



FINAL REPORT

BERKELEY VALE ZONE 11kV DEVELOPMENT

13th August 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 Berkeley Vale area in accordance with Clause 5.6.2 (h) of the National Electricity Rules (the Rules). The work proposed by this report is classified as a new small distribution asset under the Rules.

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.

11kV feeder Panel 4 supplied from Berkeley Vale zone substation have been identified to operate outside the normal licence conditions. 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 Berkeley Vale zone substation supply area and the need for augmentation of the 11kV feeders at Berkeley Vale Zone Substation.

Section 2 presents EnergyAustralia's service standards for the area and describes, in detail, various asset condition and forecast capacity issues in the area that resulted in the need for augmentation of supply to the area.

Section 3 describes the proposed augmentation in relation to the Rules. Berkeley Vale 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 of below \$10 million.

Section 4 describes the options that were considered, including Demand Side Management:

- Option 1 – Upgrade existing 11kV feeder Panel 4 at Berkeley Vale Zone Substation via Tuggerah Business Park.
- Option 2 – Upgrade existing 11kV feeder Panel 4 at Berkeley Vale Zone Substation via Wyong Rd.

Section 5 presents a least cost analysis of the options detailed in Section 4.

Section 6 concludes the preferred option is Option 1 at an estimated capital cost of \$1.13m with a Net Present Cost of \$1.19m.

EnergyAustralia's recommended action is to provide additional capacity by upgrading existing 11kV feeder Panel 4 at Berkeley Vale Zone Substation via Tuggerah Business Park at an estimated capital cost of \$1.13m. This recommendation is made on a least cost test (in accordance with regulatory test) to provide increased future capacity and to meet EnergyAustralia's reliability standard.

1. BACKGROUND

This Final Report has been prepared to advise on the 11kV development work that is proposed to be carried out at Berkeley Vale Zone Substation. The proposed works will address general load increase and developing capacity issues in the lower central coast area. The information provided includes:

- A discussion of emerging supply system limitations identified by EnergyAustralia that have lead to the necessity for 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.
- Details of the outcomes of the cost effectiveness analysis of the options considered.

Berkeley Vale is a 33/11kV zone substation supplied by 33kV feeders 793 and 715 from Ourimbah STS. The zone substation is currently above its firm capacity in summer and winter. Work is being carried out to convert Berkeley Vale into 132/11kV operation, providing more supply side capacity. This substation will be supplied from Tuggerah 330/132kV substation by two new 132kV feeders and is scheduled for completion in 2009.

Due to increasing demand in the area, loading on the 11kV feeder supplied from Panel 4 at Berkeley Vale zone substation exceeds the feeder rating under the normal condition. At times of peak load, a supply interruption on panels 4, 6, 11 and 14 will result in customers supplied from these feeders being unable to be supplied via alternative supply paths.

Action is required to ensure loading on these 11kV feeders remains within the service standard.

Figure 1, details the neighbouring geographic area. .

