



FINAL REPORT

WYONG ZONE SUBSTATION 11KV DISTRIBUTION FEEDER DEVELOPMENT

2nd December 2008

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EXECUTIVE SUMMARY

This paper has been prepared to report on upgrade work that is proposed to develop the electricity supply network in the Wyong zone substation (ZS) load area in accordance with Clause 5.6.2 (h) of the National Electricity Rules.

There are capacity issues on the Wyong zone substation 11kV distribution network due to load growth in the area. To ensure a safe and reliable electricity supply for existing customers, EnergyAustralia is providing additional capacity to restore the licence compliance of this distribution network and to meet forecast load demands.

The provision of additional capacity is required to meet network performance requirements set by EnergyAustralia in accordance with Schedule 5.1 of the Rules.

This report covers the following issues:

Section 1 provides a background of the Wyong ZS and the need for augmentation.

Section 2 describes the capacity issues on the Wyong ZS 11kV distribution network. The concept of service standard, as implemented by EnergyAustralia, is discussed.

Section 3 describes the proposed augmentation in relation to the National Electricity Rules (the Rules). The proposed development on the Wyong ZS distribution network is classified as a distribution system asset by the Rules, and the proposed development is classified as a small network asset as the proposed investment involves expenditure of less than \$10 million.

Section 4 describes the options that were considered:

- Demand Management,
- Option 1 – Uprate overhead feeders,
- Option 2 – Install new cables to replace limiting sections, and
- Option 3 – Install three new underground feeders.

Section 5 presents the results of an economic analysis of the options (base case) and a sensitivity analysis on a selection of key variables.

Section 6 concludes that the preferred option is Option 1 – Uprate overhead feeders.

EnergyAustralia's recommended action is Option 1 and this option involves uprating and reconductoring of a number of overhead sections in order to address the capacity issues on the Wyong ZS distribution network. The estimated capital cost for this option is \$3.00M with a Net Present Cost (NPC) of \$2.96M. The proposed project is planned to be completed in late 2009.

1. BACKGROUND

1.1. Introduction

This Final Report has been prepared to advise on the upgrade work that is proposed to be carried out in the Wyong zone substation load area. The information provided in this Final Report includes:

- A discussion of emerging supply system limitations identified by EnergyAustralia that have lead to the necessity for augmentation of the zone substation;
- A discussion of the service standard that has been adopted for planning purposes;
- Description of options for development of the electricity supply in the area; and
- Details of the outcomes of the cost-effectiveness analysis of the options considered.

Wyong 132/11kV zone substation (ZS) is located in the southern part of the Upper Central Coast network area. The ZS has 132kV connection with TransGrid's Tuggerah bulk supply point (BSP) and TransGrid's Munmorah power station. Wyong ZS is equipped with one 45MVA and one 50MVA transformers. Due to a number of capacity and voltage issues, an interconnected 11kV network of Panel 12 and 20 distribution feeders from Wyong ZS requires further development in order to fully comply with EnergyAustralia's licence condition.

The geographical overview of the Wyong ZS load area is shown in Figure 1 below.

