



FINAL REPORT

BEROWRA 11kV ZONE DEVELOPMENT

11th June 2009

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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 Berowra zone substation supply 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.

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 of the paper provides a background of the Berowra zone substation supply area and the need for augmentation of the 11kV network.

Section 2 describes the issues associated with the increase in 11kV feeder loading and the projected load forecast. The concept of service standard, as implemented by EnergyAustralia is discussed.

Section 3 describes the proposed augmentation in relation to the National Electricity Rules. Berowra zone substation and its associated 11kV distribution network are 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 less than \$10 million.

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

- Option 1 – New 11kV feeder from Berowra zone via route 1.
- Option 2 – New 11kV feeder from Berowra zone via route 2.
- Option 3 – New 11kV feeder from Hornsby zone.

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

Section 6 concludes the preferred option is Option 1 – New 11kV feeder from Berowra zone via route 1.

The conclusion to implement Option 1 is made on the basis that it is the least cost option in accordance with the Regulatory Test to provide increased future capacity and to meet EnergyAustralia's reliability standard. The estimated capital cost for this option is \$1.93 million and is scheduled for completion in December 2009.

1. BACKGROUND

This Final Report has been prepared to advise on the upgrade work that is proposed to be carried out on the 11kV network at Berowra, which is a part of North West Sydney load area to maintain loading within reliability standards. The information provided includes:

- A discussion of emerging supply system limitations identified by EnergyAustralia that have lead to the necessity for augmentation of the 11kV network in the area;
- A discussion of the service standard that has been adopted for planning purposes;
- A description of options for development of the electricity supply in the area; and
- Details of the outcomes of cost effectiveness analysis for the options that have been considered.

Berowra 132/11kV zone substation was commissioned in 1973 and is supplied by 132kV feeder 252 and 250, which are connected to Hornsby zone substation and Sydney North Bulk Supply Point (BSP) respectively.

Berowra zone supplies parts of the suburbs of Brooklyn, Cowan, Dangar Island, Milsons Passage, Berowra, Mount Kuring-gai, Mount Colah, Arcadia, Berowra Heights, Berowra Heights, Berowra Waters, Berrilee, and Fiddletown. Currently, the 11kV feeder supplied by Panel 13 at Berowra zone substation is approaching EnergyAustralia service standard load limit in the normal state and any contingency failures on this feeder at times of high or peak loading may not be adequately restored in accordance with the Design Planning Criteria. Similarly, the 11kV feeder supplied by Panel 44 at the adjacent Hornsby zone substation is facing a similar loading situation.

Action is required to ensure loading on the constrained 11kV feeder remains within the service standard.

Below is a geographic overview of the Berowra zone substation load area.

