



## **FINAL REPORT**

# **ENFIELD ZONE 11kV WESTERN FEEDER DEVELOPMENT**

**10<sup>th</sup> December 2008**

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## EXECUTIVE SUMMARY

This final report has been prepared to report on upgrade work that is proposed to develop the electricity supply network in the Western Enfield 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 Enfield zone substation western 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). Western Enfield 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 – New Enfield ZS 11kV feeder to Hope Street and upgrade to existing feeders.
- Option 2 – New Enfield ZS 11kV feeder to Madeline Street and upgrade to existing feeders.

**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 – New Enfield ZS 11kV feeder to Hope Street and upgrade to existing feeders.

EnergyAustralia's recommended action is to provide an increase in the 11kV feeder capacity at Enfield zone by the installation of a new feeder and upgrade of existing feeders at a cost of \$4.54M. 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 Enfield supply area.

## 1. BACKGROUND

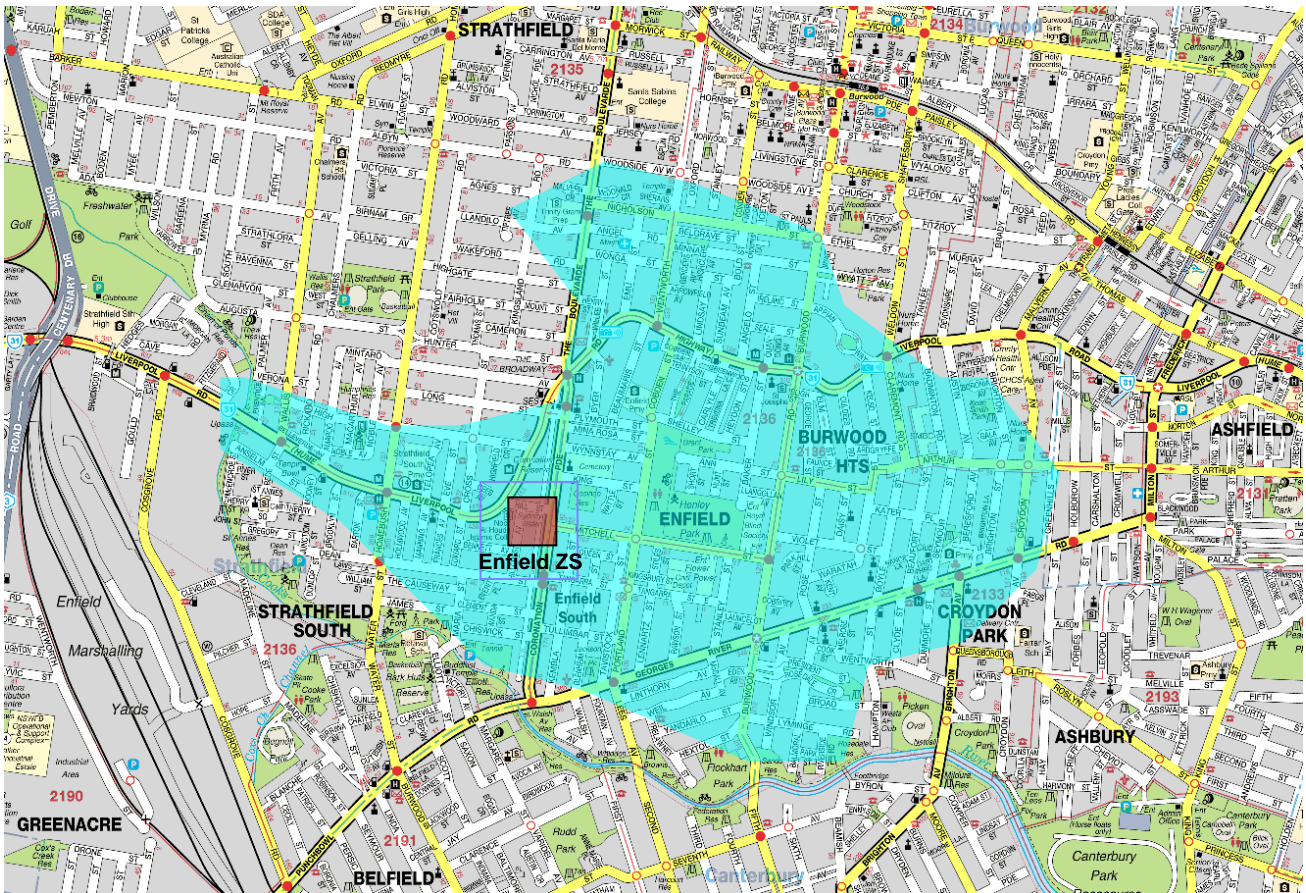
This Final Report has been prepared to advise on the upgrade work that is proposed to be carried out on the Enfield Zone Substation 11kV network. The information provided includes:

- 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.

Enfield 33/11kV zone substation was commissioned in August 1962. The 11kV feeder system supplies parts of Strathfield, Burwood Heights, Enfield, Croydon Park and Strathfield 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 Enfield zone substation.

