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EnergyAustralia™
We're on it

1 May 2008

Mr Mike Buckley
General Manager
Network Regulation North Branch
Australian Energy Regulator
GPO Box 3131
Canberra ACT 2601

Dear Mr Buckley,

Contingent project application

I am pleased to submit EnergyAustralia's contingent project application for the replacement of feeders 908-909.

This application is the result of:

- the 2005 ACCC transmission revenue cap determination for EnergyAustralia;
- National Electricity Rule requirements; and
- consultation between AER & EnergyAustralia staff.

As foreshadowed in our recent discussions, the contingent project represents a large increase in total expenditure, from the $37m allowed in the 2004 ACCC determination. However, due to capex being deferred into the next regulatory period (compared to the forecasts that were determined by the ACCC in 2005) the revenue cap for 2004-2009 is reduced. The contingent project application contains the associated details and a net revenue decrease of $4.4m is proposed for 2008-09.

For 2009 to 2014, the transmission Rules (chapter 6A), including the contingent project regime, largely do not apply to EnergyAustralia, which means this application has reduced significance. However, whilst there is not an explicit requirement in the Rules, I expect that the AER's determination of this contingent project will be considered in the making of 2009-2014 distribution price determination.

The replacement of the feeders 908 & 909 is an integral component of the Sydney CBD network development plan agreed with TransGrid and delivering projects of this nature requires EnergyAustralia to overcome many hurdles. As such, there can be no delays before our construction phase commences. Therefore, with the regulatory test complete, we propose to immediately proceed into the construction phase.

Should the AER require further information to that already provided, or for any other enquiries, please do not hesitate to contact Mr Harry Colebourn on (02) 9260 4171.

Yours sincerely

Geoff Lilliss
Executive General Manager Network

Partner

EnergyAustralia™

Contingent project application

Replacement of feeders 908-909

29 APRIL 2008

Contingent Project Application
Replacement of Feeders 908-909

29 APRIL 2008

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1 Summary

On 27 April 2005, the Australian Competition and Consumer Commission (ACCC) set a revenue cap for EnergyAustralia's transmission network in which it allowed $37m capital expenditure for the replacement of feeders 908-909. A condition of the determination was that when detailed cost estimates for the replacement of the feeders were known with sufficient certainty, the $37m allowance would be re-determined.

The regulatory test for this project is now complete (Final Report – Attachment A) and the least cost option is to replace (and augment) the supply to Bunnerong from Kurnell, rather than from Canterbury. The total capital expenditure to undertake this option is about $140m, which is the result of a tender process and means that the capital cost is the most efficient ex ante estimate available for this option.

Now that EnergyAustralia has undertaken the regulatory test for this capital expenditure, it is able to apply to the Australia Energy Regulator (AER) for a contingent project determination. This application reassesses the required capital expenditure and proposes that the AER makes a determination to adjust EnergyAustralia's transmission revenue cap for 2008/09 from $131.21m to $126.82m by changing the X-factor for the final year from -11.29% to -7.56%.

1.1 The contingent project regime

As part of the implementation of Chapter 6A of the National Electricity Rules, the AEMC included provisions in the Rules (clause 11.6.19) which recognised that this replacement contingent project had already been nominated as triggered by the ACCC and made provisions for the AER to make adjustments to the revenue cap during the regulatory control period.

In the upcoming regulatory period (2009-2014), the contingent project regime does not apply to EnergyAustralia because its entire network capital expenditure will be assessed as "distribution" capex under chapter 11 of the Rules. Nevertheless, the transmission Rules currently apply to EnergyAustralia and the AER will make a contingent project determination under the transmission framework.

The AER's contingent project determination would then reasonably become part of its consideration in making its Network Price determination for the 2009-2014 regulatory period.

1.2 The need for replacement

Feeders 908-909, between Canterbury and Bunnerong, were installed in 1956 and have exceeded the 40 year life assigned to their asset category in the ACCC post tax revenue model (PTRM). Their poor condition was one of the main factors that resulted in the ACCC considering the contingent project to be triggered in 2005. In recent times, the feeders have had a history of repeated failures, with outages up to 100 days in duration.

1.3 Options for replacement

The combination of load growth and the retirement of these cables would result in a supply shortfall in the Bunnerong and Inner Metropolitan areas. To address this shortfall, a demand management (DM) investigation has been undertaken in conjunction with the assessment of the two main supply options. In addition, a number of variants of the supply

options have been considered. The outcome of these considerations is summarised in Table 1.

The least cost option, in the Final Report (Attachment A), is a pair of submarine cables with a capacity of 400MVA between Kurnell and Bunnerong. The project is primarily driven by a replacement need but it also provides increased capacity and therefore EnergyAustralia has undertaken the regulatory test consultation process, which is required for augmentations with an expected capital cost greater than $10m.

Table 1 – Options summary

Option	Description
Retire feeders (do nothing)	Reliability requirements would not be met in supplying Bunnerong and the inner metropolitan areas.
Demand management	This option considered using demand management (DM) to enable the existing cables to be retired while deferring the need for the cable replacement project for at least one year. To maintain the necessary reliability requirements, the DM solution would need to reduce load by 100MVA in the Bunnerong area and reduce load in the broader inner metropolitan area by a further 100MVA. This quantity is too great to expect it to be achieved cost effectively in this case. No further investigation of DM options was undertaken. Further DM opportunities are being examined in relation to associated future capital expenditure in the inner metropolitan area. It should be noted that EnergyAustralia's DM assessments include reviewing the potential for non-network supply options such as embedded generation.
Like-for-like replacement *Variants:* a. no augmentation - replace with only 200MVA b. no augmentation plus uprating feeders 910 & 911 c. augmentation to 400MVA d. augmentation to 400MVA and uprating feeders 910 & 910	To support the inner metropolitan area the feeders would have a required capacity of 400MVA when the new BSP is installed. Then to utilise this 400MVA feeders 910 & 911 would have to be each upgraded to 400MVA to support the inner metropolitan area. Under variants b. & d. require the BSP by 2011/12 and variants a. & c. require the BSP by 2010/11. TransGrid has advised that commissioning the new BSP by 2012 is not feasible. This means that none of the variants under this option would comply with EnergyAustralia's supply obligations. However variant d. is the closest to being a feasible option and therefore it has been included in the analysis for comparison purposes. The major works required under this option and included in the Final Report are: • uprate feeders 910-911 to 400MVA by 2008/09; • install new 400MVA feeders in 2009/10; and • build a new bulk supply point (BSP) in the Chullora area.
Replace the supply to Bunnerong from Kurnell *Variants:* a. no augmentation - replace with only 200MVA b. augmentation to 400MVA	Similar to the like-for-like option, 400MVA is required to support the supply to the inner metropolitan area when the new BSP is installed. The 200MVA non-augmentation variant requires the BSP by 2010/11. Also similar to the like-for-like option, commissioning the BSP by 2010/11 is not feasible, the result is variant a. is not feasible. Under variant b, as discussed in the Final Report, the major works required are: • the 400MVA feeders across the bay in 2009/10; and • build the new BSP in the Chullora area by 2012/13.