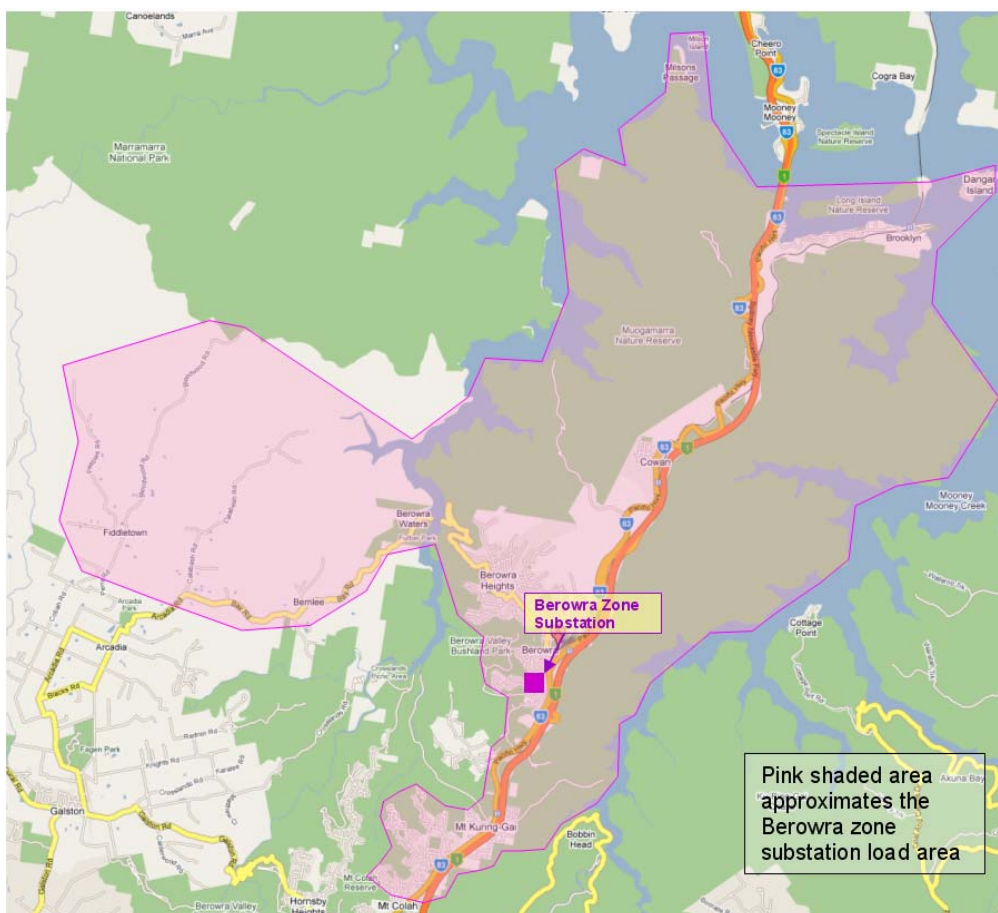


Figure 1: Geographic overview of Berowra zone substation load area

2. ISSUES

2.1. Applied Service Standard

EnergyAustralia is required to comply with service standards that are specified in the 'Design, Reliability and Performance Licence Conditions' (Licence Conditions), which were imposed on NSW distributors by the Minister for Energy on 1 October 2007. The design planning criteria are specified in Schedule 1 of the Licence Conditions and reliability standards are specified in Schedules 2 and 3. For existing network, a distributor must be as compliant as practicable with these requirements by 1 July 2014 and fully compliant by 1 July 2019. All new network elements must comply with these requirements.

The service standards that are applicable to a consideration of supply constraints affecting the Berowra area are summarised below.

Zone substations and subtransmission network (urban/non-urban)

With all elements in service, the thermal capacity is required to meet at least 115% of forecast demand.

Following a failure of a single critical element (i.e. N-1 conditions), the network must be designed to recover supply within one minute for systems supplying >10MVA, and otherwise, within best practice repair times. For systems that supply >10MVA, the forecast demand of a zone substation or overhead feeder network may exceed the N-1 capacity for up to 1% of the year i.e. a total aggregate time of 88 hours per annum, up to a maximum of 20% above the N-1 capacity; and the forecast demand of an underground feeder network may not exceed the N-1 capacity.

11kV distribution network

The planning criteria applied to 11kV networks are determined by the type of load it supplies.

For CBD feeders, there should be no loss of supply to customers following an unplanned failure of a single network element (i.e. N-1 conditions).

For feeders supplying urban areas, switch-able interconnection to adjacent feeders is required to enable restoration following an unplanned failure of a single network element (i.e. N-1 conditions). Recovery of load is determined by the time required to perform manual switching of load in the field and is expected to take less than 4 hours. Under normal system conditions, the expected demand is to be no more than 80% of the feeder thermal capacity.

For non-urban areas, recovery of load is based on best practice repair times for an asset in that location.

