



FINAL REPORT

Burwood Zone 11kV Development

29th September 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 Burwood zone substation area in accordance with Clause 5.6.2 (h) of the National Electricity Rules. The work proposed by this report is classified as a new small distribution asset.

A Distribution Network Service Provider does not need to consult on an option which would be a new small network asset. Accordingly EnergyAustralia has not previously consulted on this project.

To provide a safe and reliable electricity supply for existing customers and provide capacity for future loads, EnergyAustralia is faced with a primary need to provide additional supply system capacity to meet forecasted 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 Burwood zone substation supply area and the need for augmentation of the 11kV network.

Section 2 describes the issues associated with the increased load demand. The concept of service standard, including the risk of loss of load, as implemented by EnergyAustralia, is discussed.

Section 3 describes the proposed augmentation in relation to the National Electricity Rules (the Rules). Burwood zone substation is classified as a distribution system asset by the Rules, and the proposed development is classified as a small network asset as it involves expenditure below \$10 million.

Section 4 describes the options that were analysed, including Demand Management as well as:

- Option 1 – Install three 11kV Feeders and replace Panel 16 Feeder at Burwood Zone Substation
- Option 2 – Install three 11kV Feeders and only replace limiting sections of Panel 16 Feeder at Burwood Zone Substation

Section 5 presents the results of economic analysis of the options considered in Section 4.

Section 6 concludes that the preferred option is Option 1 – creating three new feeders from Burwood zone to the load centre around the Burwood railway station and shopping precinct. Also upgrading limiting sections of the Burwood Panel 16 feeder.

EnergyAustralia's recommended action is to provide an increase in the 11kV feeder capacity at Burwood zone by the installation of 3 new panel feeders and the 2 km replacement of the Burwood Panel 16 feeder at a cost of \$5.47M. This recommendation is made based on the least cost test to provide medium to long term capacity and meet EnergyAustralia's reliability standard for the Burwood supply area.

1. BACKGROUND

This Final Report has been prepared to advise on the upgrade work that is proposed to be carried out on the Burwood Zone Substation 11kV network. The information provided includes:

- A discussion of emerging supply system limitations identified by EnergyAustralia that have led to the necessity for the augmentation of the distribution network in the area;
- A discussion of the service standard that has been adopted for planning purposes;
- Descriptions 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.

Burwood 132/11kV zone substation was commissioned in 1972 and is situated on the corner of Ada Ave. and Lloyd George Ave. Concord. The 11kV feeder system supplies an area of inner-western Sydney including parts of Burwood, Croydon, Canada bay, Strathfield and Homebush South.

This Final Report analyses the additional capacity to the existing 11kV feeders to be achieved by the project that is the subject of this report in order to meet the required Licence Compliance Design Planning Criteria at Burwood zone substation.

2. ISSUES

2.1. Applied Service Standard

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

- 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.
- For urban 11kV distribution feeders¹, 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.
- 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. Description of Network Constraints

2.2.1. Burwood Zone Substation Capacity Issues

Feeders approaching license condition limits in the Normal state include: Burwood Panels 16, 17, 22, 29, 32, 36 and 42. Feeder 17 has the same route as a separate customer funded project. Therefore the customer funded project will be completed in conjunction with this project to reduce costs.

There is no available contingent capacity in the event of an outage on Burwood Panels 20 and 23 feeders during times of peak load, and an outage on Burwood Panel 28 would require an inappropriate number of contingency switching operations.

3. TYPE OF AUGMENTATION

Burwood zone substation is classified as a distribution system asset by the National Electricity Rules (the Rules). The addition of 3 feeders and replacement of the Burwood panel 16 feeder at the Burwood zone substation was calculated to be \$5.5M. Accordingly, since the proposed development strategy for the Burwood zone substation

¹ An urban feeder is defined as a feeder with actual maximum demand greater than 0.3MVA/km

area involves a growth component expenditure of less than \$10 million, it is regarded by the Rules as a small network asset.

The new capacity provided by the proposed work will be used to maintain existing standards of service and would thus be considered a reliability driven augmentation. EnergyAustralia has analysed the cost-effectiveness and feasibility of a range of options which will provide increased long term future capacity.

4. OPTIONS CONSIDERED

4.1. Demand Management

A Demand Management Screening Test was undertaken in May 2008, establishing the potential to reduce demand on several feeders at Burwood zone by 3.3MVA by November 2009 at \$390,000, and increase to 4.3MVA at \$760,000 the following year.

Given the large size of the demand management, the low deferral rate and the short period of time until an investment decision must be made, it is therefore not considered reasonable that Demand Management could effectively defer the project.

4.2. Option 1 – Install three 11kV Feeders and replace Panel 16 Feeder at Burwood Zone Substation

This option involves:

- The installation of three underground 11kV feeders from Burwood zone to the load centre around the Burwood railway station and shopping precinct;
- The replacement of the Burwood Panel 16 feeder (approximately 2km).

Two of the new feeders will relieve the highly loaded feeders while the third will remain on standby to provide an alternate supply route in the event of future feeder outages. This will also allow the companion feeders to operate close to the rated capacity without contingent risk and resolves the complications of transferring large loads.

The estimated capital cost of this augmentation is \$5.47M. The Net Present Cost (NPC) is \$4.78M.

The following utilisation summary considers the inter-related group of feeders – Burwood Panels 16, 17, 20, 22, 23, 28, 29, 32, 42 and 43; Five Dock Panels 6, 8, and 14; and the proposed new Burwood Panel 7, 9, and 10 feeders. It also takes account of future load increases on Burwood Panel 22 feeder due to local development.

