks and PWC Retail is measured using the following indicators:

- the time taken to complete reconnections and new connections;
- the number of complaints about quality of electricity supply;
- the time taken to answer telephone calls (after the customer has chosen to speak to an operator);
- the number of complaints about PWC Networks and PWC Retail customer service

Reconnections / connections

6.38 PWC Networks reports on the percentage of reconnections and connections of customers that occur after a defined time period:

- reconnections are to occur within 24 hours (connections to a property where there is an existing supply and no extension or augmentation of the network needed);
- connections to a property in a new subdivision in an urban area are to occur within five working days; and
- connections to a property in a new subdivision in an urban area where minor extension or augmentation of the network is required are to occur within 10 weeks

6.39 The percentage of reconnections and connections not occurring within the defined timeframe for 2005-06 to 2009-10 is presented in Table 6.1.

Table 6.1: Percentage of reconnections / connections not made within the specified time limit

All customers (% not made)	2005-06	2006-07	2007-08	2008-09	2009-10
Reconnections (existing)	0	1	1	0.8	0.5
Connections (new subdivision)	7	19.3	16	8.7	7.9
Connections (extension needed)	30	31.5	32	66.5	69.4

Source: Power and Water Corporation.

6.40 The number of connections to a property in a new subdivision is 92.1 per cent, continuing the improvement in the number occurring in time from the low point of 80.7 per cent recorded in 2006-07.

6.41 The number of connections where minor works are required was 30.6 per cent, which is worse than in 2008-09 and the worst result in the five year period. This result could be attributed to a diversion of resources from routine works to the PWC Networks remedial asset management program.

Quality of supply complaints

6.42 PWC Networks reports the number of complaints received in relation to quality of supply (e.g. voltage dips, swells and spikes). Table 6.2 presents the number of quality of supply complaints for 2006-07 to 2009-10. No data was reported for 2005-06.

Table 6.2: Quality of supply complaints

Number of complaints	2005-06	2006-07	2007-08	2008-09	2009-10
Northern (Darwin)	NA	NA	801	792	776
Katherine	NA	NA	194	109	317
Southern (Alice Springs)	NA	NA	96	139	114
Tennant Creek	NA	NA	26	21	77
Total	**NA**	**1029**	**1117**	**1061**	**1284**

Source: Power and Water Corporation.

6.43 The data show a significant increase in complaints in Katherine and Alice Springs between 2008-09 and 2009-10. No reason has been given by PWC.

Telephone call response

6.44 PWC (Networks and Retail) report the number and percentage of telephone calls responded to within 20 seconds of the customer selecting to speak to a human operator.

6.45 Table 6.3 presents the percentage and number of telephone calls answered within 20 seconds of the customer choosing to speak to a human operator for 2005-06 to 2009-10.

Table 6.3: Percentage and number of telephone calls answered within timeframe

Telephone calls answered	2005-06	2006-07	2007-08	2008-09	2009-10
Percentage	76	69	58	62	63
Number	113 871	96 562	78 453	87 013	91 614

Source: Power and Water Corporation.

6.46 The 2009-10 result represents an improvement from 2008-09, but is below the 76 per cent achieved in 2005-06.

Customer complaints

6.47 PWC (Networks and Retail) report the number of complaints received from customers.[24]

6.48 Table 6.4 gives the number of customer complaints received by PWC Networks and PWC Retail for the period 2005-06 to 2006-07.

[24] A complaint is (as defined in the Australian Standard ISO10002-2006) 'an expression of dissatisfaction made to an organisation, related to its products, or the complaint handling process itself, where a response or resolution is explicitly or implicitly expected'.

Table 6.4: Number of customer complaints

Number of complaints	2005-06	2006-07	2007-08	2008-09	2009-10
Darwin	NA	NA	1778	1718	1830
Katherine	NA	NA	121	160	160
Alice Springs	NA	NA	391	318	417
Tennant Creek	NA	NA	42	39	70
Total	**2907**	**1917**	**2332**	**2235**	**2477**

Source: Power and Water Corporation.

6.49 PWC received 2477 electricity service related complaints during 2009-10, the highest number received since 2005-06.

APPENDIX A

System maximum demand forecasts 2010-11 to 2019-20

Table A.1: Forecast Darwin-Katherine annual maximum system demand for 2010-11 to 2019-20

MW per annum	E&P (medium – 2.8%)	PWC (medium – 2.2%)	PWC (high – 2.6%)
2009-10 (actual)	*273.4*	*273.4*	*273.4*
2010-11	281.1	279.4	280.5
2011-12	288.9	285.6	287.8
2012-13	297.0	291.9	295.3
2013-14	305.3	298.3	303.0
2014-15	313.9	304.8	310.9
2015-16	322.7	311.5	318.9
2016-17	331.7	318.4	327.2
2017-18	341.0	325.4	335.7
2018-19	350.5	332.6	344.5
2019-20	360.4	339.9	353.4

Source: Evans & Peck and Power and Water Corporation.

Table A.2: Forecast Alice Springs annual maximum system demand for 2010-11 to 2019-20

MW per annum	E&P (medium – 1.7%)	PWC (medium – 1.2%)	PWC (high – 1.6%)
2009-10 (actual)	*54.9*	*54.9*	*54.9*
2010-11	55.9	55.6	55.8
2011-12	56.8	56.3	56.7
2012-13	57.8	57.0	57.6
2013-14	58.8	57.6	58.6
2014-15	59.8	58.3	59.5
2015-16	60.8	59.0	60.4
2016-17	61.8	59.7	61.4
2017-18	62.9	60.5	62.4
2018-19	64.0	61.2	63.4
2019-20	65.0	61.9	64.4

Source: Evans & Peck and Power and Water Corporation.

