TRANSMISSION NETWORK LIMITATIONS IN THE COWRA/FORBES/PARKES AREA

NEEDS STATEMENT

March 2006

1. Introduction

1.1. Purpose and Scope

This document has been prepared to:

- provide information on:
  - the nature of the demand for electricity (the electrical load) in the Cowra/Forbes/Parkes area;
  - the capability of the transmission network supplying that load; and
  - the basis on which TransGrid and Country Energy have identified network constraints (inadequate network capacity) which are expected to arise in the future;
- seek comments on the approach and criteria adopted by TransGrid and Country Energy; and
- seek information on solutions to the network constraints that may be provided by persons other than TransGrid and Country Energy.

TransGrid and Country Energy are currently developing possible options to relieve the constraints identified. This document does not describe those options, however readers are encouraged to suggest possible options. A future consultation paper will describe the feasible options which arise from comments on this document as well as those being developed by TransGrid and Country Energy.

1.2. Background

1.2.1. Introduction

This document considers the area supplied from Cowra, Forbes and Parkes 132/66 kV substations. That area includes the Cowra, Forbes, Parkes and Weddin shires as well as parts of Lachlan shire. It has a resident population of around 50,000.

The area electrical load is characterised primarily by rural loads with urban residential loads and commercial/light industrial loads in the main population centres.

1.2.2. Local Supply Arrangements

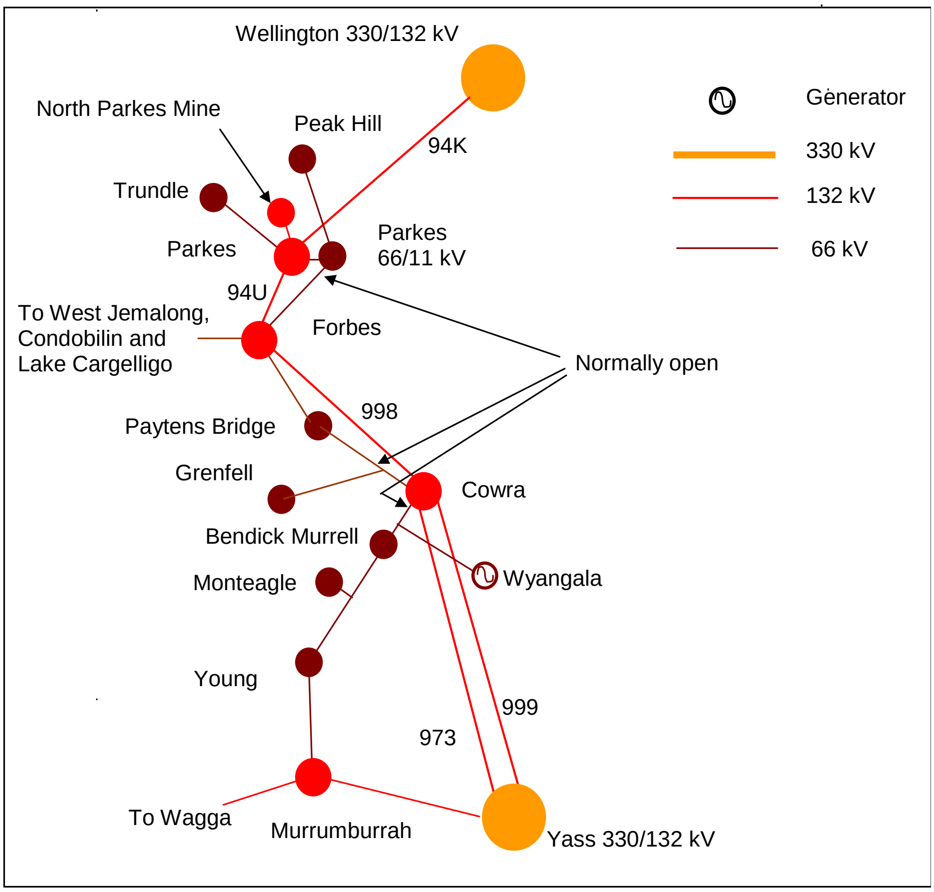
This area is supplied via a 132 kV transmission network some 350 kilometres long linking Yass and Wellington 330/132 kV substations, as shown in Figure 1. This 132 kV network supplies 132/66 kV substations at Cowra, Forbes and Parkes, which in turn supply Country Energy's 66 kV networks in those areas. Country Energy also owns the 132 kV line supplying the North Parkes mine.