Note: this summary excludes capex common to all options

1.4 Incremental expenditure and revenue requirement.

The ACCC made an indicative allowance of $37m in capex for the replacement of feeders 908-909. The current least cost option includes capex of $144.25m[1] to replace those feeders. This difference in capex does not require any increase in the 2004-2009 revenue cap decision, because of the delayed timing of the expenditure compared with the allowance.

Whilst the replacement of the feeders will proceed during this current regulatory control period (2004-2009), the commissioning date has been deferred by a year since the time of the revenue cap decision. This has resulted in the majority of the capex, about $100m, being planned for 2009/10, which means that it does not earn a return until the following year under the PTRM. Given this increase in capex and revenue will commence in the next regulatory period, the revenue cap for this period will decrease slightly. However, EnergyAustralia is proceeding with this application to ensure that the AER can make a determination as intended by the ACCC determination and by clause 11.6.19 of the Rules.

Table 2 summarises the incremental capital and operating expenditure and the associated change in the revenue cap. The reduction in the revenue cap shown in table 2 can be achieved by changing the X-factor from -11.29% to -7.56% in the final year of the determination.

Table 2 – Incremental capex, opex and revenue

Expenditure (real $m 2004)	**04/05**	**05/06**	**06/07**	**07/08**	**08/09**	**09/10**
Incremental capex	-0.03	-0.76	-15.62	-6.3	32.1	96.43
Incremental opex	0.00	0.00	0.00	-0.02	3.50	n/a
Changed revenue cap	0.00	0.00	0.00	0.00	(4.39)	n/a

[1] This is in real $2004 for comparison with the allowed capex. This includes $96.43m in 2009-10.

2 Background

2.1 ACCC decision

Appendix B of the ACCC's revenue cap decision sets out the process, by which it was anticipated that EnergyAustralia's contingent projects would be: firstly, assessed; and secondly; rolled into the regulatory asset base as at 30 June 2009 in the upcoming regulatory reset. There are 5 stages to the ACCC's process:

(1) Invoke the contingent event

This part of the process was for EnergyAustralia to identify the drivers of contingent project and show that the need to proceed with its development had eventuated. However, only a brief discussion of the need is provided here because the ACCC has already indicated that this project has been triggered.[2] This stage also includes the development of feasible options. EnergyAustralia developed a range of initial options to arrive at a viable set of options for full consideration. A number were ruled out because they resulted in a network configuration that would not meet current reliability requirements.

(2) Investment appraisal

This part of the process was for EnergyAustralia to undertake an economic assessment of the viable options. The ACCC noted that the investment appraisal may be the subject of public consultation.

EnergyAustralia has undertaken the full regulatory test consultation, which requires the economic assessment of any new large transmission asset. The findings of the regulatory test are attached in the Final Report (Attachment A).

(3) Set an incentive

Under the ACCC decision, the contingent project regime would result in the AER determining a forecast capex to be rolled into the RAB for 5 years, with the actual depreciated value rolled in after that. That is, for 5 years EnergyAustralia would have the incentive to under spend the forecast because overspending the forecast would result a loss of both 'return on' and 'return of' that asset for the 5 years.

This application outlines the capex, opex and revenue required to undertake the replacement project for the AER to set the incentive. EnergyAustralia's expenditure and revenue requirement for this incentive is set out in chapter 5.

(4) Invest in the contingent project

In this stage, EnergyAustralia would be able to choose how to best manage its expenditure given the ACCC's incentive. The implementation will commence shortly after the AER's determination.

[2] ACCC, *Decision – ACT and NSW transmission revenue cap EnergyAustralia 2004-05 to 2008-09*, 27 April 2005, page 149.

(5) Implementation of the contingent project approval

This stage was to deal with the rolling into the RAB at the 2009 regulatory reset. This will form part of the AER's determination for the 2009-2014 regulatory reset.

2.2 Rule requirements

In relation to stage 3 – setting the incentive – the Rules have some specific provisions that must be considered. On 16 November and 21 December 2006, the Australian Energy Market Commission (AEMC) amended chapter 6 of the National Electricity Rules (the Rules) and implemented a new Chapter 6A to apply to the economic regulation and pricing of transmission networks.[3] As a consequence, Savings and Transitional provisions were introduced in chapter 11 of the Rules in relation to:

- existing transmission revenue cap decisions (clause 11.6.2)
- the contingent project regime to be applied to EnergyAustralia (11.6.19).

These transitional provisions, generally, provide that the new chapter 6A Rules should not affect the administration of any existing transmission revenue cap decisions that were made under a previous version of the Rules/Code. However, in the case of EnergyAustralia, some aspects of the new Chapter 6A provisions, relating to cost pass throughs and re-openings, were applied to the existing ACCC determination. The contingent project regime was largely grandfathered to enable the AER to make a contingent project determination with a variation that allows the revenue cap to be amended before the 2009 reset.

In developing this application, EnergyAustralia has considered what the AER must determine to set the incentive in stage 3 in developing this application. To understand what information the AER would need, EnergyAustralia has looked to the 2005 determination, AER's advice and the effect of the transitional Rules for guidance. The Rules provide specific guidance as to what the AER must determine and it follows that EnergyAustralia should provide information to allow the AER to make its determination.