Average Normal State Utilisation	Do Nothing		After Selected Option	
	Current Utilisation	Forecast Utilisation - 6 Years	Current Utilisation	Forecast Utilisation - 6 Years
Burwood Panel 7	-	-	73%	93%
Burwood Panel 9	-	-	38%	49%
Burwood Panel 10	-	-	55%	62%
Burwood Panel 16	97%	119%	64%	81%
Burwood Panel 17	97%	124%	51%	65%
Burwood Panel 20	84%	103%	56%	66%
Burwood Panel 22	96%	123%	75%	96%
Burwood Panel 23	70%	88%	76%	92%
Burwood Panel 28	70%	133%	70%	80%
Burwood Panel 29	77%	99%	78%	100%

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Average Normal State Utilisation	Do Nothing		After Selected Option	
	Current Utilisation	Forecast Utilisation - 6 Years	Current Utilisation	Forecast Utilisation - 6 Years
Burwood Panel 32	96%	110%	44%	50%
Burwood Panel 35	72%	92%	67%	86%
Burwood Panel 36	97%	124%	67%	85%
Burwood Panel 42	77%	98%	43%	43%
Burwood Panel 43	41%	52%	38%	38%
Five Dock Panel 6	51%	51%	0%	0%
Five Dock Panel 8	95%	95%	58%	58%
Five Dock Panel 14	38%	38%	59%	59%

As shown in the table above, Burwood Feeders 16, 17, 20, 22, 32, 36 and Five Dock Feeder 8 are currently above 80% utilisation.

4.3. Option 2 – Install three 11kV Feeders and only replace limiting sections of Panel 16 Feeder at Burwood Zone Substation

This option involves:

- The installation of three underground 11kV feeders from the Burwood zone to the load centre around the Burwood railway station and shopping precinct
- The replacement of the limiting sections of the Burwood Panel 16 feeder (approximately 1km).
- Replacement of the remaining sections of Burwood panel 16 feeder in Summer 2015/16 at which the load is forecast to exceed its rated capacity.

Two of the new feeders will relieve the highly loaded feeders while the third will remain on standby to provide an alternate supply route in the event of future feeder outages. This will also allow the companion feeders to operate close to the rated capacity without contingent risk and resolves the complications of transferring large loads.

The estimated capital cost of this augmentation is \$5.71M. The Net Present Cost (NPC) is \$4.80M.

5. ANALYSIS OF OPTIONS

In the following section, the costs for Option 2 are based on planning estimates.

5.1. Base Case Analysis

The results of the base case economic analysis are summarised below using a discount rate of 8.5%.

Table 1: Summary of base case analysis of options

Options	Capital Cost (\$M)	NPC (\$M)
Option 1 – Install three 11kV Feeders and replace Panel 16 Feeder at Burwood Zone Substation	5.47	4.78
Option 2 – Install three 11kV Feeders and only replace limiting sections of Panel 16 Feeder at Burwood Zone Substation	5.71	4.80

Refer to Appendix A for further details of the base case economic analysis.

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

5.2. Sensitivity Analysis

The NPC results for variations in discount factor, capital cost and load growth rate are shown in table 2 below:

Table 2: Summary of sensitivity analysis of options

Scenario	NPC (\$M)	
	Option 1	Option 2
7% discount factor	4.91	4.95
10% discount factor	4.67	4.66
25% decrease in capital cost	4.62	4.64
25% increase in capital cost	4.78	4.91
25% decrease in load growth	4.78	4.80
25% increase in load growth	4.78	4.80

Variations in load growth have no impact on the timing of the project supply options due to Burwood zone being presently loaded above EnergyAustralia service standards.

Option 1 is the least cost option under all analysed sensitivity scenarios.

6. CONCLUSION

Option 1 is the least cost option under all scenarios and is thus recommended as the course of action to be taken by EnergyAustralia.

EnergyAustralia intends to install three 11kV Panel Feeders and upgrade Burwood Panel 16 Feeder at an estimated cost of \$5.47M .

This work is forecast to be completed by December 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%

Option 1 – Install three 11kV Feeders and replace Panel 16 Feeder at Burwood Zone Substation

Actions	NPV (\$M)	CAPEX (\$M)	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16
Bulk Cable Laying	2.10	2.42		0.70	1.72						
Materials	0.65	0.74		0.30	0.44						
Permanent Reinstatement	1.21	1.42		0.00	1.42						
PM and Lab	0.10	0.12		0.02	0.10						
Field Services South	0.67	0.78		0.20	0.58						
O&M	0.05					0.00	0.01	0.01	0.01	0.01	0.01
	4.78	5.47									

Option 2 – Install three 11kV Feeders and only replace limiting sections of Panel 16 Feeder at Burwood Zone Substation

Actions	NPV (\$M)	CAPEX (\$M)	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16
Stage 1 - 3 Feeders and Limiting sections of Panel 16											
Bulk Cable Laying	2.58	2.96		0.85	2.11						
Materials	0.45	0.51		0.22	0.29						
Section Replacement of Panel 16	0.19	0.22		0.00	0.22						
PM and Lab	0.55	0.64		0.11	0.53						
Field Services South	0.58	0.67		0.17	0.50						
Stage 2 - Replace Aged Sections of Panel 16											
Bulk Cable Laying	0.28	0.50								0.50	
Materials	0.04	0.08								0.08	
PM and Lab	0.06	0.10								0.10	
Field Services South	0.02	0.04								0.04	
O&M	0.05					0.00	0.01	0.01	0.01	0.01	0.01
	4.80	5.71									

Note: The above figures are quoted in real (2007/08) dollars.