The major developments in establishing TransGrid's 132 kV network are shown in Table 1 below.

Table 1 Major 132 kV Line and Substation Developments

Period	**Substations**	**Lines**
Early 1960s	Cowra	Yass – Cowra (999 line) Cowra – Forbes (initially operating at 66 kV)
Late 1960s	Forbes	Yass – Cowra (973 line)
Mid 1980s		Wellington – Forbes (via Parkes)
Early 1990s	Parkes	

Figure 1 The Transmission System Supplying the Cowra/Forbes/Parkes Area



Over the years, capacitor banks have been installed at Forbes and Parkes to improve voltage levels both with all elements in service and following outage of one network element. TransGrid plans to install additional capacitors at Cowra, Forbes and Parkes by early 2007. The capacitors installed at TransGrid substations in the area are shown in Table 2 below.

Table 2 Capacitors at TransGrid Substations

Location	Capacitors Installed
Cowra	2 x 8 MVAr 66 kV (to be installed by early 2007)
Forbes	1 x 12 MVAr 132 kV (to be installed by early 2007) 2 x 9 MVAr 66 kV
Parkes	1 x 10 MVAr 66 kV 1 x 8 MVAr 66 kV (to be installed by early 2007)

Parkes 132/66 kV substation has only a single transformer, with a back-up supply being provided from Forbes via Country Energy's 895 Forbes – Parkes 66 kV line. TransGrid plans to install a second transformer at Parkes as the capacity of Country Energy's 66 kV line is limited.

There is a hydro generator at Wyangala dam which operates when water is released for irrigation. Connection arrangements have required the output be directed to Young rather than reducing the load normally supplied from Cowra. The availability and capacity of generation depends on the quantity of water able to be released which depends on the water level in the dam. Due to its unpredictable nature, generation at Wyangala cannot be relied upon to be available at times of high area load. Consequently generation from this source has not been considered in this analysis.

2. Identification of Future Network Constraints

2.1. Load Forecast

2.1.1. The Nature of the Electrical Load

The highest demand for electricity occurs during the afternoon of summer working weekdays and on evenings (around 6:00 pm to 7:00 pm) and nights (around 11:00 pm to 1:00 am) of winter working weekdays. Winter maximum demands are presently typically 95% of the summer maximum demands.

Figure 2 below shows the maximum demands (averaged over a half hour period) for each day from 1 July 1996 to 3 February 2006.

