



FINAL REPORT

REPLACEMENT OF 33kV FEEDERS TO RIVERWOOD ZONE SUBSTATION

23rd 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 Riverwood 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.

Load growth in the Riverwood load area combined with the condition of the 33kV underground feeders supplying the zone from Peakhurst STS has prompted the need to replace the feeders to provide an increase in substation capacity and address aged asset issues associated with the underground cables. To ensure a safe and reliable electricity supply for existing customers, EnergyAustralia is providing additional capacity 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 Riverwood Zone Substation and the need for augmentation.

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). Riverwood 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 considered, including Demand Management as well as:

- Option 1 – Replacement of 33kV feeders to Riverwood Zone Substation ; and
- Option 2 – Conversion of Riverwood to 132/11kV operation.

Section 5 presents the results of economic analysis of the options considered, sensitivity analysis and the ranking of the options and identification of the least cost option.

Section 6 concludes that the preferred option is Option 1 – Replacement of 33kV feeders supplying Riverwood Zone Substation .

EnergyAustralia's recommended action is to provide an increase in substation firm capacity at Riverwood Zone by the replacement of two underground 33kV feeders and the installation of a third 33kV Feeder from Peakhurst STS at an estimated cost of \$7.28M. This recommendation is made based on the least cost test to provide medium to long term capacity for the Riverwood supply area.

1. BACKGROUND

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

- A discussion of emerging supply system limitations identified by EnergyAustralia that have lead to the necessity for the replacement of the two existing 33kV feeders and the installation of a third 33kV feeder to the zone substation;
- 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.

Riverwood 33/11kV zone substation was commissioned in 1966 and is situated in the St George supply area. Riverwood currently supplies parts of the following suburbs: Beverley Hills, Hurstville, Hurstville Grove, Hurstville South, Lugarno, Penshurst, Riverwood, Peakhurst and Narwee.

Load growth in the Riverwood area has resulted in the need to provide additional capacity at Riverwood 33/11kV zone substation. Riverwood Zone is forecast to be loaded above firm capacity in winter 2008 in addition to condition issues associated with the underground 33kV feeders from Peakhurst STS.

In accordance with the St George area strategy, the preferred supply option to address these capacity and condition issues is the refurbishment of Riverwood 33/11kV zone substation and retention of the 33/11kV supply voltage. This Final Report analyses the replacement of the two existing 33kV feeders and the installation of a third 33kV feeder to provide additional firm capacity as the existing feeders are forecast to limit the Riverwood Zone Substation firm capacity.

2. ISSUES

2.1. Applied Service Standard

The service standards that are applicable to a consideration of supply constraints affecting the Riverwood Zone Substation supply area is 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 Lines 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 networks, 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 Feeders

For an underground subtransmission feeder, 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.