[3] National Electricity Amendment (Economic Regulation of Transmission Services) Rule 2006 No.18

Table 3 – AER determination and information requirements

Rule Clause	AER determinations	Information provided
11.6.19(d)(1)(i)	Total capex required for the project including the allowance that has already been provided in the ACCC decision.	EnergyAustralia has provided the best estimates of capex and opex for the replacement project available at this time. The total capex that EnergyAustralia proposes is $143.37m*. These are based on latest tendered prices. EnergyAustralia has also provided various other planning reports in relation to the alternative options to allow the AER to determine that EnergyAustralia has chosen the most efficient option.
11.6.19(d)(1)(ii)	The incremental capex and opex above that allowed in the ACCC decision.	As above, the capex information is based on tender prices. Opex information provided is based on the EnergyAustralia opex model that was used to set EnergyAustralia's transmission maintenance expenditure in the ACCC's 2005 determination.
11.6.19(d)(1)(iii) 11.6.19(f)	The likely commencement and completion dates of the contingent project. The intended date for commencing the contingent project must be during the current regulatory control period	EnergyAustralia has provided information about the replacement project and its capital expenditure. Given the need to replace the feeders by the summer of 2009/10, EnergyAustralia will formally commence the project immediately after the AER's decision on this application. The expected completion date is planned to be shortly prior to when the replacement is needed for the summer of 2009/10.
11.6.19(d)(1)(iv) and (2)	The incremental revenue as a result of the contingent project.	The incremental revenue was derived using the ACCC's PTRM and the incremental capex and opex requirements. All other input parameters are set equal to that of the ACCC's 2005 decision. The one exception is the debt margin, which was changed by AER determination on 21 December 2007.
11.6.19(d)(1)(v)	The Maximum Allowed Revenue (MAR) for each of the remaining years in the regulatory period, including the incremental revenue from 11.6.19(d)(1)(iv).	The incremental MAR for the remaining year of the regulatory period, 2008/09, is -$4.39m. This is proposed to be achieved by changing the X-factor for that year to -7.56% from -11.29%

* real $m 2004 to be consistent with the ACCC 2005 revenue cap decision.

2.3 Process

The project will constitute a reliability augmentation for the purposes of the National Electricity Rules and is a new large transmission network asset under Chapter 5 of the Rules.

EnergyAustralia has undertaken a regulatory test consultation on its proposed solution as required by Rule 5.6.6. On 5 October 2006, EnergyAustralia published its Application Notice showing that the least cost option to replace feeders 908-909 (and meet minimum

network performance requirements) was to replace their function by supplying load at Bunnerong with a submarine cable from Kurnell.[4]

No submissions or comments were received on the Application Notice. Since then EnergyAustralia has progressed its planning and the proposed solution is still the submarine cable from Kurnell to Bunnerong. On 29 April 2008, the Final Report (Attachment A) was put on its website.

[4] EnergyAustralia, *Replacement of 132kV Feeders 908 & 909 Canterbury to Bunnerong: Application Notice*, 5 October 2006

3 Replacement need

3.1 The existing 908-909 cable circuits

The existing 132kV feeders were installed in 1956 and supply up to 180MVA to the Bunnerong substation from Canterbury and also to support the inner metropolitan area. They are 3 core gas pressurised cables with a route length of about 14km. The cables are of an obsolete type, which creates issues with obtaining spares, as this type of cable is no longer manufactured. As a result, it is becoming increasingly difficult to repair these cables.

There have been several extended failures of the existing feeders over the last 10 years where repairs have been undertaken. Table 4 shows the outage history of feeders 908-909 since 2002. Being an underground cable, restoring a fault outage or repairing a leaking cable requires an extended outage to locate the fault, excavate, repair, re-pressurise and finally reinstate.

It should be noted that the existing feeders have, with maintenance, exceeded the standard life of 40 years as modelled by the ACCC's post tax revenue model (PTRM).

Table 4 – Failure history

Start		End		Durations (days)	Comment
Date	**Time**	**Date**	**Time**		
8/12/2002	4:45 am	31/03/2003	11:59 pm	113.80	Fault - UG Cable
23/08/2004	9:00 am	27/10/2004	11:30 am	65.11	Fault - Gas Leak
27/03/2005	12:00 pm	1/07/2005	5:00 pm	96.21	Planned - Gas Leak
12/09/2005	7:08 am	23/09/2005	10:00 am	11.12	Fault - UG Cable
5/01/2006	6:31 am	5/01/2006	6:50 pm	0.51	Fault - Gas Leak
6/01/2006	9:02 am	20/02/2006	8:02 pm	45.46	Planned - Gas Leak

It is of an increasing likelihood that, if these feeders fail again, they will fail irreparably. EnergyAustralia is operating these feeders to ensure that they provide service for the maximum period. However, it must also ensure that system security and reliability is maintained. EnergyAustralia's replacement strategy will ensure system security and reliability is not compromised, whilst also being the most cost effective option.

3.2 In the wider Sydney supply area

The replacement of feeder 908-909 is an integral component of ensuring adequate supply to Sydney. Figure 1 shows EnergyAustralia's 132kV network In Sydney. The area of concern (known as the Inner metropolitan transmission network) is the area covered by the 132kV system in Figure 1, supplied from TransGrid's Beaconsfield, Haymarket, Sydney South and Sydney North 330/132kV substations or bulk supply points (BSP).

A number of the 132kV circuits in the inner metropolitan transmission network form part of the EnergyAustralia transmission network, as they carry a component of "tidal" energy flows that pass through the state's transmission network as loads and generation patterns change. It should be noted that the existing feeders have been accepted by the ACCC as

part of the transmission RAB. That is, by definition, they operate in parallel and support the higher voltage transmission network.

This area includes the Sydney CBD, which under normal conditions is predominantly supplied from Haymarket and Beaconsfield BSPs. However, as these BSPs are each supplied from a single 330kV feeder, a failure of either of these feeders requires supply from Sydney South and/or Sydney North via the 132kV feeders.