Figure 2 Daily Maximum Demands for the Cowra/Parkes/Forbes Area

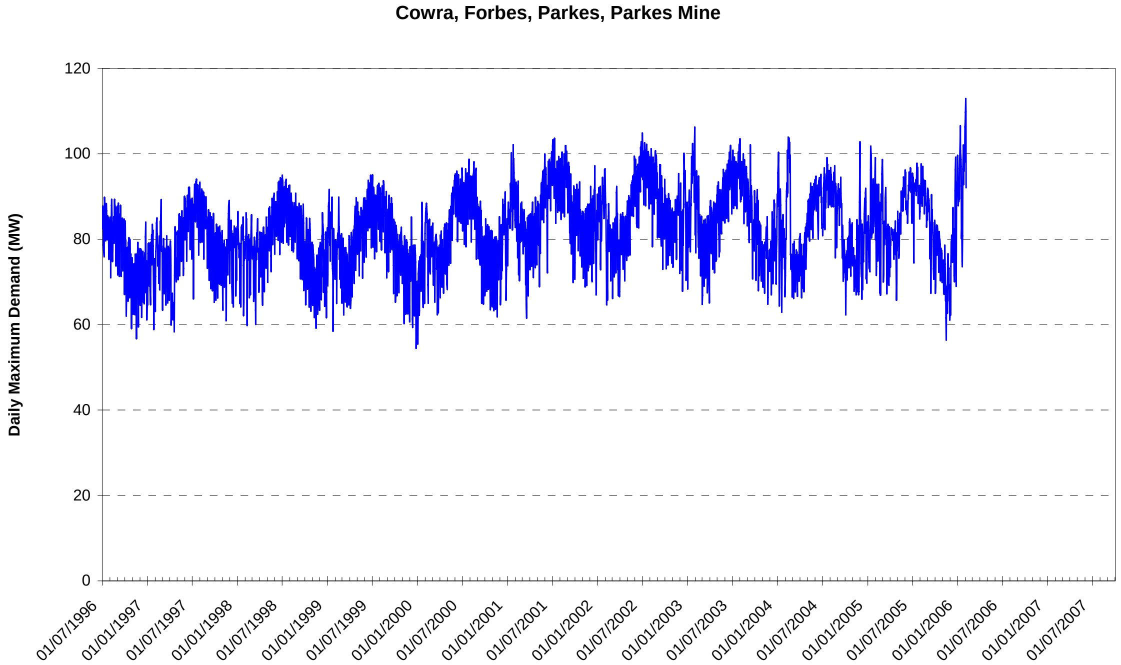


Figure 3 below shows the load on the days of maximum demand in winter 2004 and summer 2004/05.

Figure 3 Load Profile on Days of Maximum Demand

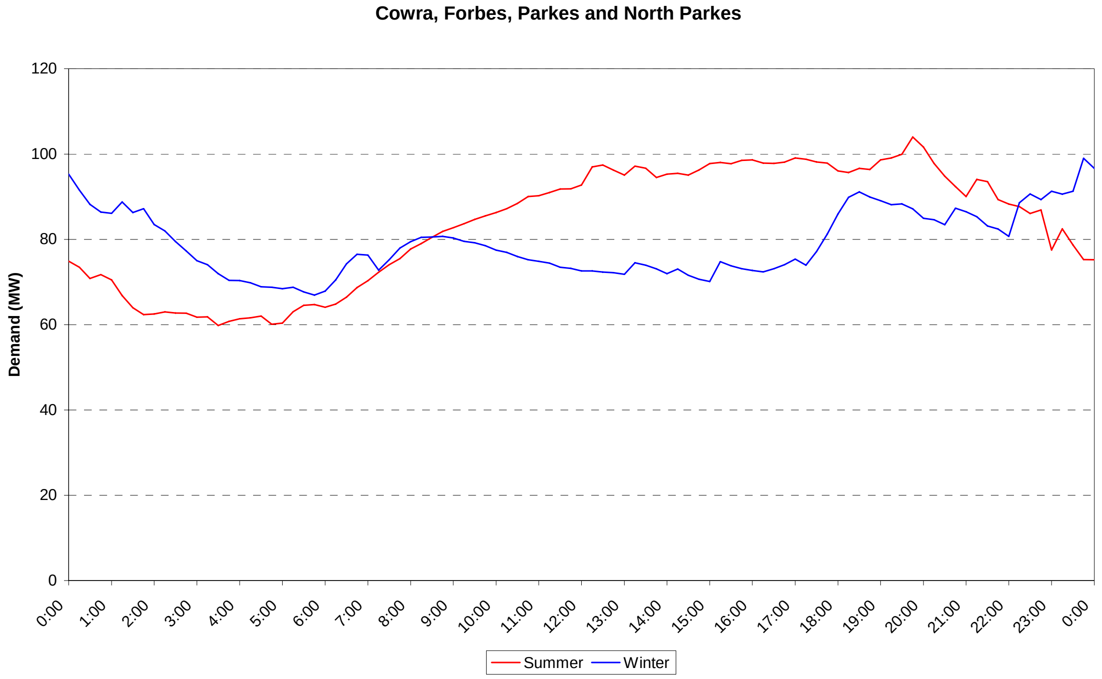
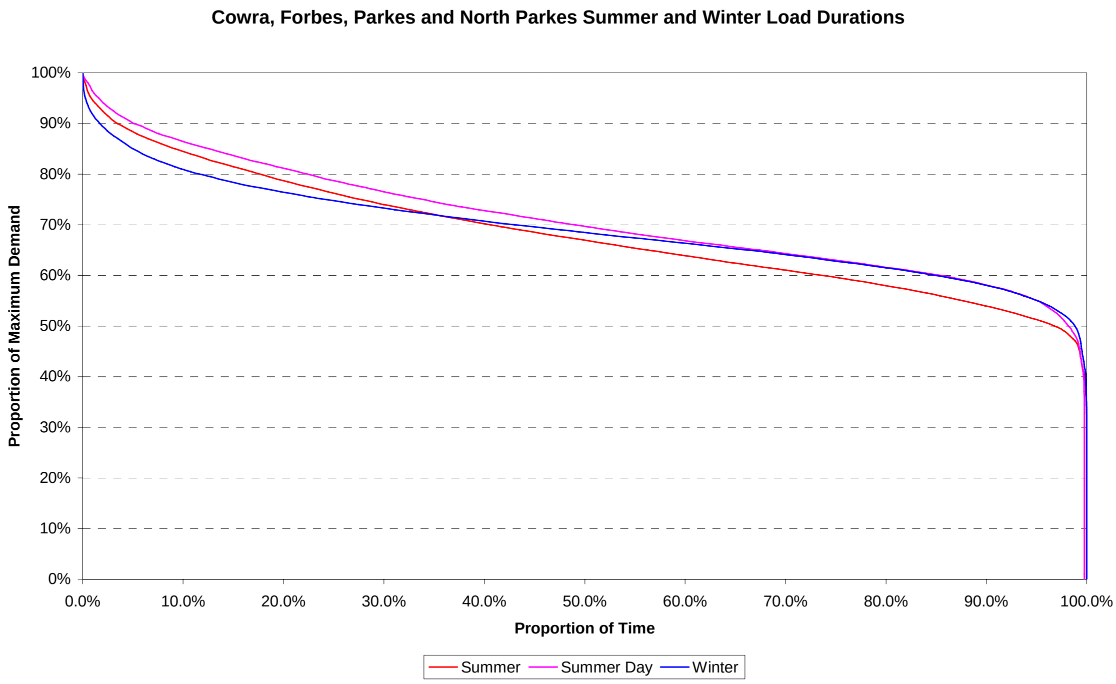


