EMERGING TRANSMISSION NETWORK LIMITATIONS ON THE NEW SOUTH WALES CENTRAL COAST

July 2002

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) on the Central Coast of New South Wales;
  - the capability of the transmission network supplying that load; and
  - the basis on which TransGrid and EnergyAustralia have identified network constraints (inadequate network capacity) which are expected to arise in the future; and to
- seek comments on the approach and criteria adopted by TransGrid and EnergyAustralia.

TransGrid and EnergyAustralia 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 EnergyAustralia.

1.2. Background

1.2.1. Introduction

The NSW Central Coast extends from the Hawkesbury River and Broken Bay in the south to the Lake Macquarie area. It has a population of around 300,000 and includes the major centres of Gosford and the Tuggerah/Entrance area.

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

1.2.2. Local Supply Arrangements

The majority of the Central Coast area is supplied via a network of 132 kV feeders emanating from TransGrid's 330/132 kV substations located at Tuggerah, Munmorah, Vales Point and Sydney East, as shown in Figure 1. This network of 132kV feeders supplies a number of zone substations and major subtransmission substations at Ourimbah and Gosford. The most heavily loaded substations in the area are Ourimbah and Gosford subtransmission substations which are remote from all 330/132kV supply points except Tuggerah.

The 132 kV network, other than the section of line from Mount Colah to Sydney East, is owned by EnergyAustralia.

A single 330/132kV transformer is installed at each of Tuggerah and Munmorah substations.

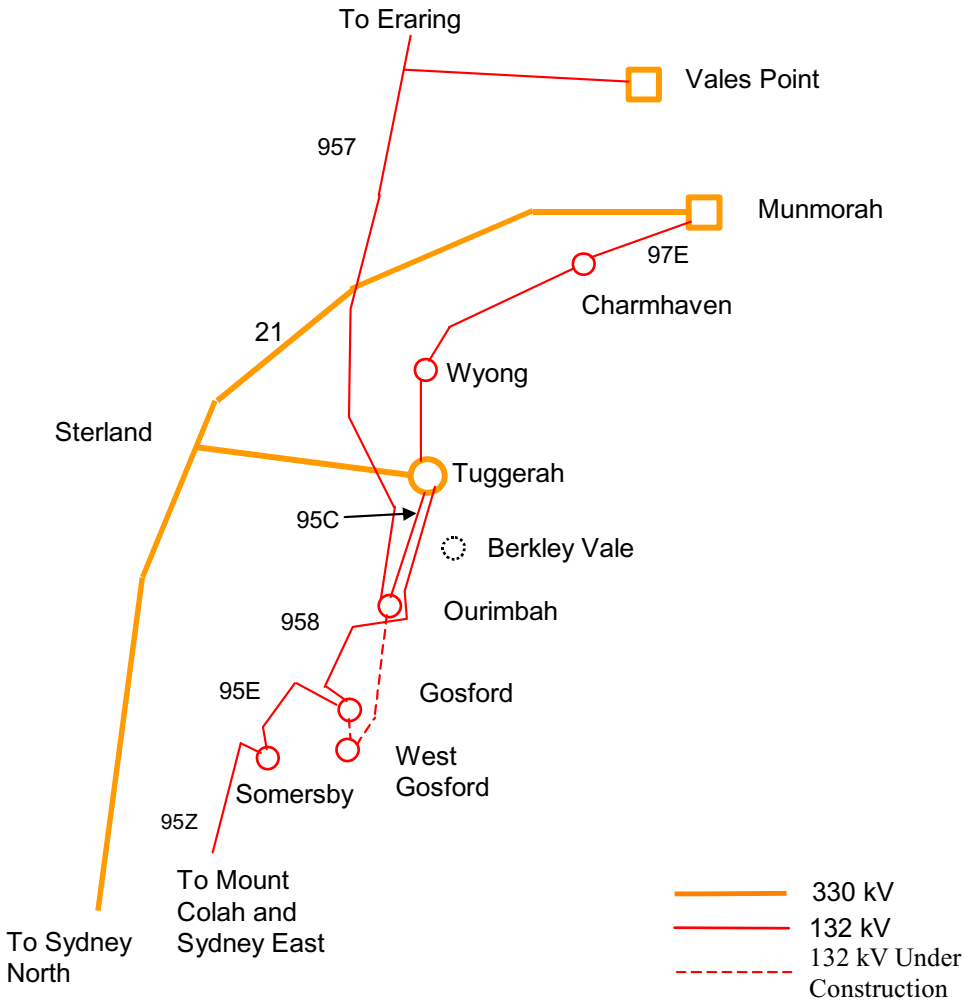
Tuggerah 330/132kV substation is supplied via a single 330kV transmission line tee connected to the 21 Munmorah – Sydney North circuit at Sterland.