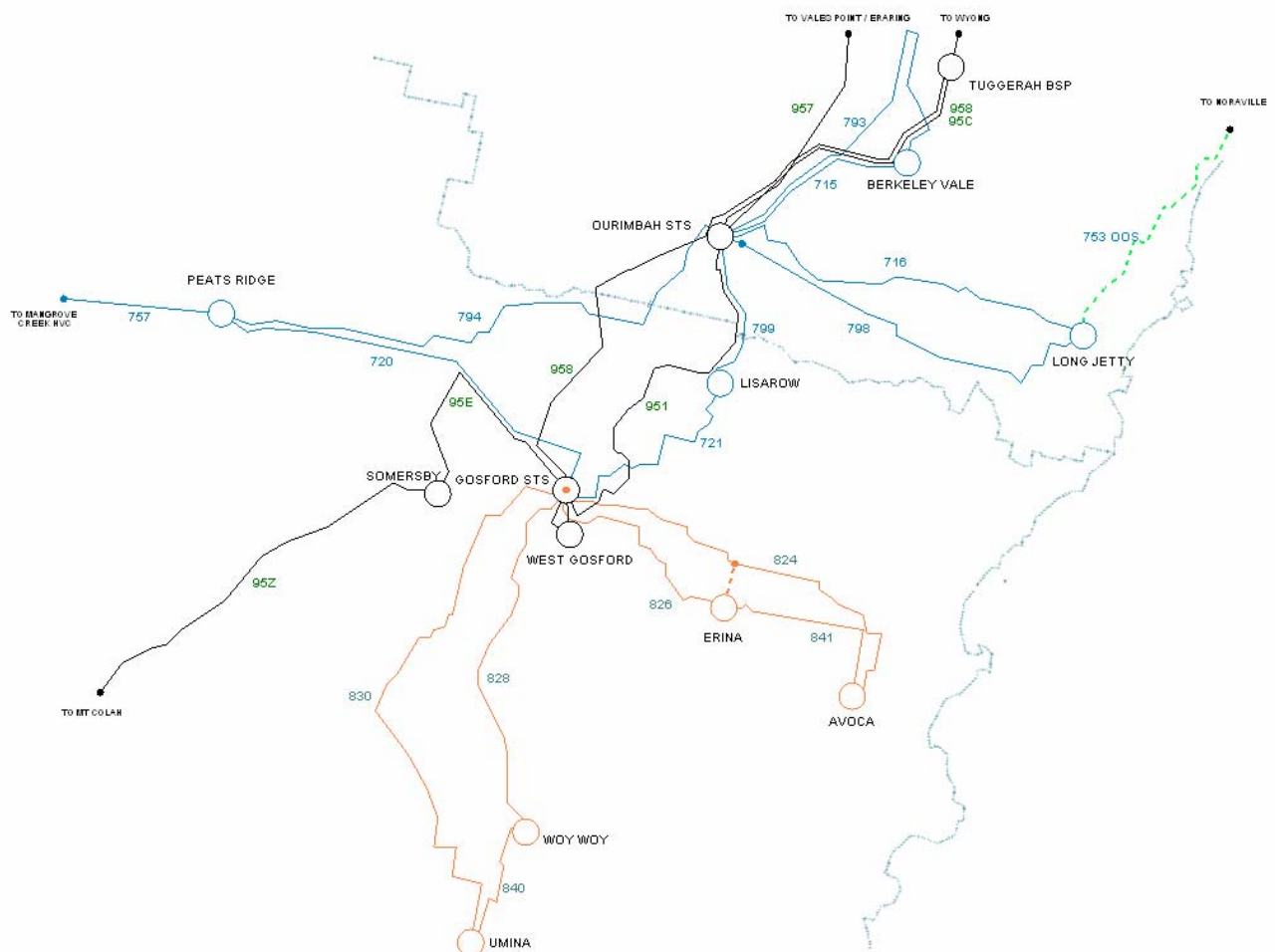


Figure 1: Current Configuration in the Lower Central Coast Region.

2. ISSUES

2.1. Applied Service Standard

The service standards that are applicable to a consideration of supply constraints affecting the Berkeley Vale supply area are summarised below:

2.1.1. 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.

2.1.2. Zone substations and Subtransmission Network

2.1.2.1 Overhead Subtransmission Line and Zone Substations

For a failure of a single critical element (i.e. N-1 conditions) within zone substations supplying greater than 10MVA of load and for overhead subtransmission network, the forecast demand is not to exceed the thermal capacity for more than 1% of the time i.e. a total aggregate time of 88 hours per annum; up to a maximum of 20% above the thermal capacity. Recovery of load should be within one minute.

Under normal conditions (i.e N conditions), the thermal capacity is required to meet at least 115% of forecast demand.

2.1.2.2 Underground Subtransmission Line

For an underground subtransmission line, any overhead section should be designed as if it was a subtransmission overhead line, providing the forecast demand does not exceed the thermal capacity of the underground section at any time under N-1 conditions.

2.1.3. 11kV Distribution Network

For urban feeders (i.e. feeders with an actual maximum demand greater than 0.3MVA/km), 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.