Figure 4 shows the load duration curves (averaged over the period summer 2000/01 to winter 2005). These curves show the proportion of time that particular demands (expressed as a proportion of the maximum demand for that year) are exceeded. Clearly, high loads exist for only a relatively short proportion of the year.

Figure 4 Load Duration Curves for the Cowra/Parkes/Forbes Area



Typically, demand is at high levels for a number of periods of short duration. Table 3 below gives the typical number and maximum duration of those periods as a function of load level.

Table 3 Typical Number and Maximum Duration of High Load Events

Proportion of Maximum Demand	Typical Number of Occurrences p.a.	Typical Maximum Duration (hours)
80%	250	14
85%	140	12
90%	70	9
95%	15	4

2.1.2. What Causes High Demands

High demands occur on hot days in summer and cold days in winter suggesting that cooling and heating are major contributors.

An inspection of maximum demand data for the days of highest winter demand since July 1996 shows that:

- The days of highest summer demands occur most frequently in January and February with the highest number in January.
- High summer demands are likely to occur on working weekdays with the highest number on Thursday and Friday.
- The days of highest winter demands occur most frequently in June, July and August with the highest number in July.
- High winter demands are likely to occur on working weekdays.

2.1.3. The Load Forecast

The forecast summer and winter maximum demands for the Cowra/Forbes/Parkes area are shown in Table 4 and Table 5 below.

Table 4 Summer Maximum Demand Forecasts (MW)

Supply Point	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Cowra	29.9	30.8	31.7	32.6	33.6	34.6	35.7	36.7	37.8	39.0
Forbes	36.0	36.9	37.8	38.7	39.7	40.7	41.7	42.8	43.8	44.9
Parkes	23.6	24.2	24.8	25.4	26.0	26.7	27.3	28.0	28.7	29.4
North Parkes	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0
Total	**115**	**118**	**120**	**123**	**125**	**128**	**131**	**134**	**136**	**139**
Diversified Total	**109**	**111**	**114**	**116**	**118**	**121**	**124**	**126**	**129**	**131**

Table 5 Winter Maximum Demand Forecasts (MW)

Supply Point	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Cowra	29.0	29.7	30.5	31.2	32.0	32.8	33.6	34.5	35.3	36.2
Forbes	32.6	33.3	33.9	34.6	35.3	36.0	36.7	37.4	38.2	39.0
Parkes	22.7	23.3	23.8	24.4	25.1	25.7	26.3	27.0	27.7	28.3
North Parkes	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0
Total	**110**	**112**	**114**	**116**	**118**	**120**	**123**	**125**	**127**	**130**
Diversified Total	**106**	**108**	**110**	**112**	**114**	**116**	**118**	**121**	**123**	**125**

Figure 5 and Figure 6 show historical and diversified forecast summer and winter maximum demands for the area.