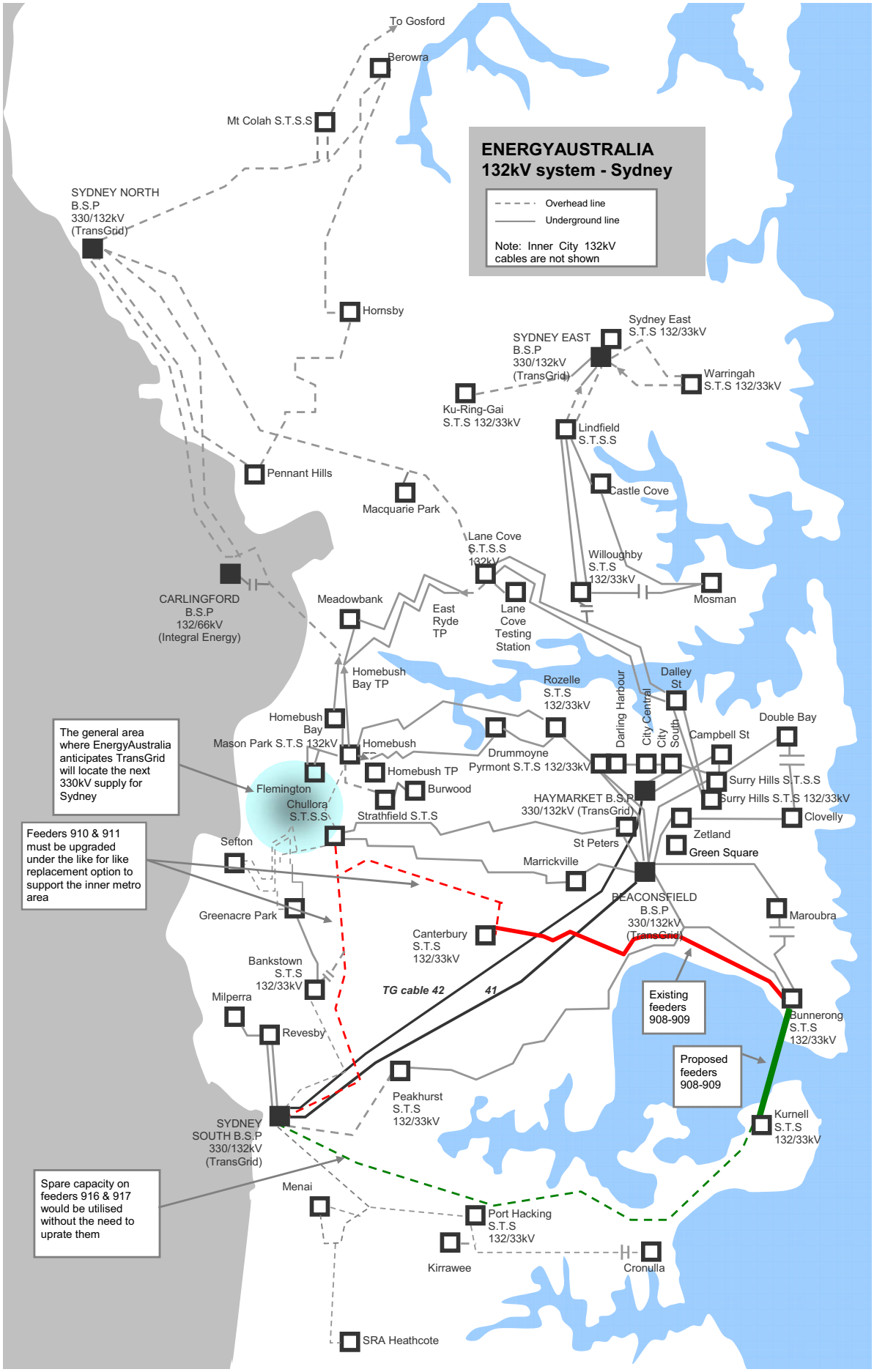
The current configuration, which can be seen in figure 1, only has three main 132kV supplies from Sydney South to Beaconsfield via:

- Canterbury STS (the current path including feeders 908, 909, 910 & 911);
- Peakhurst STS; and
- Chullora STS and then via St Peters and Marrickville.

The existing 908-909 132kV circuits from Canterbury to Bunnerong, which need to be decommissioned, form an element of this supporting supply system and their capacity needs to be replaced to continue to supply the Bunnerong demand after their decommissioning. The preferred arrangement to replace the Bunnerong supply from TG's Sydney South BSP is via Kurnell and includes an augmentation component to ensure that EA's 132kV network is able to support load in the inner metropolitan area. This arrangement will utilise the existing high capacity overhead lines (feeders 916 & 917) that supply Kurnell from Sydney South.

This proposal forms part of a complex sequence of works that has been planned jointly with TransGrid which, with currently forecast load growth, is expected to require a third 330kV supply to the inner city area from its Sydney West substation by 2012/13.

Figure 1 – EnergyAustralia's 132kV system in Sydney



4 Regulatory test

In undertaking an options analysis, EnergyAustralia had to consider feasible options that minimised the cost of replacing the feeders and satisfied the requirements of the Rules and its license. The outcome of the regulatory test is summarised below, however the final report setting, out the full details of the regulatory test, is contained in Attachment A

4.1 Reliability standard

EnergyAustralia and TransGrid jointly apply an enhanced "N-1" criteria to inner metropolitan transmission network. This standard is part of EnergyAustralia's Network Management Plan, which is required to be implemented by the Electricity Supply (Safety and Network Management) Regulation 2002.

The enhanced N-1 criteria is, based on the number of elements involved and their likelihood of failure, the reliability standard for the transmission system is that the system will be capable of meeting the peak demand under the following contingencies:

- The simultaneous outage of a single 330kV cable and any 132kV feeder or 330/132kV transformer; or
- An outage of any section of 132kV busbar.

This means that:

- Under normal system conditions, all elements must be loaded to within their recurrent cyclic ratings;
- System loadings under first contingency outages will remain within equipment recurrent cyclic ratings without corrective switching other than for automatic switching or "auto-closing";
- Cyclic load shedding (in areas other than the CBD) may be required in the short term following a simultaneous outage of a single 330kV cable and any 132kV transmission feeder or 330/132kV transformer in the inner metropolitan area until corrective switching is carried on the 330kV or 132kV systems; and
- The system should be designed to remove the impact of a bus-section outage at existing transmission substations. New transmission substations should be designed to cater for bus-section outages.

4.2 Decommissioning

The hypothetical 'do nothing' case is to simply decommission the aged feeders. If that were the case, the network would not meet the required reliability standard. Thus, EnergyAustralia must undertake some corrective action upon the decommissioning of feeders 908-909.