EnergyAustralia has progressively converted parts of the 33 kV network which previously supplied the Wyong/Charmhaven area to a higher capacity 132 kV network, which has been integrated into the overall network supplying the area. This has provided additional capacity to Tuggerah 330/132kV substation, which has already allowed uprating of the TransGrid transmission system supplying the area to be deferred. An initiative by EnergyAustralia to establish a 132 kV connection between Gosford and Ourimbah via West Gosford, is presently underway.

EnergyAustralia has recently installed a series reactor at Ourimbah to reduce the loading in the 957 Vales Point – Ourimbah line. It is now possible to operate with the supplies from Tuggerah, Munmorah, Vales Point and Sydney East normally closed.

To improve voltages in the area, particularly if the 330 kV connection to Tuggerah is out of service, TransGrid will install two 40 MVAr 132 kV capacitors at Tuggerah by mid 2003. In the medium term EnergyAustralia also proposes to install additional capacitors on the 11kV and 66kV systems.

Figure 1 330 kV and 132 kV Network Supplying the Central Coast



EnergyAustralia forecasts that load growth in the area supplied from Berkeley Vale zone will require the uprating and conversion of this substation from 33/11kV operation to 132kV/11kV operation in about 2006.

It is anticipated that Berkeley Vale zone will require a new 132kV feeder from Tuggerah substation. In conjunction with this development a 132kV bus-section circuit breaker will be required at Tuggerah substation.

2. Identification of Future Network Constraints

2.1. Load Forecast

2.1.1. What Drives the Electrical Load?

The area maximum demand is expected to continue to grow at around 4.5% p.a. (14 MW to 20 MW p.a.) over summer and at around 3% p.a. (12 MW to 14 MW p.a.) over winter.

Increases in electricity consumption are expected to occur due to a combination of factors:

- Significant growth in population due to the attractiveness of the area and continuing land releases. It is estimated that net increases in the number of dwellings on the Central Coast will result in demand increases of 10 to12 MVA (9 MW to 11 MW) p.a.

- Redevelopment of existing homes and increased household energy consumption resulting from additional amenities.

- Continuing small scale commercial and industrial development associated with population growth.

- Moderately sized spot loads including:
  - Expansion of Erina and Tuggerah Shopping Centres;
  - Development of Tuggerah and Berkeley Vale business parks; and
  - Wyong and Gosford hospital redevelopments.

In addition to the above there is a prospective major load associated with a development proposal in the Wyong area, which has not been included in the load forecast. This development is estimated by the proponent to have a peak demand of 35 to 40 MW (which is equivalent to two to three years demand growth). Recent information provided by the proponent (since the forecast was developed) envisages that the environmental and development approval process will be undertaken in 2003 and 2004, with construction starting in 2005. The project will take significant load from 2007.

2.1.2. Demand Management

EnergyAustralia is presently investigating demand side options in the Lisarow, Berkeley Vale and Erina/Avoca areas. These areas represent around one third of the total Central Coast load. These investigations are incomplete, but preliminary indications are that:

- there is potential for between 3 MVA and 6 MVA of mainly summer peak demand reduction in the Lisarow/Berkeley Vale area by about 2005; and

- around 3.5 MVA of winter peak demand reduction may be possible by winter 2004 in the Erina/Avoca area.

As these are preliminary indications of possible demand reductions, they have not been included in the load forecast.