Figure 5 Historical and Forecast Summer Maximum Demands

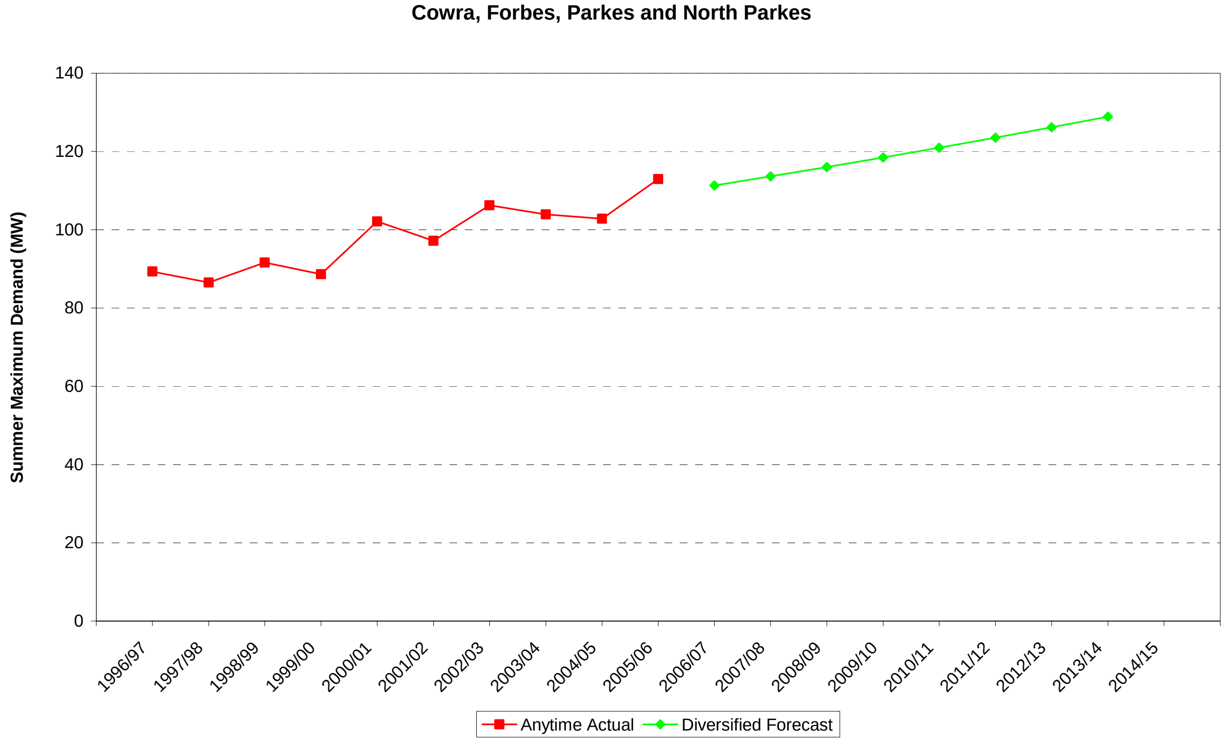
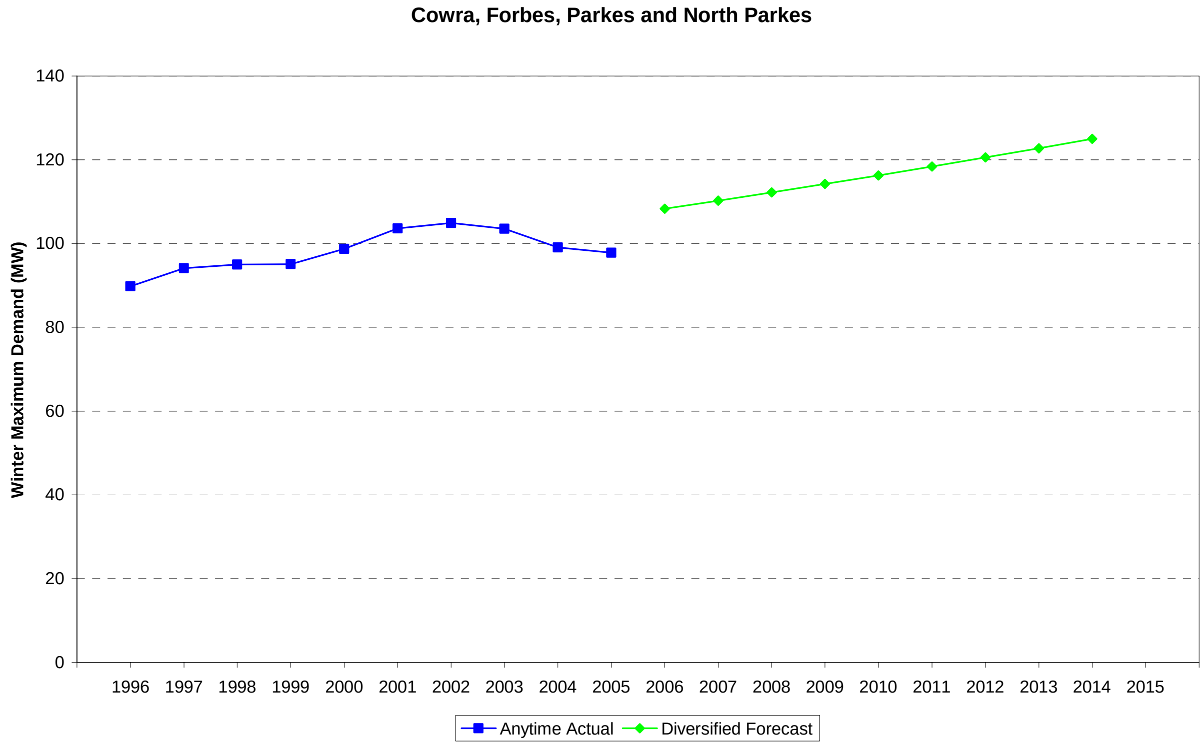