Table A.3: Forecast Tennant Creek annual maximum system demand for 2010-11 to 2019-20

MW per annum	E&P (medium – 2.0%)	PWC (medium–0.64%)	PWC (high – 1.1%)
2009-10 (actual)	*7.4*	*7.4*	*7.4*
2010-11	7.5	7.4	7.5
2011-12	7.7	7.5	7.5
2012-13	7.8	7.5	7.6
2013-14	8.0	7.6	7.7
2014-15	8.1	7.6	7.8
2015-16	8.3	7.7	7.9
2016-17	8.5	7.7	8.0
2017-18	8.6	7.8	8.0
2018-19	8.8	7.8	8.1
2019-20	9.0	7.9	8.2

Source: Evans & Peck and Power and Water Corporation.

APPENDIX B

Zone substation demand for 2007-08 to 2015-16

Zone Substations - Northern & Southern Regions	Number of Transformers	Max. Capacity MVA[1]	Min. Capacity MVA[1]	Max. Firm Capacity MVA[2]	Min. Firm Capacity MVA[2]	2007-08 Demand MVA	2008-09 Demand MVA	2009-10 Demand MVA	2010-11 Demand MVA	2011-12 Demand MVA	2012-13 Demand MVA	2013-14 Demand MVA	2014-15 Demand MVA	2015-16 Demand MVA
Palmerston 11/22kV	1	7.5	7.5	0.0	0.0	5.0	5.3	5.6	5.7	5.9	6.0	6.2	6.3	6.5
McMinns 66/22kV	3	40.5	30.0	27.0	20.0	21.1	20.4	20.7	21.3	21.9	22.6	23.2	23.9	24.6
Weddell 66/22kV	2	10.0	10.0	5.0	5.0	-	6.0	6.0	6.2	6.3	6.5	6.6	6.8	7.0
Humpty Doo 66/22kV	3	7.5	7.5	5.0	5.0	1.5	1.5	1.6	1.6	1.7	1.7	1.8	1.8	1.9
Mary River 66/22kV	1	5.0	5.0	0.0	0.0	1.3	1.3	1.3	1.3	1.4	1.4	1.4	1.5	1.5
Marrakai 66/22kV	2	5.0	5.0	2.5	2.5	-	-	-	1.5	1.5	1.5	1.6	1.6	1.7
Manton 132/22kV	1	27.0	20.0	0.0	0.0	6.0	5.6	5.7	5.8	6.0	6.1	6.3	6.4	6.6
Batchelor 132/22kV	1	27.0	20.0	0.0	0.0	11.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Pine Creek 11/66kV	2	40.0	40.0	20.0	20.0	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5
Katherine 132/22kV	2	54.0	40.0	27.0	20.0	25.6	28.6	28.8	29.0	29.2	29.4	29.6	29.8	30.0
Berrimah 66/11kV	2	76.0	50.0	38.0	25.0	35.6	36.1	36.1	37.7	34.4	36.0	37.6	39.3	41.0
Leanyer 66/11kV[3]	2	54.0	40.0	27.0	20.0	-	-	-	-	15.0	15.5	16.0	16.5	17.0
Casuarina 66/11kV	3	114.0	75.0	76.0	50.0	47.9	44.6	32.3	52.2	43.9	45.3	46.7	48.2	49.8
Snell Street 66/11kV	4	47.0	40.0	35.0	30.0	41.1	36.7	36.2	37.3	38.4	39.6	40.7	42.0	43.2
City Zone 66/11kV	3	120.0	90.0	80.0	60.0	61.3	62.1	61.3	42.6	43.6	44.5	45.5	46.5	47.6
Frances Bay 66/11kV[3]	1	40.0	30.0	0.0	0.0	-	-	-	20.0	20.4	20.9	21.3	21.8	22.3
Centre Yard 66/11kV	2	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6
Palmerston 66/11kV	2	80.0	60.0	40.0	30.0	43.3	42.6	43.1	46.0	34.2	36.5	39.0	41.6	44.4
Archer 66/11kV[3]	2	54.0	40.0	27.0	20.0	-	-	-	-	15.0	16.0	17.1	18.3	19.5
Pine Creek 11/22kV	4	10.0	10.0	7.5	7.5	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8
Union Reef 66/11kV	1	12.5	10.0	0.0	0.0	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
Brocks Creek 66/11kV	2	7.0	7.0	3.5	3.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cosmo Howley 66/11kV	2	15.0	15.0	7.5	7.5	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3
Alice Springs - Lovegrove 22/11kV	3	35.0	25.0	20.0	15.0	15.1	15.1	15.5	15.9	16.3	16.7	17.1	17.5	18.0
Alice Springs - Sadadeen 22/11kV[4]	2	38.0	30.0	19.0	15.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Alice Springs - Ron Goodin[4]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Tennant Creek[4]	2	15.0	15.0	7.5	7.5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Network - Substation Totals	**55**	**942.0**	**723.0**	**475.0**	**364.0**	**332.1**	**322.5**	**310.9**	**341.2**	**352.1**	**363.4**	**375.2**	**387.4**	**400.2**

Notes:

1. Maximum and minimum capacity are based on the ratings of the substation transformers.
2. Based on N-1 contingency criteria (i.e. the loss of one transformer). Example: Pine Creek Zone Substation consists of 2 transformers rated at 20 MVA; if one transformer fails the minimum firm capacity is 20 MVA.
3. Actual and forecast demand commences from completion of construction of the zone substation.
4. Sadadeen, Ron Goodin and Tennant Creek are stations with generators. Loading on the transformers depends on the generators dispatched.
5. Load will be shared between adjacent zone substations in the cases where the minimum firm capacity is less than demand to avoid potential load shedding.

Source: Power and Water Corporation.