2.1.3. The Load Forecast

EnergyAustralia's most recent forecasts for the area, up to Winter 2007, (excluding the possible Wyong load and the possible demand management opportunities described above), are shown in Table 1, Table 2 and Figure 2 below. The forecast loads beyond 2007 have been extrapolated. Forecasts for the individual zone substations are included in Appendix A.

Table 1 Forecast of Summer Maximum Demands

Summer	MW	MVAr [1]
2001/02	299.5	97.3
2002/03	312.9	105.6
2003/04	323.0	118.2
2004/05	338.3	128.1
2005/06	355.1	138.9
2006/07	371.5	149.3
2007/08	388.2	161.8
2008/09	405.7	173.2
2009/10	424.0	185.1
2010/11	443.1	197.5

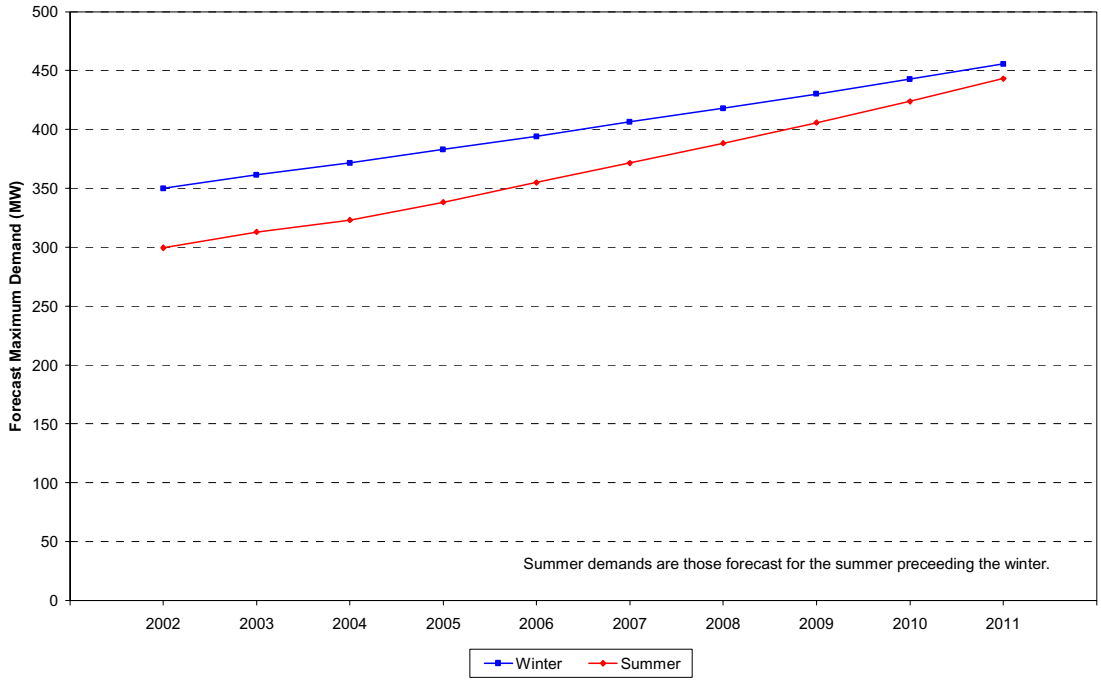
NOTE 1: Includes the effect of 90 MVAr of existing Energy Australia 33 kV and 66 kV capacitors. In addition, two 40 MVAr capacitors are to be installed at Tuggerah in early to mid 2003.

Table 2 Forecast of Winter Maximum Demands

Winter	MW	MVAr [2]
2002	350.0	57.3
2003	361.4	62.1
2004	371.4	70.7
2005	383.1	75.7
2006	394.0	80.2
2007	406.3	85.4
2008	418.0	106.0
2009	430.1	111.6
2010	442.6	117.5
2011	455.4	123.5

NOTE 2: Includes the effect of 90 MVAr of existing Energy Australia 33 kV and 66 kV capacitors. In addition, two 40 MVAr capacitors are to be installed at Tuggerah in early to mid 2003.