Figure 6 Historical and Forecast Winter Maximum Demands



2.2. The Criteria Used to Determine Network Capacity

TransGrid and Country Energy have assessed the capability of the network to supply the forecast loads with one network element (a line or a transformer) out of service. This approach is widely used internationally and is generally referred to as an "N-1 criterion".

2.3. Description of Network Constraints

If all elements of the network are in service, it is presently capable of adequately supplying the area at all times. However, with the 94K Wellington – Parkes 132 kV line out of service, the increased loading on the remaining lines results in large voltage drops along those lines. This results in low voltages at Forbes. The limit of the network's capacity is reached when the transformer tap changers at Forbes and at the substations within the underlying Country Energy network can no longer restore the voltage to within the acceptable range at end use customer premises. The present minimum acceptable voltage at Forbes is 1.05 per unit due to the need to maintain satisfactory voltage levels within Country Energy's 66 kV network which extends westwards to Condobolin and Lake Cargelligo.

The critical outages are described in the sections below, together with the magnitudes of demand reductions required to avoid the need to augment the transmission network.

2.3.1. Outage of 94K Wellington – Parkes 132 kV Line

For this outage Cowra, Forbes and Parkes are supplied from Yass, a distance of around 230 kilometres. At times of high demand in summer and winter, low voltages can occur at Forbes. Also, at times of high summer demand, the thermal rating of the 999 Yass – Cowra 132 kV line can be exceeded. These two limitations are discussed below.

The Voltage Limitation

The tap-changer on the 132/66 kV transformer at Parkes is capable of providing 20% boost whereas the older units at Forbes and Cowra have only 15% boost. Consequently, for this outage, the voltages at Forbes and Parkes 66 kV busbars are similar (once the tap-changers have reached maximum boost position).

Following installation of the additional capacitors at Cowra, Forbes and Parkes, this constraint is not expected to re-emerge until around 2010. As the load in the Cowra/Forbes/Parkes area is growing at around 3 MW p.a., reductions of this order would be required each year from around 2010 to manage this limitation.

Demand reductions at Parkes and Forbes would be the most effective in managing the voltage limitation, with reductions at Cowra being much less effective. The approximate effectiveness of reductions at Cowra and Forbes relative to reductions at Parkes is shown in Table 6.

Table 6 Relative Effectiveness of Demand Reductions at Various Locations (Voltage Limit)

Location	Cowra	Forbes	Parkes
Relative Effectiveness	0.4	0.95	1.0

The Thermal Rating Limitation

The 999 Yass – Cowra 132 kV line was the first 132 kV line in the area. It has light steel tower structures and was designed for a lower operating temperature than other lines in the area. Table 7 shows the approximate maximum load reduction in the Cowra/Forbes/Parkes area and the approximate total duration of periods during which load reductions may be required to manage the thermal rating limitation.