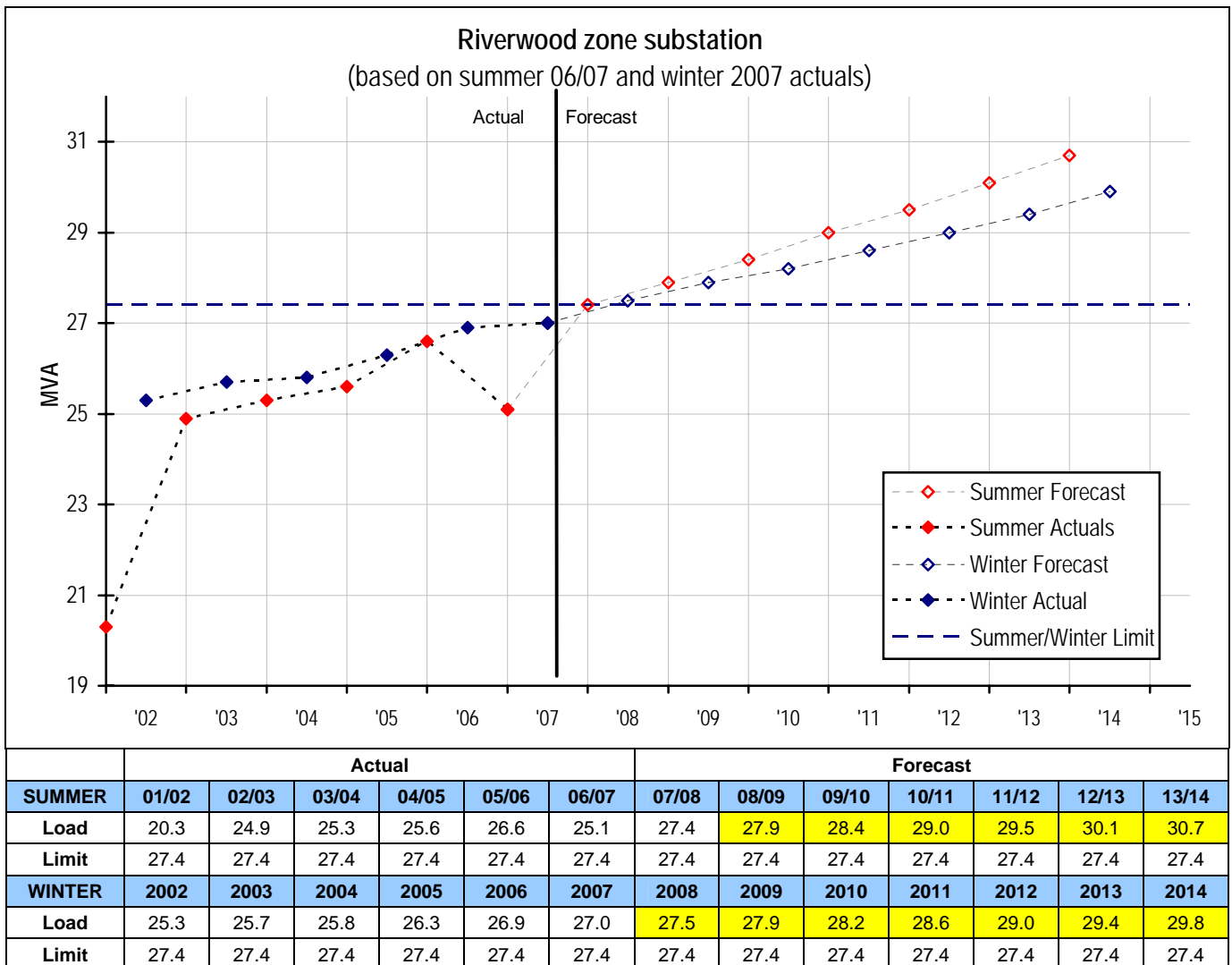
2.2. Description of Network Constraints

2.2.1. Riverwood Zone Substation Capacity Issues

Riverwood 33/11kV zone substation is supplied from Peakhurst 132/33kV STS via two 33kV underground feeders 778 and 779, and is equipped with one 15MVA and two 19MVA 33/11kV transformers. Riverwood has a firm capacity of 27.4MVA in both summer and winter, limited by the rating of the 33kV feeders. As these feeders are underground, risk is not applicable at Riverwood and hence the zone is required to be limited to N - 1 operation in order to remain compliant with licence conditions.

The summer and winter peak load forecast for Riverwood Zone is shown below:

Figure 2: Riverwood Zone Substation Load Forecast



Riverwood Zone is presently loaded below the firm capacity in summer and winter, however it is forecast to exceed its winter firm capacity during 2008. Since risk is not applicable at Riverwood, the zone will be loaded above licence conditions from winter 2008 by 0.1MVA. The forecast indicates that this excess load will increase to 3.3MVA by summer 2013/14 if the recommended actions within this report are not implemented.

2.2.2. Riverwood Zone Substation Equipment Condition Issues

Riverwood is supplied via two 33kV underground feeders: 778 and 779. These feeders are gas pressure cables and form part of the overall population of cables to be progressively retired from the network due to their operational difficulties and failure rates.