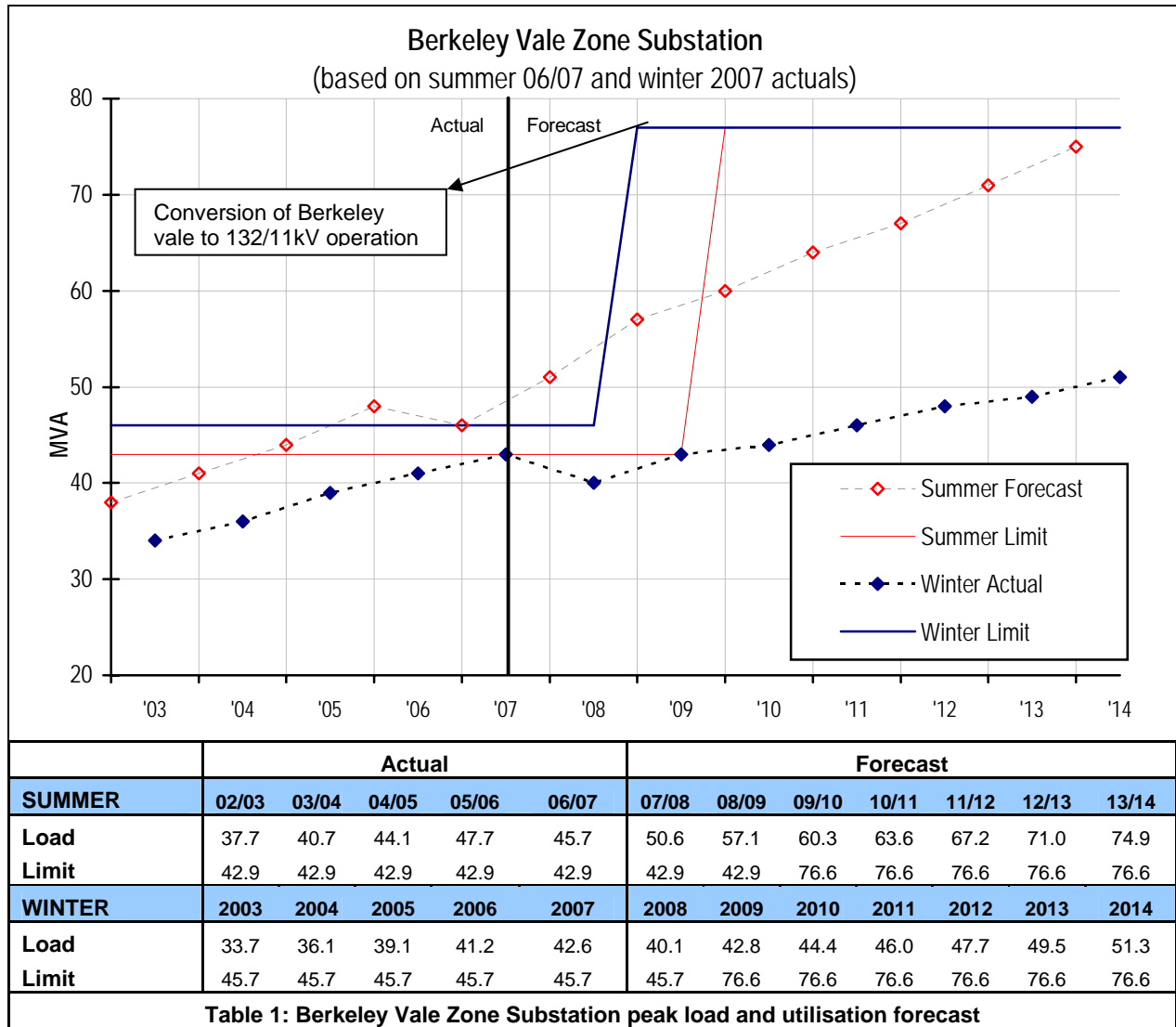
For 11kV networks, voltage drops of up to 5% are regarded as satisfactory. Higher voltage drops are permissible provided that the network connection provided to low voltage customers is within the limits specified in Australian Standard AS2926.