Figure 2 Forecast Maximum Demands



It can be seen from the above forecasts that peak demand in Winter is expected to remain higher than Summer throughout the next decade. Despite this, the impact of Summer demand is more critical as:

- The thermal capacity of equipment, particularly overhead lines, is significantly lower in summer due to the higher ambient temperatures.
- While peak winter loads persist for only a short period summer loads remain high for long periods during the day.

Demand may vary considerably with ambient temperature. The above forecast information represents the median outcome and has a 50% chance of exceedance.

2.1.4. The Nature of the Electrical Load

Profiles of the Ourimbah and Gosford loads, the two largest, on days of high demand are shown in Figure 3 and Figure 4 below.

Figure 3 Ourimbah and Gosford Typical Demand Profiles on Days of High Demand in Summer

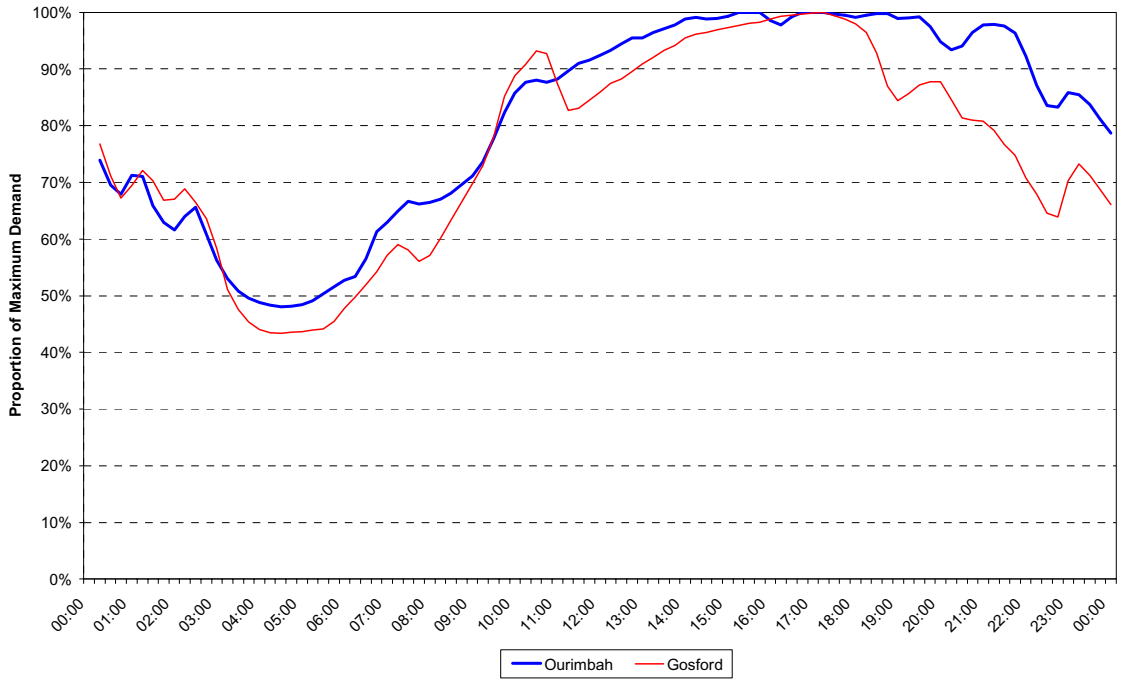
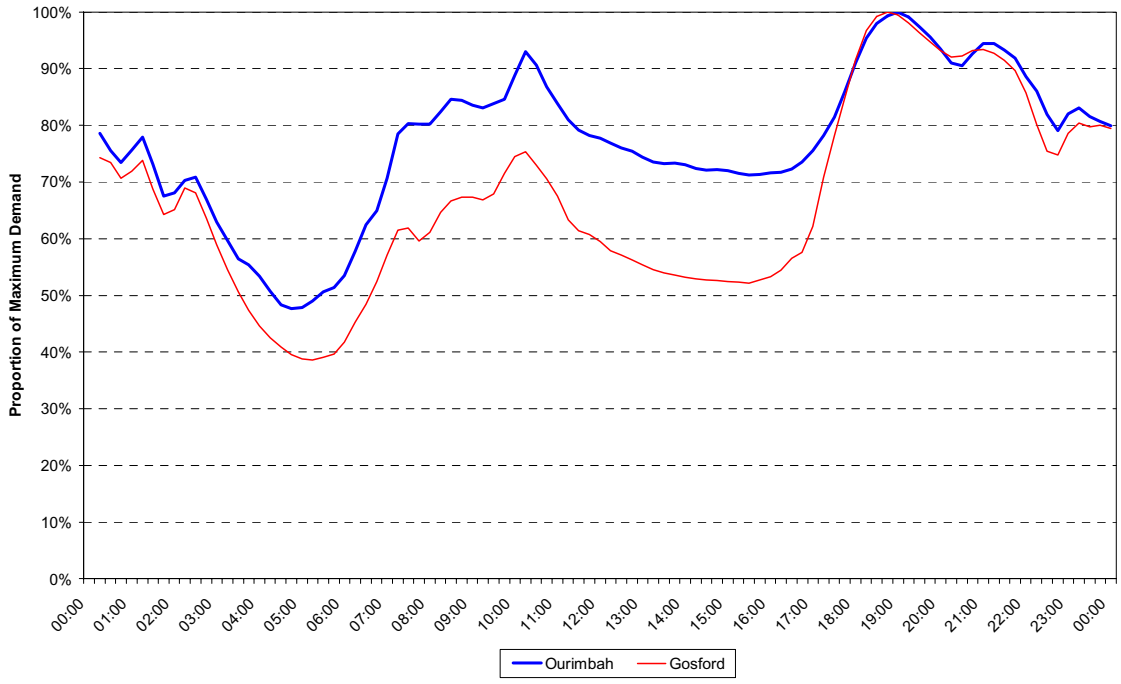