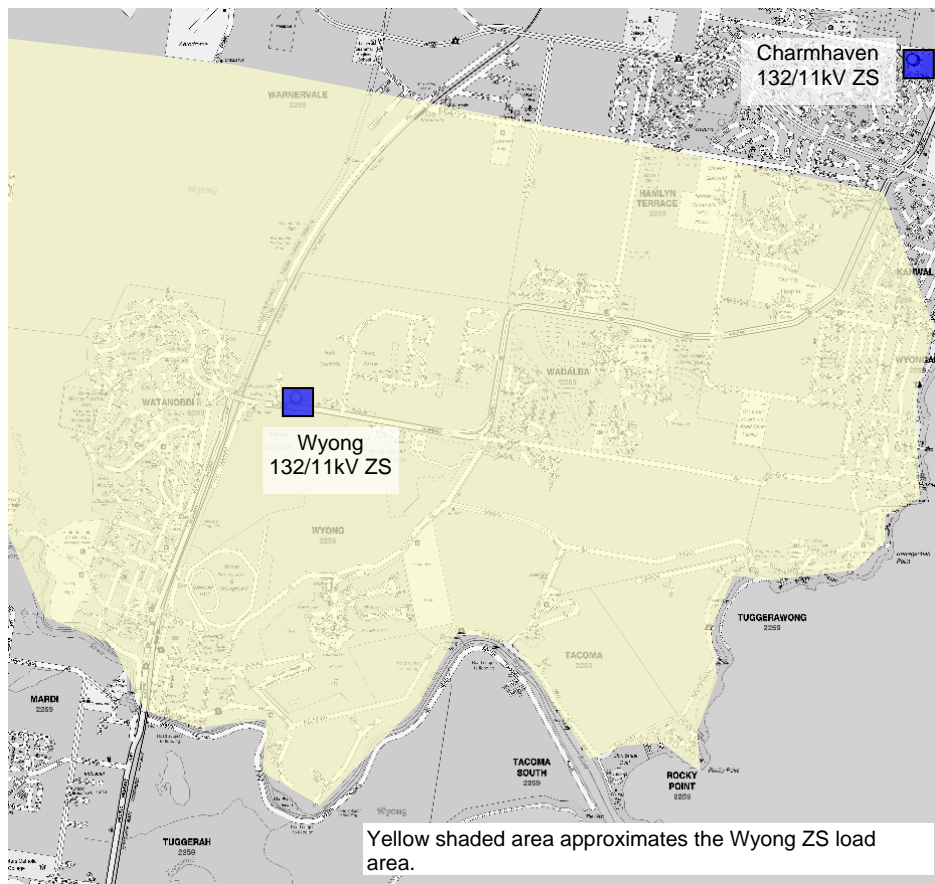


Figure 1 – Geographical overview of Wyong ZS load area

2. ISSUES

2.1. Licence Conditions

The service standards that are applicable to a consideration of supply constraints affecting the Wyong zone substation load area are summarised below:

Applicable to all Network Elements

The minimum requirement for any network element is that, with all elements in service, the thermal capacity is required to meet at least 115% of forecast demand. The requirements described in the following sections are additional to this requirement.

11kV Distribution Network

For a distribution feeder in urban¹ area, the expected demand is to be no more than 80% of feeder thermal capacity (under system normal operating conditions), with switchable interconnection to adjacent feeders to enable restoration following an unplanned failure of a single network element (i.e. N-1 conditions). The 11kV network where in a number of feeders forms an interrelated system, the limits apply to the average loading of the feeders within the one system. The customer interruption time following an outage is expected to be less than four hours.

For 11kV networks, voltage drops of up to 5% are regarded as satisfactory. Higher voltage drops are permissible provided that the network connection provided to low voltage customers is within the limits specified in Australian Standard AS2926.

2.2. Capacity Issues

Due to the load growth in the area west of the F3 Freeway and the limitations on several overhead network sections, the average utilisation of the interconnected group of Panel 12 and 20 feeders is greater than 80% during normal state, and hence these feeders presently do not fully comply with the licence condition. The present average utilisation and forecast utilisation of these feeders are shown in Table 1 below.

Table 1: Average utilisation of Pa 12 and 20 feeders

System Normal State	Average utilisation of interconnected Pa 12 and 20 feeders
Present utilisation	98%
Forecast utilisation – 6 years	104%

In addition, at times of peak load, these feeders are not able to maintain the N-1 licence condition for all failure scenarios. There are also voltage issues on these feeders.

3. TYPE OF AUGMENTATION

Wyong ZS is classified as a distribution system asset by the National Electricity Rules (the Rules).

The Rules require that, where analysis indicates that any relevant technical limits of a distribution system will be exceeded, the Distribution Network Service Provider (DNSP) must notify any affected Registered Participants and interested parties of these limitations and the expected time for corrective action. Further, the DNSP must consult with affected Registered Participants and interested parties on the possible options to address the projected limitations of the relevant distribution system. A Network Service Provider does not need to consult on a network option that would be a new small network asset, or for options that do not augment the system.

¹ Urban, for EnergyAustralia, means an area where the majority of land is zoned for residential and/or commercial and/or industrial use within a town or city type of area which is contiguous with other similar town or city areas with an aggregated population of at least 5,000 people.

The proposed development strategy for the Wyong ZS distribution network involves the expenditure of less than \$10M and hence the proposed strategy is considered as a new small distribution network asset.

A Distribution Network Service Provider is not required to consult on a project that is a new small distribution asset and hence no Consultation Paper was issued in regards to this project.

The new capacity provided by the proposed augmentation has been necessitated by the need to meet the service standards described in Section 2 and has therefore been treated as a reliability driven augmentation for the purposes of the Regulatory Test. Consequently, EnergyAustralia has used a least cost test to examine the options identified to address projected system limitations.

4. OPTIONS CONSIDERED

The development strategy for the Wyong ZS load area is driven by the need to address the capacity and voltage issues on the 11kV distribution network. The following section describes options to address these issues.

4.1. Demand Management

An investigation of Demand Management opportunities in the Wyong ZS load area was carried out in October 2008. In order to defer the proposed supply side solution by one year, the required demand reduction is 1.98MVA in Summer 2009/10. This represents 61% of the forecast demand on the relevant feeders. The cost saving from a one year deferral is \$107/kVA, which is moderate.

Considering the very high demand reduction required and the relatively low cost saving, it is not considered reasonable to expect that the proposed supply side solution can be cost effectively deferred by implementing Demand Management strategies. Therefore, Demand Management is not a viable option in this instance.

4.2. Option 1: Uprate Overhead Feeders

This option involves upgrading and replacing of several overhead sections in order to achieve higher operating temperature and greater capacity. This option provides licence compliance under both system normal and N-1 conditions. The voltage levels will also be maintained within appropriate levels.

The present average utilisation and forecast utilisation of the interconnected Panel 12 and 20 feeder network after the implementation of the Option 1 is shown in Table 2 below.