2.2. Description of Network Constraints

2.2.1. Berkeley Vale Zone Substation

Berkeley Vale Zone Substation has a firm capacity of 35.7MVA in summer and 38.1MVA in winter, which is limited initially by the transformer rating and then by the 33kV feeders. After the conversion of zone to 132/11kV operation, which is scheduled for completion in 2009, the new Berkeley zone will have a firm capacity of 63.8MVA in both summer and winter. Under the current planning limits of 120%, Berkeley Vale zone has a system limit of 76.6MVA both in summer and winter. The zone is not expected to exceed planning limits until 2014 and beyond which a third 50MVA transformer will be commissioned at Berkeley Vale zone substation.

The peak load and utilisation forecast for Berkeley Vale Zone Substation for summer and winter is shown in Table 1 based on summer 2005/06 and winter 2006 actual values.



2.2.1. 11kV Network Capacity Limitation at Berkeley Vale Zone Substation

The load at Berkeley Vale zone, including feeders 4, 6, 11 and 14, is forecast to grow at 5.6% per annum in summer and 3.8% per annum in winter. The load in this area is predominantly commercial and light industrial with daytime peaks, with summer peak demand higher than in winter. There are significant new loads expected on the relevant feeders in the near future.

Scenario	Capacity of limiting section	Peak demand (Including proposed load)
Outage of the critical section of feeder 4	feeder 11 – 6.1 MVA	7.4 MVA
	feeder 6 - 7.6 MVA	8.6 MVA

Table 2 – Loading on 11kV Feeder panel 6 & 11 at Berkeley Vale Zone

During peak loads, the Berkeley Vale feeder Panel 4 is not complying EnergyAustralia’s Planning Standards. Further, at times of peak load, an outage of either the Berkeley Vale Panel 4, 6, 11 and 14 feeders would result in load not being able to be picked up in an appropriate number of contingency switching operations

Panel	Utilisation 2008	Utilisation 2014
4	102%	145%

Table 3- Current Network Utilisation

Without augmentation, the existing feeders will have insufficient capacity to maintain supply in an 'N-1' scenario or will involve an unacceptably high number of switching operations, and thus will not comply with EnergyAustralia's Planning Standards.

2.3. Asset Condition

2.3.1. Berkeley Vale Zone Substation

There is a project in progress to convert the Berkeley Vale zone substation from 33/11kV to 132/11kV and is scheduled for completion in 2009. Hence, no aged asset issues are foreseen in future.

3. TYPE OF AUGMENTATION

The requirements of the National Electricity Rules (the Rules) for new asset proposals are outlined in Section 5.6 and depend on the cost, purpose and function of the new asset.

The 11kV Berkeley Vale zone feeder upgrade is classified as distribution system assets by the Rules. The Rules (clauses 5.6.2(e) and (f)) require that, where analysis indicates that any relevant technical limits of a distribution system will be exceeded, that the Distribution Network Service Provider must notify any affected Registered Participants of these limitations and of the expected time for corrective action and consult with affected 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 small network asset, or for options that do not augment the system.

Each of the options considered under Section 4 are considered new small distribution network assets as they involve a network augmentation with expenditure less than \$10 million. A DNSP is not required to consult of 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

4.1. Demand Management

A demand management screening test was carried out in December 2007. Based on the demand management screening study, 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 - Upgrade existing 11kV feeder Panel 4 at Berkeley Vale Zone Substation via Tuggerah Business Park

This option involves the installation of 700m of 11kV feeders from Berkeley Vale zone substation to Tuggerah Business Park, through laying 400mm² AL 3 core cable in existing conduits and five spare ducts which includes the under-boring of Ourimbah Creek. The option also provides for the installation of a spare duct for EnergyAustralia fibre communications which also includes the under-boring of Ourimbah Creek, in conjunction with minor network augmentation works.

Upgrading the existing limiting section of the cable increases the capacity of the feeders supplying the Berkeley Vale area. Following below are the benefits obtained by increasing the throughput rating of the feeders from the trunk portions to the main inter-connectors between these feeders:

- Decrease the overall utilisation of the associated feeders to acceptable levels for the forecast load period.
- Able to maintain N-1 for all feeders during times of peak loads both now and for the forecast load period.
- Decrease the number of switching steps required to pick up feeders during failure scenarios.
- Improve the overall reliability of the associated feeders

Upgrading of feeder Panel 4 will reduce the overall utilisation of the Panels 6, 11, and 14 feeders respectively to be within the Design Planning Criteria. The forecast utilisation summary is shown below for the constrained 11kV feeders at Berkeley Vale before and after the proposed work.