The 33kV oil-filled circuit breakers and busbar are due for retirement before 2010/11 based on asset condition and fire mitigation issues.

The preferred supply option outlined below addresses the condition of the existing 33kV feeders.

3. TYPE OF AUGMENTATION

Riverwood Zone Substation is classified as a distribution system asset by the National Electricity Rules (the Rules).

The replacement of the feeders at the Riverwood Zone Substation was calculated to be \$7.28M and will provide an additional 8.5MVA capacity. Accordingly, since the proposed development strategy for the Riverwood 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 May 2008 in respect of this area. The review produced the following results.

- If demand could be reduced by 1.7MVA by summer 2011/12 and 2.7MVA by winter 2012, then the project could be deferred by two years. This is 9% of total demand on the substation. The value of this deferral is \$20,000, or \$9/kVA, which is very low.
- If demand could be reduced by 2.2MVA in summer and 3.3MVA in winter, then the project could be deferred by three years. This is 11% of total demand on the substation. The value of this deferral is \$500,000, or \$150/kVA, which is moderate.
- If demand could be reduced by 2.7MVA in summer and 3.9MVA in winter, then the project could be deferred by four years. This is 12% of total demand on the substation. The value of this deferral is \$940,000, or \$240/kVA, which is moderate.

Given the relatively high demand reduction requirement, predominantly residential customer base, moderate deferral value, and short time until an investment decision must be made, it is not reasonable to expect that demand management would provide a cost effective solution in this case.

Based on this analysis 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 – Replacement of 33kV feeders to Riverwood Zone Substation

This option involves the replacement of two existing 33kV underground feeders 778 and 779, and installing a third 33kV feeder to be identified as 670, supplying Riverwood Zone from Peakhurst STS. These works will provide a firm capacity increase of approximately 8.5MVA to the Riverwood Zone.

The scope of this project (stage 1) includes the following works:

- Replacement of the existing 33kV feeders 778 and 779 with two new 33kV cables;

- Install a new third 33kV feeder (670);
- Retire the 33kV bus and associated switchgear from the Riverwood ZS; and
- Tail-end the three 33kV feeders to the three existing 33/11kV transformers.

Stage 2, shown in Appendix A in which the 11kV switchgear replacement is included in the model, is not part of the scope of this project. It is used in the model to provide a Net Present Cost in a balanced scenario to compare Option 1 with Option 2.

The estimated capital cost of Stage 1 of this augmentation is \$7.28M (of which \$3.75M is related to growth). The Net Present Cost (NPC) is \$10.02M.

4.3. Option 2 – Conversion of Riverwood to 132/11kV Operation

This option involves the conversion of the existing Riverwood 33/11kV zone substation to 132/11kV operation. It is assumed that the conversion would take place on an adjacent site for the purposes of costing. The existing Riverwood Zone Substation is situated in close proximity to Peakhurst STS, which results in reduced 132kV connection costs.

The new Riverwood 132/11kV zone would initially be equipped with two 50MVA 132/11kV transformers, resulting in a firm capacity of approximately 68MVA. The scope of works of a 132/11kV conversion of Riverwood would include:

- Establishment of a new 132/11kV zone substation on an adjacent site, currently owned by EnergyAustralia, to the existing Riverwood 33/11kV zone;
- 132kV connection costs; and
- 11kV load transfers from the existing Riverwood Zone to the new 132/11kV substation.

The costs do not include the additional requirements at Peakhurst STS to establish an additional 132kV feeder (eg bay construction)

The estimated capital cost of this augmentation is \$33.21M. The Net Present Cost (NPC) is \$29.96M.

5. ANALYSIS OF OPTIONS

In the following section, the costs for the 11kV switchgear component of Option 1 and the entire 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 – Replacement of 33kV feeders to Riverwood Zone Substation	7.28	10.02 ¹
Option 2 – Conversion of Riverwood to 132/11kV operation	34.89	31.60

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.