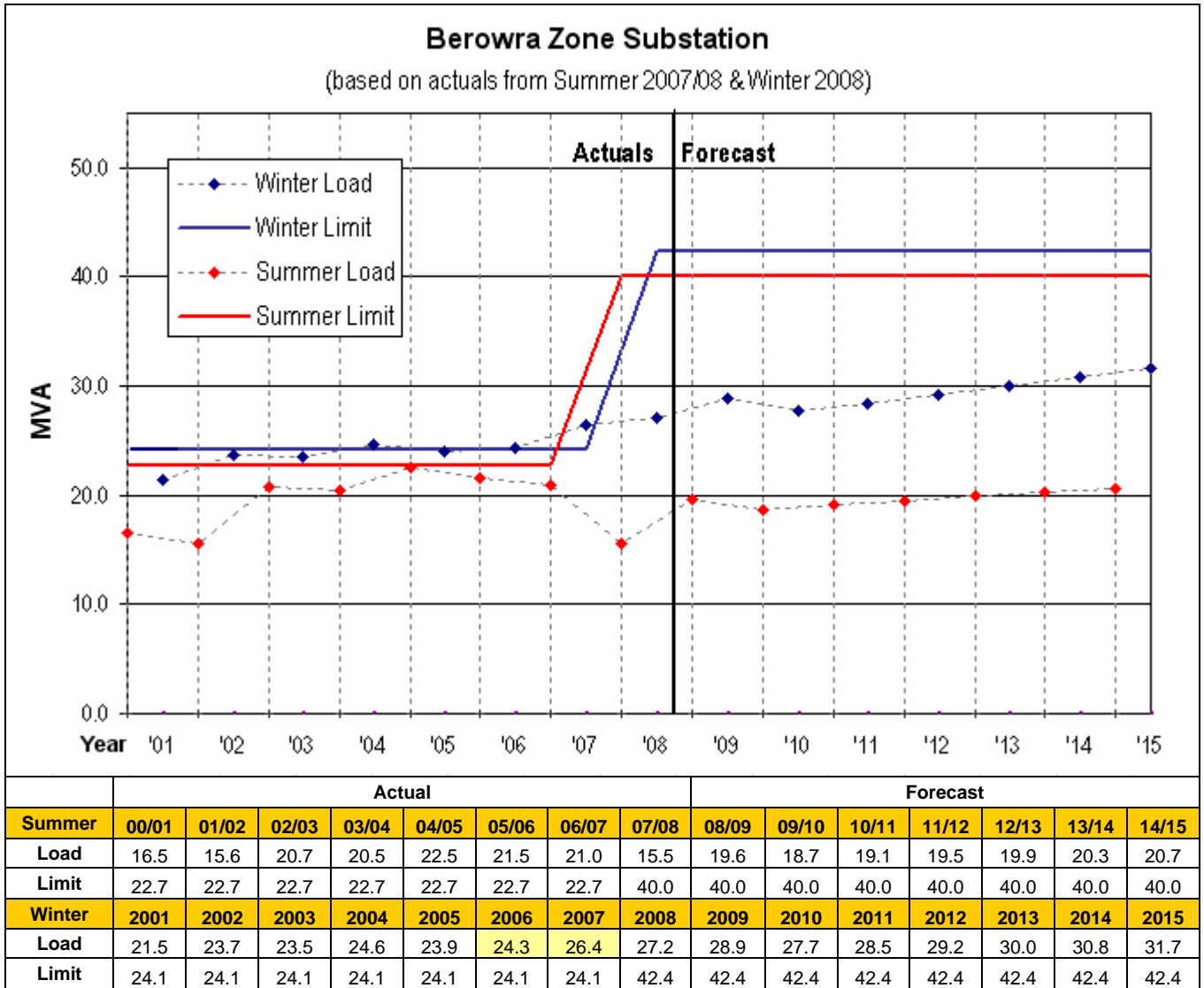
EnergyAustralia may choose to provide a higher level of reliability in order to comply with the reliability standards specified in Schedules 2 and 3 of the Licence Conditions.

2.2. Capacity Issues

2.2.1. Berowra Zone Substation

Berowra zone substation is equipped with two 37.5MVA 132/11kV transformers and it has a firm capacity of 40.0MVA in summer and 42.4MVA in winter. The load is not forecast to exceed firm capacity within the forecast period.

Load forecast for Berowra zone substation is shown in the graph below.



2.2.2. Berowra Zone 11kV Network

Under existing normal operating conditions, the 11kV feeder supplied from Panel 13 at Berowra zone has a utilisation greater than 80% and hence does not fully comply with the Design Planning Criteria. This constraint if not addressed may result in load not being able to be supplied via alternative pathways, or not being able to meet the 11kV network service standard under N-1 condition.

Additionally the Berowra panel 23 feeder is forecast to be loaded above 80% of its capacity under normal state in 6 years.

2.2.3. Hornsby Zone 11kV Network

The utilisation of 11kV feeder supplied from panel 44 at Hornsby zone has also exceeded 80% of its capacity, being not able to achieve the required Licence Compliance Design Planning Criteria.

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 Berowra 11kV zone development 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 (DNSP) 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 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 standard 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

An assessment of demand management opportunities in the Berowra area was carried out in January 2009. The demand reduction requirement is moderate in absolute terms but very high relative to total demand on the specific feeder location where it is required. The savings from deferral are moderate to high, however the timeframe before an investment decision must be made is short. On this basis it was concluded that it would not be reasonable to expect that demand management strategies could form a cost effective alternative.