Figure 4 Ourimbah and Gosford Typical Demand Profiles on Days of High Demand in Winter



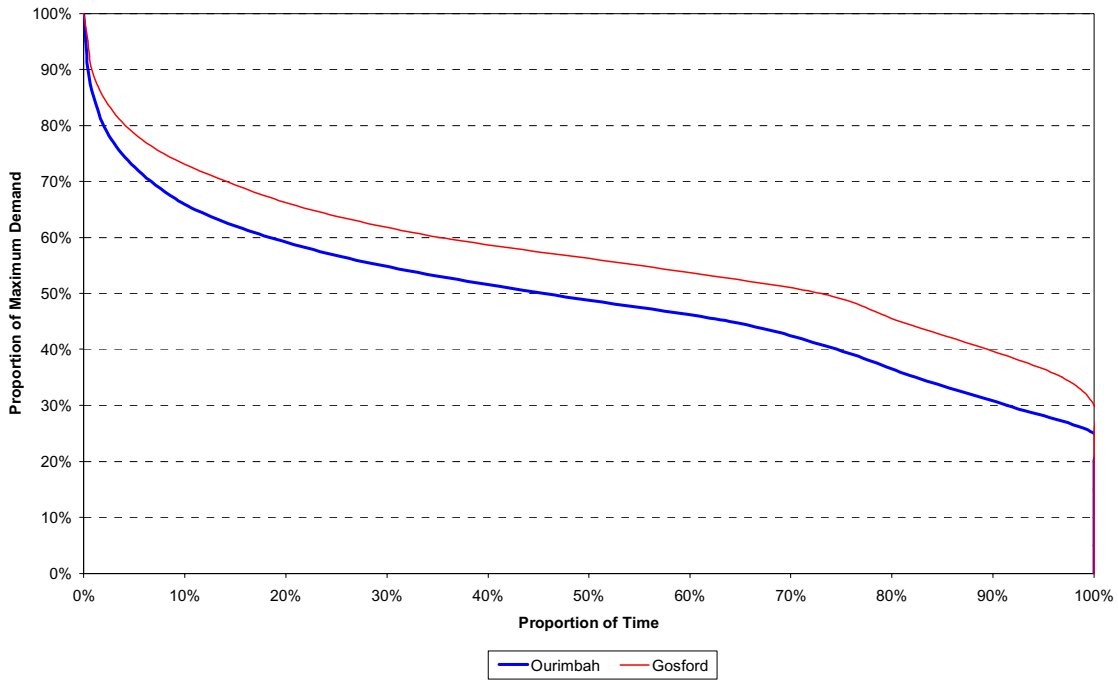
The impact of EnergyAustralia's existing demand management (load control) equipment in shifting load from "daytime" (from around 7 am to around 8 pm) to "night time" (after around 8 pm) is clearly visible by secondary peaks occurring at around 10 pm.