In deciding the appropriate corrective action the Bunnerong and the inner metropolitan must be understood. Currently, Bunnerong STS has a secure capacity of 320MVA and is normally supplied by four 132kV feeders:

- Canterbury STS (feeders 908 & 909);
- Peakhurst STS (feeder 91L); and

- Beaconsfield West BSP (feeder 91M/3).

A 5th feeder (265) from Maroubra is connected to Bunnerong; however the capacity of this feeder is limited and is normally open.

The forecast load at Bunnerong STS is shown in Table 5.

Table 5 - Bunnerong load forecast

Year	Load MW (PF=0.94)
2008/9	275
2009/10	282
2010/11	290
2011/12	298
2012/13	306
2013/14	313
2014/15	320

Studies have found that upon decommissioning feeders 908-909, with the above load growth, the capacity of the remaining 132kV supplies would be insufficient to supply Bunnerong, under the reliability requirement agreed with TransGrid.

Table 6 illustrates the different constraints that would bind in 2009/10 when different outages occur under only an N-1 reliability standard in the Bunnerong supply area. Under the enhanced N-1 standard that is applied in this case, there are further limitations that arise, which have not been listed here. These have a wider impact on the inner metropolitan area, rather than just on the Bunnerong supply area. As a result EnergyAustralia must take action.

Table 6 - Do nothing constraints 2009/10

Contingency outage	Constrained element	Shortfall (MVA)
Feeder 91L O/S	Feeder 265 overloaded	2
Feeder 91M/3 O/S	Feeder 265 overloaded	111
Feeder 264 O/S	Feeder 91M/3 overloaded	86
Feeder 265 O/S	Feeder 91M/3 overloaded	34

4.3 Supply options

In addition to the do nothing option, EnergyAustralia initially considered supplying Bunnerong from the following 132kV sources:

- Peakhurst – was not viable because the distance from Peakhurst to Bunnerong was longer. Thus the cost of installing a feeder(s) on an underground route would be greater.
- Maroubra or Beaconsfield BSP – were not viable because they would not provide an alternative path for load flows from Sydney South to Beaconsfield West to support the Inner Metropolitan 132kV Network.

- Canterbury (the current supply situation) – a 'like-for-like' route option was, at the time, considered feasible and thus, is considered in the economic assessment.
- Kurnell (proposed solution) – this is a viable option and was the shortest route. Although it was not a 'standard job', involving undersea crossing of the mouth of Botany Bay, the potential benefits of supplying Bunnerong from Kurnell made it worth investigation. Subsequently it is also considered in the economic assessment.

In considering the feasible network solutions, EnergyAustralia considered whether there would be benefit in deferring the large capex amounts through the use of demand management. Demand management was also considered in the economic assessment and is discussed further below.

The options assessed are summarised in Table 7 below. The Final Report sets out the least cost assessment of the options under the regulatory test, which is Attachment A to this application.

Table 7 – Options summary

Option	Description
Retire feeders (do nothing)	Reliability requirements would not be met in supplying Bunnerong and the inner metropolitan areas.
Demand management	This option considered using demand management (DM) to enable the existing cables to be retired while deferring the need for the cable replacement project for at least one year. To maintain the necessary reliability requirements, the DM solution would need to reduce load by 100MVA in the Bunnerong area and reduce load in the broader inner metropolitan area by a further 100MVA. This quantity is too great to expect it to be achieved cost effectively in this case. No further investigation of DM options was undertaken. Further DM opportunities are being examined in relation to associated future capital expenditure in the inner metropolitan area. It should be noted that EnergyAustralia's DM assessments include reviewing the potential for non-network supply options such as embedded generation.
Like-for-like replacement *Variants:* a. no augmentation - replace with only 200MVA b. no augmentation plus uprating feeders 910 & 911 c. augmentation to 400MVA d. augmentation to 400MVA and uprating feeders 910 & 910	To support the inner metropolitan area the feeders would have a required capacity of 400MVA when the new BSP is installed. Then to utilise this 400MVA feeders 910 & 911 would have to be each upgraded to 400MVA to support the inner metropolitan area. Under variants b. & d. require the BSP by 2011/12 and variants a. & c. require the BSP by 2010/11. TransGrid has advised that commissioning the new BSP by 2012 is not feasible. This means that none of the variants under this option would comply with EnergyAustralia's supply obligations. However variant d. is the closest to being a feasible option and therefore it has been included in the analysis for comparison purposes. The major works required under this option and included in the Final Report are: • uprate feeders 910-911 to 400MVA by 2008/09; • install new 400MVA feeders in 2009/10; and • build a new bulk supply point (BSP) in the Chullora area.
Replace the supply to Bunnerong from Kurnell *Variants:* a. no augmentation - replace with only 200MVA b. augmentation to 400MVA	Similar to the like-for-like option, 400MVA is required to support the supply to the inner metropolitan area when the new BSP is installed. The 200MVA non-augmentation variant requires the BSP by 2010/11. Also similar to the like-for-like option, commissioning the BSP by 2010/11 is not feasible, the result is variant a. is not feasible. Under variant b, as discussed in the Final Report, the major works required are: • the 400MVA feeders across the bay in 2009/10; and • build the new BSP in the Chullora area by 2012/13.

4.4 Related capital works

The related works that are common to all options do not affect the identification of the least cost outcome. As such, the costs of these works are not included in the assessment. Any related works that are not be required in some options or the timing of their requirement is different have been included in the least cost assessment.

Appendix A discusses these related works and explains why they are required and are illustrated in Figure 2 below.

4.5 Least cost option

The following table (8) shows that supplying Bunnerong from Kurnell is shown to be the least cost option. Further detail can be found in the Final Report for the Regulatory Test, Attachment A.

