



FINAL REPORT

REPLACEMENT OF 33kV FEEDERS TO CONCORD ZONE SUBSTATION

3rd OCTOBER 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 Concord 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 Concord load area combined with the condition of the 33kV underground feeders supplying the zone from Homebush 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 Concord 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). Concord 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 supplying Concord Zone substation; and
- Option 2 – Conversion of Concord 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 Concord Zone substation.

EnergyAustralia's recommended action is to provide an increase in substation firm capacity at Concord Zone by the replacement of four underground 33kV feeders from Homebush STS at an estimated cost of \$6.64M. This recommendation is made based on the least cost test to provide medium to long term capacity for the Concord supply area.

1. BACKGROUND

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

- A discussion of emerging supply system limitations identified by EnergyAustralia that have led to the necessity for the replacement of the 4 feeders 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.

Concord 33/11kV zone substation was commissioned in 1955 and is situated in the Inner West supply area. Concord currently supplies parts of the following suburbs: Rhodes, Liberty Grove, Breakfast Point, Mortlake, Cabarita, Concord, Concord west and North Strathfield.

Load growth in the Concord area has resulted in the need to provide additional capacity at Concord 33/11kV zone substation. At present, Concord Zone is loaded above firm capacity in summer in addition to condition issues associated with the underground 33kV feeders from Homebush STS, 33kV circuit breakers and 11kV switchgear.

In accordance with the Inner West area strategy, the preferred supply option to address these capacity and condition issues is the refurbishment of Concord 33/11kV zone substation and retention of the 33/11kV supply voltage. This Final Report analyses the replacement of the 33kV feeders to provide additional firm capacity as the existing feeders limit the Concord 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 Concord 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.

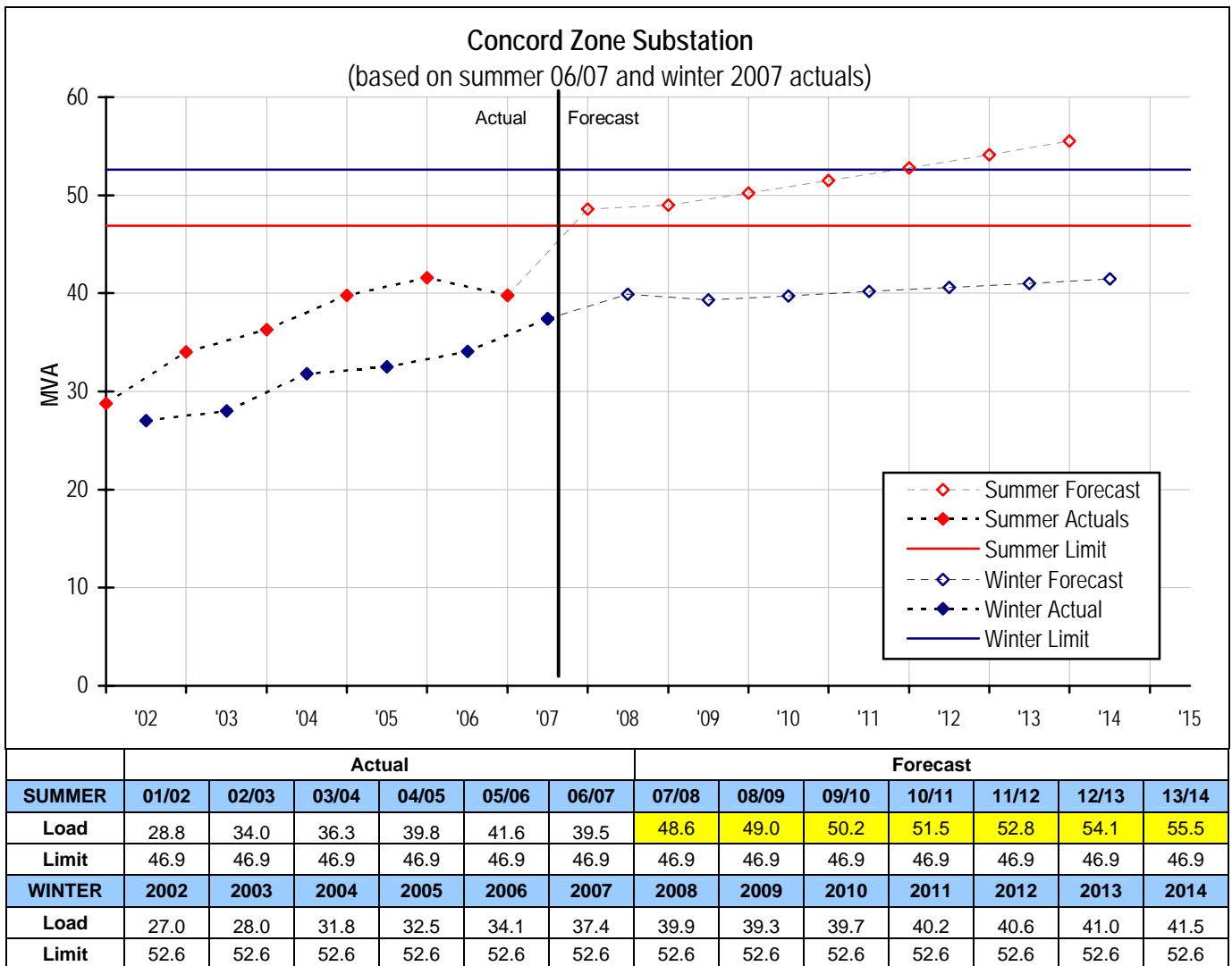
2.2. Description of Network Constraints

2.2.1. Concord Zone Substation Capacity Issues

Concord 33/11kV zone substation is supplied from the existing Homebush 132/33kV STS via four 33kV underground feeders 606, 607, 608 and 609, and is equipped with three 19MVA and one 15MVA 33/11kV transformers. Concord has a firm capacity of 46.9MVA in summer and 52.6MVA in winter, limited by the rating of the underground 33kV feeders. As the 33kV feeders are underground, risk is not applicable at Concord 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 Concord Zone is shown below:

Figure 2: Concord Zone Substation Load Forecast



Two spot loads and supplementary loading from the Concord Hospital in 2008 increased the supply requirement from the Concord Zone, resulting in a step increase in the 07/08 summer forecast as depicted in the charts. Concord Zone is presently loaded above firm capacity for summer (07/08) as a consequence to this additional

load. As the feeders are underground, risk is not applicable at Concord and consequently the zone is loaded above licence conditions by 1.7MVA for summer (07/08). The forecast indicates that this excess load will increase to 5.9MVA by November 2012 if the recommended actions within this report are not implemented.

2.2.2. Concord Zone Substation Equipment Condition Issues

Concord is supplied via four 33kV underground feeders: 606, 607, 608 and 609. The feeders 606 and 607 are paper insulated lead sheathed cables, while the feeders 608 and 609 are aluminium sheathed gas pressure cables. These cables form part of the overall population of cables to be progressively retired from the network due to their operational difficulties and failure rates.

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

3. TYPE OF AUGMENTATION

Concord Zone Substation is classified as a distribution system asset by the National Electricity Rules (the Rules). The replacement of the feeders at the Concord Zone Substation was calculated to be \$6.64M and will provide an 11MVA increase in firm capacity. Accordingly, since the proposed development strategy for the Concord 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 July 2008, establishing the potential to reduce demand at Concord Zone by 4.3MVA at a cost of \$2.2M. The deferral for one year would require a 5.8MVA reduction. It is therefore not considered reasonable that Demand Management could effectively defer the project.

Due to the forecast loading in the interim period up to the completion of the project, a further investigation of DM options will be undertaken to determine if cost effective risk reduction options can be implemented in parallel with the adopted build option.

4.2. Option 1 – Replacement of 33kV feeders to Concord Zone Substation

This option involves the replacement of the four existing 33kV underground feeders 606, 607, 608 and 609 supplying Concord Zone from Homebush STS. These works will provide a firm capacity increase of approximately 11MVA to the Concord Zone.

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

- Replacement of the existing 33kV feeders 606, 607, 608 and 609 with four new 33kV cables.

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 this project is \$6.64M (of which \$2.48M is related to growth). The Net Present Cost (NPC) is \$9.40M.

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

This option involves the conversion of the existing Concord 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 Concord Zone Substation is situated in close proximity to the 132kV feeder 900 (Mason Park STSS to Rozelle

STS). Feeder 900 is currently not capable of taking up the additional load but is due for replacement in November 2011, which coincides with the anticipated completion date of a new 132kV zone substation construction, resulting in minimal 132kV connection costs.

The new Concord 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 Concord would include:

- Establishment of a new 132/11kV zone substation on an adjacent site to the existing Concord 33/11kV zone;
- 132kV connection to the new 132/11kV zone substation;
- 11kV load transfers from the existing Concord Zone to the new 132/11kV substation; and
- Decommissioning of the existing Concord 33/11kV ZS.

The estimated capital cost of this project is \$28.06M. The Net Present Cost (NPC) is \$25.78M.

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 ¹ (\$M)	NPC (\$M) ²
Option 1 – Replacement of 33kV feeders and 11kV Switchgear at Concord Zone substation	6.64	9.40
Option 2 – Conversion of Concord to 132/11kV operation	28.06	25.78

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	10.00	26.64
10% discount factor	8.88	24.97
25% decrease in capital cost	8.92	19.33
25% increase in capital cost	9.88	32.22
25% decrease in load growth	9.40	25.78
25% increase in load growth	9.40	25.78

¹ Capital cost of work proposed by this Final Report

² Including future works covering the long term strategy for the area

Variations in load growth have no impact on the timing of the project supply options due to Concord 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 analysed scenarios and is thus recommended as the course of action to be taken by EnergyAustralia.

EnergyAustralia intends to replace the existing 33kV underground cables supplying Concord Zone from Homebush STS at an estimated cost of \$6.64M (of which \$2.5M is related to growth).

This work is forecast to be completed by early 2011. 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 – Replacement of 33kV feeders to Concord 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	16/17	17/18
STAGE 1 - Replace 33kV feeders from Homebush STS to Concord Zone													
Material & Major Equipment	1.78	1.93		1.93									
Civil works & Contracted services	2.28	2.52		2.01	0.50								
Labour	1.91	2.15		1.09	1.07								
STAGE 2 - Replace 11kV Breakers Concord Zone													
11kV Switchgear Replacement	3.08	6.68										3.34	3.35
O&M	0.35					0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	9.40	13.29											

Option 2 – Conversion of Concord 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	16/17	17/18
Concord 132/11kV conversion													
Establish new 132/11kV Concord Zone	20.65	23.81	0.35	6.79	14.84	1.83							
11kV transfers from Concord 33kV ZS to Concord 132kV ZS	1.38	1.75			0.13	1.62							
132kV Connection (Feeder 900)	1.57	2.00				2.00							
Decommission Concord 33/11kV zone													
Decommission Concord 33kV ZS	0.39	0.50				0.50							
O&M	1.79						0.30	0.33	0.33	0.33	0.33	0.33	0.33
	25.78	28.06											

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