Feeder	% Utilisation			
	Do Nothing		After Option 1	
	2008	2014	2008	2014
Panel 4	102%	145%	52%	74%
Panel 12	92%	138%	50%	72%

Table 4: Utilisation summary for Panel 4 and 12 after Option 1

The total estimated capital cost of this option is \$1.13m. The Net Present Cost (NPC) is \$1.19m.

4.3. Option 2 - Upgrade existing 11kV feeder Panel 4 at Berkeley Vale Zone Substation via Wyong Rd.

This option involves the installation of 2.4km of 11kV feeders from Berkeley Vale zone substation via Wyong Rd. This option has a greater scope of difficulty due to geographical constraints and an increase in scope of under-boring at Ourimbah Creek.

The total estimated capital cost of this option is \$4.30m. The Net Present Cost (NPC) is \$4.53m.

5. ANALYSIS OF OPTIONS

5.1. Base Case Analysis

The results of the base case economic analysis are summarised in table 4 below using the base discount factor of 8.5%.

Options	NPC (\$m)**	Capital Cost (\$m)
Option 1 - Upgrade 11kV feeders Panel 4 at Berkeley Vale Zone Substation via Tuggerah Business Park	1.19	1.13
Option 2 - Upgrade 11kV feeder Panel 4 at Berkeley Vale Zone Substation via Wyong Rd.	4.53	4.30

** The net present cost includes operation and maintenance cost.

Table 5: Summary of Base Case Economic Analysis.

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

Under the base case analysis, 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 and Line cost

The NPC results for variation in line costs, discount rate of 7% and 10% are shown in table 4 below.

Sensitivity Factor	NPC (\$m)	
	Option 1	Option 2
8.5 % Discount Rate (Base Case)	1.19	4.53
7.0% Discount Rate	1.20	4.55
10% Discount Rate	1.19	4.52
50% Increase in line costs	1.34	5.12
50% Decrease in line costs	1.04	3.94

Table 6: Sensitivity Analysis

5.2.2 Variations in Load Growth Rates

Variations in load growth rates will not affect the cost of the supply options as the network constraint issues exist during the construction period of the project.

6. CONCLUSION

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

EnergyAustralia intends to upgrade existing 11kV feeder Panel 4 at Berkeley Vale Zone Substation via Tuggerah Business Park at an estimated capital cost of \$1.13m.

This work is forecast to be completed by April 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

Discount Rate = 8.5%

Option 1 - Upgrade 11kV feeder Panel 4 at Berkeley Vale Zone Substation via Tuggerah Business Park

Description	NPC (\$m)	Capex (\$m)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Design	0.01	0.01	0.01									
Project Management	0.02	0.02	0.02									
Survey Easement Preparation	0.02	0.02	0.02									
Environmental Services	0.03	0.03	0.03									
Construction Labour	0.20	0.20	0.20									
Construction Materials	0.28	0.28	0.28									
Contracted survey	0.10	0.10	0.10									
Contract Cable Laying	0.48	0.48	0.48									
Total	1.13	1.13										
O&M Costs	0.06			0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
TOTAL	1.19	1.13	1.13	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

All amounts are quoted in 2007/08 real dollars (\$million). 2008 refers to the 2008/09 financial year and so forth.

Option 2 - Upgrade 11kV feeder Panel 4 at Berkeley Vale Zone Substation via Wyong Rd.

Description	NPC (\$m)	Capex (\$m)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Design	0.01	0.01	0.01									
Project Management	0.02	0.02	0.02									
Survey Easement Preparation	0.02	0.02	0.02									
Environmental Services	0.04	0.04	0.04									
Construction Labour	0.80	0.80	0.80									
Construction Materials	1.12	1.12	1.12									
Contracted survey	0.38	0.38	0.38									
Contract Cable Laying	1.90	1.90	1.90									
Total	4.30	4.30										
O&M Costs	0.23			0.01	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
TOTAL	4.53	4.30	4.30	0.01	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04

All amounts are quoted in 2007/08 real dollars (\$million). 2008 refers to the 2008/09 financial year and so forth.