Table 8 – Least cost option

Description	Capex	NPV of cost
Replace supply to Bunnerong from Canterbury (400MVA)	162.4	545.1
Replace supply to Bunnerong from Kurnell (400MVA)	151.5	494.9

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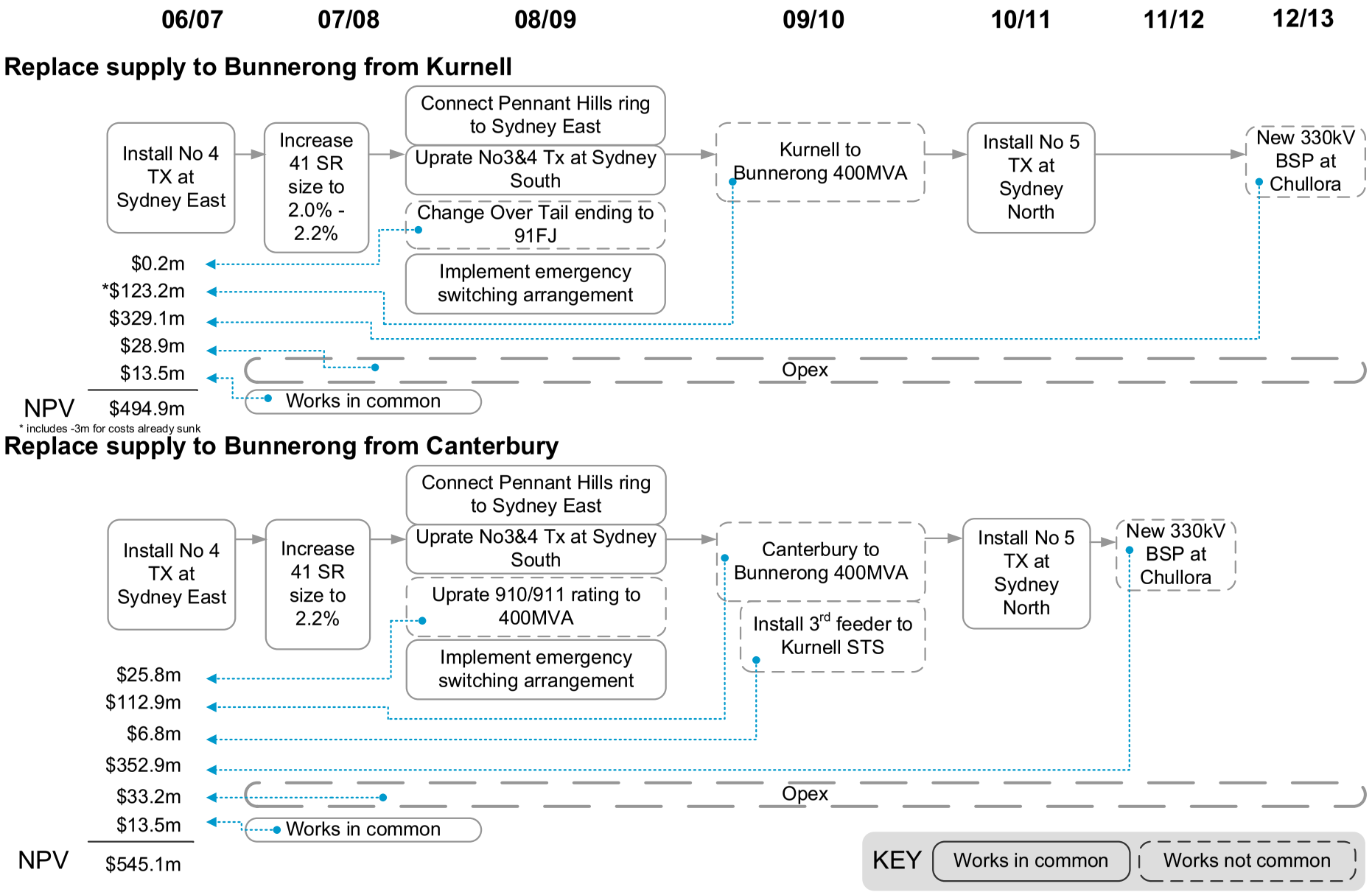
Figure 2 - Replacement options and related works



5 Expenditure and revenue

Given that the supply to Bunnerong from Kurnell has been shown to be the least cost option, the incremental revenue requirement has been modelled on the capex and opex associated with replacing the supply to Bunnerong from Kurnell at 400MVA. EnergyAustralia has applied the ACCC's PTRM to calculate the revenue requirements. In addition, the ACCC made a capex and opex allowance in its decision. To avoid double counting EnergyAustralia has also netted off of these amounts.

5.1 Capital Expenditure

This contingent project is only in relation to additional transmission expenditure. It should be noted that the replacement project will result in some other assets (on the path created between Bunnerong, Kurnell and Sydney South) being transferred from distribution to transmission for the purpose of pricing at the next reset, assuming the status quo Rule arrangements.

In the 2004 IPART determination the Kurnell substation was included as a distribution asset, thus that determination implicitly allowed for capital and operating expenditure at Kurnell. To avoid any double counting, the major capex at Kurnell has not been included in this application. However, the minor connection works at Kurnell were included in the ACCC $37m allowance. Therefore the incremental cost of the minor connection works is included

5.1.1 Indicative contingent allowance

At the time of the last determination EnergyAustralia provided a set of high level capex estimates to the ACCC, shown in Table 9.

Table 9 - Allowed capex

Capex ($m real 2004)	2004/05	2005/06	2006/07	2007/08	2008/09	Total
132kV Underground feeders	0.4	1.5	16.4	12.4	6.0	36.7

This capital expenditure profile was based on the following expenditure:

- Submarine cable installation;
- Land cable installation;
- Substation costs (minor connection costs at Kurnell and Bunnerong); and
- Project management costs.

The latest capex estimates in Table 10 have been calculated on the basis and include actual expenditure on planning and option development in 2004-2007, which will be capitalised to the new assets regardless of the option.

Table 10 - Latest capex estimates

Capex ($m real 2004)	04/05	05/06	06/07	07/08	08/09	09/10
Latest capex estimate	0.4	0.7	0.80	6.0	38.2	96.4*
Less: previous allowance	0.4	1.5	16.4	12.4	6.0	-
Total capex added to the PTRM	-0.0	-0.8	-14.8	-6.4	32.2	-

* Note: there is $96.4m capital expenditure planned for 2009/10, which is not part of the current regulatory period, however it is relevant to the AER's determination of total capex required. See Rule clause 11.6.19(d)(1)(i).

5.2 Operating Expenditure

EnergyAustralia forecasts its operating expenditure based on its capital expenditure. In the previous regulatory reset PB Associates (March 2004 – Section 4.1.1) commented on the modelling undertaken by EnergyAustralia in relation to capital and operating expenditure relationships. It describes the fundamental approach used to forecast opex based on capex forecasts.