**Figure 1 – Area supplied by Enfield ZS shaded in blue**



## 2. ISSUES

### 2.1. Applied Service Standard

The service standards that are applicable to a consideration of supply constraints affecting the Enfield 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 feeders<sup>1</sup>, 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. Enfield Zone Substation Capacity Issues

Feeder 10 at Enfield ZS is currently operating at 90% utilisation at peak summer loads and is forecast to exceed 100% utilisation within the forecast load period. Panels 11 and 21 are expected to exceed the licence requirement of 80% utilisation within the same period. High utilisation of the feeders extends beyond the immediate trunk sections to almost 50% of the total feeder length.

The increase in utilisation has been derived from:

- a 19% and 4% load growth at Enfield ZS in the 6 years to 2013 for summer and winter respectively,
- proposed developments at Cosgrove Road, and
- redevelopment of the Enfield Marshalling initially requiring 1MVA, and possibly increasing to 7MVA in the future.

**Table 2-1 Loads on limiting feeder sections during outages on feeders 10, 11 and 12.**

Scenario	Pickup Feeders	Limiting Section	Capacity of Limiting Section (Amps @11kV)	Summer Day Emergency Load (%)	Summer Day Emergency Load Forecast (%)			
					2009	2010	2011	2012
Outage on Feeder 10	1, 3, 21	S825 to S1081	125	112	151	156	116	166
Outage on Feeder 11	3	S825 to S1081	125	88	130	134	138	142
Outage on Feeder 21	1, 14	S4211 to S848	150	163	167	173	177	183

Table 2-1 above is a forecast of loads and the deficiencies in subsequent pickup feeders to comply with the N-1 requirement, following the outages of feeders 10, 11 and 21.

**Table 2-2 Current and forecast utilisation of feeders 10, 11 and 21.**

Average Normal State Utilisation	Current Utilisation	Utilisation in 6 years
Feeder 10	89%	106%
Feeder 11	57%	68%
Feeder 21	75%	90%

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

### 3. TYPE OF AUGMENTATION

Enfield zone substation is classified as a distribution system asset by the National Electricity Rules (the Rules). All options investigated are estimated to cost less than \$10M. Accordingly, since the proposed development strategy for the Enfield zone substation 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 October 2008, establishing the potential to reduce demand at Enfield zone by 4.1MVA by summer 2009/10 at \$360,000, and increase to 4.5MVA at \$690,000 the following year. These are low to moderate savings.

Given the size of the demand management requirement, the moderate savings potential, and the relatively short timeframe to make the investment decision, it is not considered reasonable to expect that it would be cost-effective to postpone the proposed supply-side solution by implementing demand management strategies.

#### 4.2. Option 1 – New Enfield ZS 11kV feeder to Hope St and upgrade to existing feeders.

This option involves:

- The installation of a new 500mm<sup>2</sup> Al3 11kV feeder from Enfield zone to Hope Street.
- Upgrade feeder 10 and 11 with 400mm<sup>2</sup> Al3 11kV feeder from Cosgrove street to Hope Street.
- Upgrade feeder 21 with 400mm<sup>2</sup> Al3 11kV feeder from Hope Street to Madeline Street, and from Cosgrove Road to Hume Highway

***The estimated capital cost of this augmentation is \$4.54M.***

**Table 4-1 Summary of utilisation of feeders 10, 11 and 21 after Option 1.**

Average Normal State Utilisation	Current Utilisation	Utilisation in 6 years
Feeder 10	34%	40%
Feeder 11	57%	68%
Feeder 21	41%	49%

### 4.3. Option 2 – New Enfield ZS 11kV feeder to Madeline St and upgrade to existing feeders

This option involves:

- The installation of an 500mm<sup>2</sup> Al3 11kV feeder from Enfield zone to the intersection of Madeline and Chisholm roads.

*The estimated capital cost of this augmentation is \$4.7M.*

## 5. ANALYSIS OF OPTIONS

### 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)
<b>Option 1</b> – New Enfield ZS 11kV feeder to Hope Street and upgrade to existing feeders	<b>4.54</b>	<b>4.13</b>
<b>Option 2</b> – New Enfield ZS 11kV feeder to Madeline Street and upgrade to existing feeders	4.70	4.28

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	<b>4.21</b>	4.38
10% discount factor	<b>4.06</b>	4.20
25% decrease in capital cost	<b>3.99</b>	4.14
25% increase in capital cost	<b>4.13</b>	4.42

Variations in load growth have no impact on the timing of the project supply options due to Enfield zone 11kV feeders 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 a new Enfield zone 11kV feeder in conjunction with minor feeder upgrades.

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

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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** – New Enfield ZS 11kV feeder to Hope Street and upgrade to existing feeders.

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	1.47	1.60		1.60							
Materials	0.54	0.59		0.59							
Permanent Reinstatement	1.59	1.80		0.90	0.90						
Project Management and Labour	0.14	0.15		0.15							
Field Services	0.34	0.40			0.40						
<b>O&amp;M</b>	0.04					0.002	0.007	0.007	0.007	0.007	0.007
	<b>4.13</b>	<b>4.54</b>									

**Option 2** – New Enfield ZS 11kV feeder to Madeline Street and upgrade to existing feeders.

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	1.53	1.61		1.66							
Materials	0.56	0.61		0.61							
Permanent Reinstatement	1.65	1.86		0.93	0.93						
Project Management and Labour	0.14	0.16		0.16							
Field Services	0.35	0.41			0.41						
<b>O&amp;M</b>	0.04					0.002	0.007	0.007	0.007	0.007	0.007
	<b>4.28</b>	<b>4.70</b>									

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