Effectively, with the Wellington – Parkes 132 kV line out of service, the rating of the 999 Yass – Cowra line limits the maximum load which can be supplied at Cowra, Forbes and Parkes 66 kV busbars to just over 70 MW on summer days.

Demand reductions at Parkes and Forbes would be the most effective in managing the thermal limitation, with reductions at Cowra being less effective. The approximate effectiveness of reductions at Cowra and Forbes relative to reductions at Parkes is shown in Table 8.

Table 7 Approximate Load Reductions to Manage the Thermal Rating Limitation

Summer	Approximate Maximum Load Reduction (MW)	Approximate Total Duration of Load Reductions (hours)
2006/07	37	540
2007/08	40	560
2008/09	44	580
2009/10	47	605
2010/11	51	625
2011/12	55	650
2012/13	60	675

Table 8 Relative Effectiveness of Demand Reductions at Various Locations (Thermal Limit)

Location	Cowra	Forbes	Parkes
Relative Effectiveness	0.85	1.0	1.0

2.3.2. Outage of a Cowra 132/66 kV Transformer

Cowra 132/66 kV transformer is equipped with two 30 MVA transformer which are now around 35 years old. If one transformer is out of service at times of high summer demand, the thermal rating of the other is expected to be exceeded from summer 2009/10.

As the Cowra summer maximum demand is growing by around 1 MW p.a., demand reductions of this order would be required to manage this limitation.

3. Assessment of Options

To assist the development of possible options to overcome the limitations described above, the following requirements, which the options must satisfy, have been developed. Broadly, possible options will either increase the network capacity or reduce the loading on critical network elements. Load reductions can be achieved by reducing electricity usage at critical times or generating electricity "down stream" of the critical network elements (close to where it is used).

As it is possible that a combination of proposals may satisfy all of the criteria, even if each on its own may not, interested parties are encouraged to submit proposals which meet one or more of the criteria.

3.1. Size and Location

Options must, individually or collectively, reduce the loading on key network elements during the outages described above. The magnitude of required demand reductions (at the most effective location) are given above.

The physical location of the additional capacity or load reduction is also important. Table 6 and Table 8 show the relative effectiveness of demand reductions or generation at particular locations in managing the voltage and thermal limitations for an outage of the 94K Wellington – Parkes 132 kV line.

3.2. Time of Year

Possible options must be capable of reducing network loading or increasing network capacity during periods of high load in summer. Should a critical line outage occur at times of high load, voltages in the area would change almost instantaneously. Possible options should preferably be in service at times of high demand. However, if an option is controllable (for example curtailing an industrial process), it should be capable of being implemented very fast (within a few seconds). This would most probably require an automatic control system.

3.3. Timeframe

The timeframes by which options would need to be in operation depend on the network limitation being overcome. The presently expected timeframes for the two critical outages are shown in Table 9.

Table 9 Expected Required Operational Dates

Network Limitation	Required Date
Outage of 94K Wellington – Parkes 132 kV line • Voltage limitation • Thermal rating limitation	 Summer 2009/10 As soon as possible
Outage of a Cowra 132/66 kV transformer	Summer 2009/10

3.4. Reliability and Certainty

Options should be capable of reliably providing additional capacity or reducing load. They should also utilise proven technology and be capable of being installed and operating by the required date. Contractual arrangements may be required to ensure proposals are implemented as agreed.

3.5. Economic Assessment

As TransGrid and Country Energy may be required to make the submissions public, any commercially sensitive material and any other material which the party making the submission does not want to be made public should be clearly identified.

Under the regulatory requirements, TransGrid is required to publish the outcomes of its application of the AER's Regulatory Test. Should parties making submissions elect to not provide cost data for commercial reasons, TransGrid may rely on cost estimates from its own or independent specialist sources.

It should also be noted that, in accordance with regulatory requirements, TransGrid will recommend development of the option that satisfies the AER's Regulatory Test.

4. Provision of Submissions

Proposals and other comments should be provided by Friday 26 May 2006 to:

Email: Regulatory.Consultation@transgrid.com.au