4.2. Option 1 – New 11kV feeder from Berowra zone via route 1

This option involves constructing a new 11kV feeder from Berowra zone, south along the Pacific Hwy to the corner of Beaumont Rd which is a total distance of 2km, installed into existing ducts which run the entire length. The new feeder and subsequent network re-configuration will ensure that feeders connected to the above mentioned feeders from Berowra zone substation and Hornsby zone substation meet the required service standard over 6 years.

The following utilisation summary shows the constrained 11kV feeder loading at Berowra after the proposed work. It considers the inter-related group of feeders – Panel 13, 15, 23 Berowra zone, 44 Hornsby zone and the proposed new feeder connected to Berowra panel 22.

Average Normal State Utilisation	Do Nothing		After Option 1	
	Current Utilisation	Forecast Utilisation – 6 Years	Current Utilisation	Forecast Utilisation – 6 Years
Panel 13 Berowra	96%	126%	48%	63%
Panel 23 Berowra	69%	99%	46%	59%
Panel 15 Berowra	40%	56%	53%	70%
Panel 44 Hornsby	81%	91%	56%	69%
Panel 22 Berowra (new)	N/A	N/A	58%	77%

The total estimated capital cost of this option is \$1.93M.

4.3. Option 2 – New 11kV feeder from Berowra zone via route 2

This option involves a new feeder from Berowra zone to the feeder between substation S.35941 Beaumont Gundah No.1 and S.35942 Beaumont Gundah No.2. This option will form a highly loaded tee joint at the proposed new feeder and does not provide the benefit that provided by option 1.

The total estimated capital cost of this option is \$2.05M.

4.4. Option 3 – New 11kV feeder from Hornsby zone

This option involves installation of a new 11kV feeder of 4.5km length from Hornsby zone to the load centre of the feeder supplied from Hornsby panel 22. The proposed new feeder would then use existing connectivity between Hornsby and Berowra zone to relieve load from the Berowra panel 13 feeder. This option would lead to potential voltage drop issues.

The total estimated capital cost of this option is 3.60M.

5. ANALYSIS OF OPTIONS

5.1. Base Case Analysis

The results of the base case economic analysis are summarised in Table 2 below using the base discount rate of 8.5%.

Options	NPC (\$M) *	Capital Cost (\$M)	Ranking
Option 1: New 11kV feeder from Berowra zone via route 1	1.97	1.93	1
Option 2: New 11kV feeder from Berowra zone via route 2	2.09	2.05	2
Option 3: New 11kV feeder from Hornsby zone	3.60	3.60	3

* The net present cost is higher as it includes operation and maintenance costs

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 and capital cost are shown in Table 3 below:

Scenario	NPC		
	Option 1 (\$M)	Option 2 (\$M)	Option 3 (\$M)
7% discount factor	1.99	2.11	3.63
10% discount factor	1.96	2.08	3.58
25% decrease in capital cost	1.48	1.60	2.70
25% increase in capital cost	2.47	2.59	4.51

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

Variation in load growth rates will not affect the cost of the supply options as the 11kV network is already constrained at time implementation of the preferred option. Hence, it is not included in the sensitivity analysis.

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 develop a new 11kV feeder from Berowra zone substation at a cost of \$1.93M to ensure the service standard are maintained for the 11kV distribution network in the Berowra load area. All works are anticipated 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 = 0.085

Option 1 – New 11kV feeder from Berowra zone via route 1

Actions	NPV (\$M)	CAPEX (\$M)	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
Total estimated capital cost	1.88	1.93	1.27	0.66								
Operation & Maintenance	0.10		-	-	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Total	1.97	1.93	1.27	0.66								

Option 2 – New 11kV feeder from Berowra zone via route 2

Actions	NPV (\$M)	CAPEX (\$M)	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
Total estimated capital cost	2.00	2.05	1.36	0.70								
Operation & Maintenance	0.10		-	-	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Total	2.09	2.05	1.36	0.70								

Option 3 – New 11kV feeder from Hornsby zone

Actions	NPV (\$M)	CAPEX (\$M)	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
Total estimated capital cost	3.50	3.60	2.38	1.22								
Operation & Maintenance	0.10		-	-	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Total	3.60	3.60	2.38	1.22								

1) All costs are quoted in 2008/09 real dollars. Year 08/09 refers to 2008/09.