The timing and duration of the peak summer demand should also be noted. In particular the peak summer demand at both Gosford and Ourimbah subtransmission substations occurs in the late afternoon. High summer loads, particularly those at Ourimbah, extend well into the early evening. The occurrence of peak

summer loads beyond normal business hours suggests that domestic loads such as air-conditioning are having a significant impact on the peak demand in the area.

Load duration curves for Ourimbah and Gosford are shown in Figure 5 below. These curves show the proportion of time for which loads are above a given level.

Figure 5 Ourimbah and Gosford Load Duration Curves



2.2. The Criteria Used to Determine Network Capacity

TransGrid and EnergyAustralia 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".

The ability to transfer loads via lower voltage networks and to utilise short time cyclic equipment ratings have been included in the assessment of network capacity.

2.3. Description of Network Constraints

If all elements of the network are in service, it is expected to be capable of adequately supplying the area at all times over the next ten years. However, within this period the network is expected to be constrained during the outages described in the following sections. The adequacy of the system to meet demand during outages will depend on the timing of the Wyong development.

2.3.1. Outage of the 330 kV Line to Tuggerah or the Tuggerah 330/132 kV Transformer

If either the 330 kV line to Tuggerah or the 330/132 kV transformer at Tuggerah is out of service, the capacity of the 132kV network supplying the area is limited by the thermal ratings of feeders 957 and 97E.

It is expected that with the forecast level of growth, these feeders will both be loaded to their sustained emergency rating (following transfer of loads on the lower voltage networks) in Summer 2008/09. 132kV system voltage levels at West Gosford are also an issue, with voltages close to the level below which it would not be possible for transformer tap changers to maintain acceptable voltages at end use customer premises.

The establishment of the Wyong development project would add appreciably to system loading and would change the balance of power flows within the Central Coast system. The establishment of the project would cause feeder 957 to be loaded to above its sustained emergency thermal rating, during outages at Tuggerah from the time the project is commissioned (projected by the proponent to be in 2007).

2.3.2. Outage of the 330/132 kV Transformer at Munmorah or the Munmorah – Charmhaven 132 kV Line

If either the 330/132 kV transformer at Munmorah or Energy Australia's 97E Munmorah – Charmhaven 132 kV line is out of service, the capacity of the 132kV network supplying the area is limited by the thermal rating of the Tuggerah transformer (following transfer of loads on the lower voltage networks).

The analysis conducted by EnergyAustralia and TransGrid shows that this limit would be exceeded by summer 2010/11 if the proposed Wyong development proceeds.

2.3.3. Outage of 957 Vales Point – Ourimbah 132 kV Line

If EnergyAustralia's 957 line is out of service, the capacity of the 132 kV network supplying Gosford and Ourimbah is limited by the rating of the Tuggerah transformer and the two 132kV lines running south from Tuggerah (following transfer of loads on the lower voltage networks).

These outages are not expected to be an issue until after 2010.

2.3.4. Summary of Network Constraints

The timing of the expected occurrence of each constraint is shown in Table 3 below.