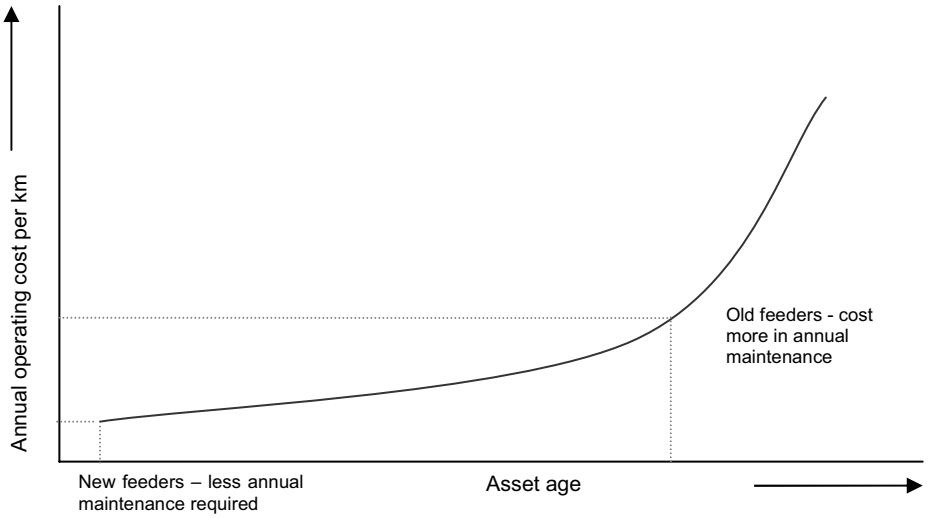
> *In EnergyAustralia's case, cost curves for inspection, correction and breakdown (O&M of system assets) were determined from base case figures (year 0 new assets) provided by SKM, and actual figures derived from EnergyAustralia's current costs, assets and asset ages. EA has produced cost equations from these two data points for each asset type using exponential logarithmic equations. These extrapolations of the two data points will not reflect actual costs but should provide a sound basis for the average costs of O&M based on relatively small variations around the average.*
>
> *EA's model applies the average age profile for each class of asset to the O&M cost curve to determine the expected O&M for each year based on a prescribed capital expenditure levels. Actual O&M will be a function of the groups of assets in each age category and the associated O&M for that quantity and age. An average age plotted on the cost curve will give a reasonable approximation for a large and diversified asset group, but may also understate the marginal impact on O&M resulting from changes in capital expenditures.*

In simple terms, EnergyAustralia collates the past operating cost of its different assets and with this information it can determine the average annual operating expenditure required for a given type of asset at a given age. It has also determined that operating expenditure in the first year of an assets life is different to the annual average for the remainder of its life.

At the time of the revenue cap decision there was no explicit operating expenditure allowance associated with the 908-909 replacement project. However, using the same model, it was possible to net off an implicit operating expenditure allowance to avoid double counting.

EnergyAustralia's approach to maintenance cost modelling determines a replacement cost per kilometre of separate classes of asset (in this case 132kV feeder) based on the age profile of the feeder. The Age – Cost curve, which displays an increasing maintenance cost with age, is illustrated in Figure 3.

Figure 3 - Example operating cost profile



The maintenance costs of the old 132kV feeders from Canterbury to Bunnerong have been assigned the same maintenance cost profile as the new 132kV feeders from Kurnell to Bunnerong. However, the old feeders have a significantly higher annual maintenance cost, because of their greater age, than the new assets.

The full indicative capex allowance of $37m for feeders 908-909 was based on installing '132kV underground feeders'. Therefore, the same basis is used for estimating the maintenance costs in this application. At the time of determination of the revenue cap, the existing feeders were to be retired by 2008/09, when the new feeders were commissioned. Their maintenance cost would have been removed from the final year and replaced with the lower cost of maintaining new replacement cables.

Given the construction of the new feeders has been deferred by one year, the old high maintenance feeders must be maintained in service for an extra year. For this reason, the operating cost will be higher than that estimated at the time of the determination. Maintenance of the existing feeders is now estimated to cost $3.5m in 2008/09, which would not have occurred under the indicative scenario in the revenue cap decision.

Table 11 shows the operating expenditure implicitly allowed in the ACCC transmission revenue cap for the indicative replacement of feeders 908-909 and the incremental change as a result of deferring the retirement of the old cables.

Table 11 - Opex for 908-909

Opex ($real 2004)	**Feeders**	**04/05**	**05/06**	**06/07**	**07/08**	**08/09**
Revenue cap allowance	Existing	2,200k	2,500k	2,800k	3,100k	-
	New	-	-	-	8k	8k
Contingent project	Existing	2,200k	2,500k	2,800k	3,100k	3,500k
	New	-	-	-	-	8k
Incremental opex		***0***	***0***	***0***	***-8k***	***3,500k***

5.3 Required revenue

The net effect of the actual capex and opex on the revenue cap is a net decrease in required revenue during the current regulatory control period. The net decrease has been summed up here as a decrease in revenue of $4.39m in the 2008/09 financial year. Alternatively this can be expressed by a change of the current X-factor from -11.29% to -7.56%.

Table 12 – Total expenditure required to supply Bunnerong from Kurnell

Expenditure ($m nominal)	04/05	05/06	06/07	07/08	08/09
Incremental capex	-0.0	-0.8	-15.6	- 6.4	32.2
Incremental opex	0.00	0.00	0.00	(0.01)	3.49
Existing revenue cap[#]	91.3	98.6	106.5	115.1	131.2
New revenue cap	91.3	98.6	106.5	115.1	126.8
Changed revenue cap	0.0	0.0	0.0	0.0	(4.39)*

***The entire change in the revenue requirement resulting from the changed capex over the regulatory period has been summed into a single change in 2008/09.**

[#]The existing revenue cap is derived from the X-factor for 2008/09 of -11.29% determined by the AER in its revocation decision dated 21 December 2007.

Appendix A Required capital works

The following table describes the works associated with both options. The costs of these works are the same for all options and have not been considered explicitly within this application.