¹ Includes total strategy costs associated with stage 1 and stage 2 works

5.2. Sensitivity Analysis

The NPC results for variations in discount rate, 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 ²	Option 2
7% discount rate	10.12	32.68
10% discount rate	9.29	30.59
25% decrease in capital cost	9.03	23.95
25% increase in capital cost	10.34	39.25
25% decrease in load growth	10.02	31.60
25% increase in load growth	10.02	31.60

Variations in load growth have no impact on the timing of the project supply options since Riverwood Zone is forecast to be loaded above EnergyAustralia service standards in winter 2008.

6. CONCLUSION

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

EnergyAustralia intends to replace the two existing 33kV underground cables and install a third 33kV cable to supply Riverwood Zone from Peakhurst STS, retire the 33kV switchgear and associated busbars, and tail-end the new 33kV feeders onto the existing Riverwood transformers at an estimated cost of \$7.28M.

This work is forecast to be completed by July 2010. 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.

² Includes total strategy costs associated with stage 1 and stage 2 works

7. APPENDIX A – ECONOMIC ANALYSIS OF BASE CASE

WACC = 8.5%

Option 1 – Replacement of 33kV feeders to Riverwood 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 – Replacement of 33kV feeders supplying Riverwood Zone											
Materials	2.33	2.61		1.57	1.04						
Labour	0.62	0.72		0.21	0.50						
Contracts	2.61	2.95		1.47	1.47						
PM	0.15	0.17		0.05	0.12						
Design	0.62	0.70		0.28	0.42						
STAGE 2 - 11kV switchgear											
11kV Switchgear Replacement	3.08	4.99						0.38	4.62		
O&M	0.61					0.00	0.16	0.01	0.01	0.04	0.16
	10.02	12.14									

Option 2 – Conversion of Riverwood to 132/11kV Operation

Actions	NPV (\$M)	CAPEX (\$M)	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16
Riverwood 132/11kV conversion											
Establish new 132/11kV Riverwood Zone	21.24	24.49		0.36	6.98	15.26	1.88				
132kV connection (1.6km from PeakHurst STS using 800mm ² cable)	5.60	7.15				0.00	7.15				
11kV transfers from Riverwood 33 ZS to Riverwood 132 ZS	1.38	1.75				0.13	1.62				
Decommission Riverwood33ZS	0.39	0.50					0.50				
Additional Land Acquisition (1000m ²)	1.00	1.00		1.00							
O&M	1.99							0.30	0.37	0.37	0.37
	31.60	34.89									

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

8. APPENDIX B - ECONOMIC ANALYSIS SUMMARY OF ST GEORGE AREA STRATEGY

The economic analysis summary below is taken from "Final Report - Development of Supply to the St George Area" published on 27th November 2007.

St George Area Strategy - Summary of Economic Analysis

Scenario	NPV of Costs (\$M)		
	Option 1A Mixed 132kV and 33kV strategy	Option 1B Full 132kV strategy	Option 2 Full 33kV strategy
Base case	168.7	208.0	173.9
25% reduction in substation costs	143.6	172.2	144.8
25% increase in substation costs	192.8	243.8	203.0
25% reduction in transmission mains costs	156.6	198.7	168.6
25% increase in transmission mains costs	178.3	217.2	179.1
25% reduction in distribution mains costs	163.6	203.0	169.6
25% increase in distribution mains costs	173.5	213.1	178.2
7% discount factor	181.0	224.4	189.2
10% discount factor	157.7	193.4	160.4
25% reduction in load growth	153.5	200.3	157.6
25% increase in load growth	170.2	215.4	178.0

Option 1A - Mixed 132kV and 33kV development is the least cost option under all analysed scenarios. This option includes the 33kV refurbishment of Riverwood Zone Substation including the replacement of 33kV gas feeders from Peakhurst STS and replacement of 11kV switchgear.