Table 3 Summary of Network Constraints

Constraint	Expected to Occur From	
	Wyong Project Proceeds	**Wyong Project Delayed**
Overloading of feeders 957 and 97E on outage of the 330 kV line to Tuggerah or the Tuggerah 330/132 kV transformer.	When operation commences operation (presently projected by the proponent to be 2007)	Summer 2008/09
Overloading of the Tuggerah 330/132 kV transformer on outage of the 330/132 kV transformer at Munmorah or the Munmorah – Charmhaven 132 kV line.	Summer 2010/11	Beyond 2010
Overloading of the Tuggerah 330/132 kV transformer and the two 132kV lines running south from Tuggerah on outage of 957 Vales Point – Ourimbah 132 kV line.	Beyond 2010	Beyond 2010

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

Options must, individually or collectively, reduce the loading on key network elements during the outages described above. The load is growing at around 14 MW to 20 MW p.a. over summer. Additional network

capacity or reductions in the load on the network of at least this magnitude would be required to delay the onset of network limitations by one year. Should the Wyong project proceed additional capacity or load reductions of at least 35 MW to 40 MW would be required to "compensate" for the additional load.

The physical location of the additional capacity or load reduction is also important. For example, when the 330 kV line to Tuggerah or the 330/132 kV transformer at Tuggerah is out of service, both 957 and 97E 132 kV lines are heavily loaded. To be effective, any proposed option must reduce the loading on both of these lines. Hence, load reductions in the Wyong to Gosford area would be likely to be the most effective.

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. If they are controllable (such as generation which can be started and stopped), they should (preferably) be in service at times of high load or be capable of being brought into service rapidly.

3.3. Timeframe

Options would need to be in operation by summer 2008/09 or to meet establishment of the Wyong development should it proceed before then.

3.4. Reliability and Certainty

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

3.5. Economic Assessment

As TransGrid and EnergyAustralia 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 ACCC'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 ACCC's Regulatory Test.

4. Provision of Submissions

Proposals and other comments should be provided by 31 August 2002 to:

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APPENDIX A

Table 4 EnergyAustralia Central Coast 132kV Supply Network Forecast of Summer Maximum Demands

	2001/02		2002/03		2003/04		2004/05		2005/06		2006/07	
	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr
Gosford STS	138	107.1	102.9	79.9	122.5	95.1	128.4	99.7	134.3	104.2	140.1	108.8
West Gosford Zone			41	32	43.2	33.5	45.4	35.2	47.6	37.0	50.0	38.8
Ourimbah	109.1	46.5	114.5	48.8	99.7	42.5	104.7	44.6	109.9	46.8	115.4	49.2
Somersby Zone	9.8	6.1	9.8	6.1	10.8	6.7	10.8	6.7	11.8	7.3	11.8	7.3
Wyong Zone	20.6	11.7	21.6	12.2	22.7	12.9	23.8	13.5	25.0	14.2	26.3	14.9
Charmhaven Zone	21.9	16.4	22.9	17.2	24.1	18.1	25.3	19.0	26.6	19.9	27.9	20.9
Total	299.4	187.8	312.7	152.6	323.0	208.8	338.4	218.7	355.2	229.4	371.5	239.9

Table 5 EnergyAustralia Central Coast 132kV Supply Network Forecast of Winter Maximum Demands

	2002		2003		2004		2005		2006		2007	
	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr
Gosford STS	161.2	108.4	133.4	68.4	161.8	82.9	165.8	84.9	170	87.1	174.2	89.3
Ourimbah STS	126.8	41.7	131.2	43.1	110.0	36.2	113.9	37.4	117.8	38.7	122.0	40.1
West Gosford Zone			31.8	16.3	32.6	16.7	33.4	17.1	34.2	17.5	35.1	18.0
Somersby Zone	12.0	7.1	13.0	7.7	13.0	7.7	14.0	8.3	14.0	8.3	15.0	8.9
Wyong Zone	24.0	7.9	25.0	8.2	26.0	8.5	27.0	8.9	28.0	9.2	29.0	9.5
Charmhaven Zone	26.0	8.5	27.0	8.9	28.0	9.2	29.0	9.5	30.0	9.9	31.0	10.2
Total	350.0	173.6	361.4	152.6	371.4	161.2	383.1	166.1	394.0	170.7	406.3	176.0

Notes: a)The reactive loads exclude the effect of existing capacitors

b) Forecasts include the impact of load transfers.

c) Loads are diversified to the time of overall peak demand