Table 2: Average utilisation of Pa 12 and 20 feeders after implementation of Option 1

System Normal State	Average utilisation of interconnected Pa 12 & 20 feeders	
	Present network	After Option 1
Present utilisation	98%	65%
Forecast utilisation – 6 years	104%	69%

The estimated capital cost of this option is **\$3.00M**.

4.3. Option 2: Install New Cables to Replace Limiting Sections

This option involves installation of underground cables instead of upgrading overhead lines in order to bypass the capacity limiting sections on the Panel 12 and 20 feeder network. Replacing the overhead lines with underground cables also necessitates the conversion of several pole top transformers to kiosks. This option provides similar benefits as those of Option 1 but this option is more costly mainly due to the cost of underground works being greater than the overhead works.

The estimated capital cost of this option is **\$18.40M**.

4.4. Option 3: Install Three New Underground Feeders

This option involves installation of three new underground feeders from Wyong ZS. Upgrading of several overhead sections are also required as part of this option. This option provides similar benefits as those of Option 1 but this option is more costly mainly due to the cost of underground works being greater than the overhead works.

The estimated capital cost of this option is **\$11.90M**.

5. ANALYSIS OF OPTIONS

5.1. Base Case Analysis

The results of the base case economic analysis are summarised in Table 3 below using a discount rate of 8.5% per annum.

Table 3 – Summary of base case economic analysis

Options	NPC# [\$M]	Capital Cost [\$M]
Option 1 – Upgrade overhead feeders	2.96	3.00
Option 2 – Install new cables to replace limiting sections	18.15	18.40
Option 3 – Install three new underground feeders	11.74	11.90

Note: NPC is higher than Capital Cost since the NPC also includes the operation and maintenance costs.

Refer to Appendix A for further details of base case.

Under the base case condition, Option 1 is the least cost option.

5.2. Sensitivity Analysis

Sensitivity Analysis was carried out to consider the impact of various factors.

5.2.1. Variations in Discount Factor

Summary of economic analysis with various discount factors is shown in Table 4 below.

The Net Present Cost also includes operation and maintenance costs.

Table 4 – Summary of economic analysis with various discount factors

Sensitivity Factor	NPC [\$M]		
	Option 1	Option 2	Option 3
8.5% p.a. Discount Rate (Base Case)	2.96	18.15	11.74
7.0% p.a. Discount Rate	3.01	18.44	11.92
10% p.a. Discount Rate	2.92	17.87	11.56

For the upper and lower discount factors, Option 1 is the least cost option in all cases.

5.2.2. Variations in Capital Cost

The NPC results for +/-25% variation of capital costs at the base case discount factor of 8.5%p.a. are shown in Table 5 below.

Table 5 – Effects of variation in capital costs

Options	NPC [\$M]	
	-25% Capital Cost	+25% Capital Cost
Option 1 – Uprate overhead feeders	2.22	3.70
Option 2 – Install new cables to replace limiting sections	13.61	22.68
Option 3 – Install three new underground feeders	8.80	14.67

For the upper and lower limits of capital cost variation, Option 1 is the least cost option in all cases.

5.2.3. Variations in Load Growth Rate

Variations in load growth rates will not affect the cost of the supply options as the network constraint issues already exist.

6. CONCLUSION

Option 1 has the lowest NPC under the base case and under all sensitivity scenarios.

EnergyAustralia intends to augment the Wyong ZS 11kV distribution network by uprating overhead feeders in order to address the issues discussed in Section 2.

The estimated capital cost for this option is \$3.00M with a NPC of \$2.96M.

The works associated with the Option 1 are forecast to be completed by late 2009. This service availability date may change if the project is affected by circumstances beyond EnergyAustralia's control, such as changes in the timing of customer load increases or other issues such as: delays in the approval process, equipment supply difficulties, unforeseen technical constraints, acts of God, and industrial action.

7. APPENDIX A – ECONOMIC ANALYSIS OF BASE CASE

WACC = 8.5% p.a.

Option 1 – Uprate Overhead Feeders

Actions	NPC[\$k]	CAPEX[\$k]	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019
Uprate and reconductor overhead feeders	2,796	3,003	362	2,641									
Operation & Maintenance	165	-			10	36	36	36	36	36	36	36	36
TOTAL	2,961	3,003	362	2,641	10	36	36	36	36	36	36	36	36

Option 2 – Install New Cables to Replace Limiting Sections

Actions	NPC[\$k]	CAPEX[\$k]	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019
Install underground cables and associated overhead to underground conversions	17,132	18,400	2,218	16,182									
Operation & Maintenance	1,013	-			63	221	221	221	221	221	221	221	221
TOTAL	18,145	18,400	2,218	16,182	63	221	221	221	221	221	221	221	221

Option 3 – Install Three New Underground Feeders

Actions	NPC[\$k]	CAPEX[\$k]	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019
Install three new underground feeders	11,080	11,900	1,434	10,466									
Operation & Maintenance	655	-			40	143	143	143	143	143	143	143	143
TOTAL	11,735	11,900	1,434	10,466	40	143	143	143	143	143	143	143	143

All values are in 2008/2009 real \$k.