Related works	Reason[5]
Replace the series reactor on TransGrid's cable 41 to 2.2 per cent	Summer 2007/08: In all options an outage of the 132kV feeder 91M/1 will result in an overload on cable 41. This can not be resolved with switching arrangements, but is planned to be resolved by increasing the cable 41 reactor impedance to 2.2%.
Connect the Pennant Hills ring to Sydney East	Summer 2008/09: In all options an outage of a Sydney North transformers 1, 2, 3 or 4 will result in the remaining transformers being overloaded, This will be resolved by switching the Pennant Hills ring to Sydney East.
Uprate transformers 3 and 4 at TransGrid's Sydney South BSP	Summer 2008/09: In all options an outage of Sydney South BSP transformers 3 or 4 will result in an overload of Sydney South BSP transformer 3 or 4. This will be resolved by uprating the transformers from 250MVA to 375MVA.
Implementing emergency switching arrangements	Summer 2008/09: An outage on any of transformers 1, 2, 5 or 6 at Sydney South BSP will result in the remaining transformers being overloaded. This is resolved by undertaking works to allow Transformer number 4 to be switched onto the same busbar To pickup the excess load.
Change over tail ending at Sydney South to 91FJ	Summer 2008/09: Under the Kurnell replacement option, an outage of feeder 910 or 911 the remaining feeder and associated transformer will be overloaded. This could be resolved by uprating feeders 910-911. However, a less costly solution would be to connect feeders 910-911 to the main busbar and tail end feeders 91F-91J to transformers 3 and 4 at the Sydney South BSP. Given the outages required for the work at Sydney South in 2008/09, it would make sense to undertake this work at the same time as shown in figure 2.
Uprating EnergyAustralia's feeders 910-911to 400MVA [6]	Summer 2008/09: Under the Canterbury replacement option, an outage of feeder 910 or 911 the remaining feeder and associated transformer will be overloaded. In this case it can not be resolved by changing the tail ending to 91F-91J. It could be resolved by uprating feeders 910-911 to 400MVA each.
Install a number 4 transformer at EnergyAustralia's Sydney East substation	Winter 2010/11: In all options an outage of any of the existing three transformers at the Sydney East substation, would result in an overload on the remaining transformers. This was/will be fixed with an additional transformer being installed at Sydney East.
Refurbish Kurnell 132kV busbar	A number of 132kV connections are required at Kurnell for the Desalination plant[7], a future Zone substation, a 3rd 132/33kV transformer and additional feeders.

5 This assume the enhanced "n-1" criteria, thus all scenarios involve an outage of cable 41 or 42.

6 Includes re-stringing, bay upgrade at Canterbury and associated opex.

7 The desalination plant had not received planning approval at the time the Application Notice was published on 5 October 2006. At that time the timing of the Kurnell busbar work was dependant on the option chosen. Now that the

Related works	Reason[5]
Installing Number 5 transformer at EnergyAustralia's Sydney north substation	Summer 2010/11: An outage of transformer 1, 2, 3 or 4 at Sydney North will result in the remaining transformers being overloaded, even after switching to the Pennant Hills ring. This can be resolved by installing a standby (5th) transformer at Sydney North.
New BSP in Chullora area. [8]	Summer 2011/12: Under the Canterbury replacement option, an outage of Sydney South BSP transformer 4 results in both cable 41 and Sydney South BSP transformer 3 will be overloaded. The new BSP is required. Summer 2012/13: Under the Kurnell replacement option, an outage of any of the transformers at the Sydney South BSP will result in transformers 1, 2, 5 and 6 being overloaded. Also an outage of feeder 91M/1 will result in cable 41 being overloaded.
3rd Feeder to Kurnell	Under the Canterbury replacement option a 3rd feeder to Kurnell STS will be required to maintain supply while the refurbishment of the overhead tower line 916/917 is undertaken. The Kurnell replacement option does not require this feeder because the Kurnell – Bunnerong feeders can be used to maintain supply.

desalination plant has been given planning approval the Kurnell busbar works will proceed independently of the 908/909 replacement.

8 Includes TransGrid capex at Holroyd and Potts Hill and EnergyAustralia capex at Potts Hill and the associated TransGrid and EnergyAustralia operating expenditure.

Attachment A Final Report

FINAL REPORT

REPLACEMENT OF 132KV FEEDERS 908 & 909 CANTERBURY TO BUNNERONG

29th April 2008

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EXECUTIVE SUMMARY

This paper has been prepared to report on the assessment of options for the replacement of 132kV feeders 908 and 909 Canterbury to Bunnerong, in accordance with Clause 5.6.6 (h) of the National Electricity Rules (the Rules). The report recommends the replacement of 908 and 909 with 2 x 200MVA feeders from Kurnell to Bunnerong, which will be classified as a new large distribution network asset under the National Electricity Rules.

An Application Notice paper on the projected limitation and options for corrective action was published on 5th October 2006. This Application Notice paper included a preliminary application of the Regulatory test to options which had been identified to address the projected limitations. No submission was received in response to the Application Notice paper.

Feeder 908 & 909 are two 132kV gas pressure insulated cables that were installed by the Electricity Commission in 1956 between Bunnerong and Canterbury subtransmission substations. EnergyAustralia has made a decision to replace these cables based on their condition, historical reliability and the availability of spare cables and joints

To provide a secure and reliable electricity supply for existing customers and new developments in the Inner Metropolitan area, EnergyAustralia is faced with a primary need to replace these feeders and a secondary 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 in accordance with Schedule 5.1 of the Rules and EnergyAustralia's DNSP licence conditions.

This report covers the following issues:

Section 1 provides a background of the Inner Metropolitan load area.

Section 2 presents EnergyAustralia's service standards for the area and describes, in detail, the nature of the growing load in the area, the issues affecting the supply network in the area and the need for augmentation of supply to the area.

Section 3 describes the proposed augmentation and its status under the Rules. The proposed Kurnell to Bunnerong feeders will be classified as a transmission network asset by the Rules, and the proposed augmentation component is classified as a large network asset as it involves expenditure of above $10M.

Section 4 describes the options that were considered, including Demand Side Management. The options investigated include:

- Option 1 – Establishment of two new 200MVA feeders from Kurnell to Bunnerong and retire 908 & 909
- Option 2A – Replacement of feeder 908 & 909 Canterbury to Bunnerong with a single 180MVA feeder
- Option 2B – Replacement of feeder 908 & 909 Canterbury to Bunnerong with a single 180MVA feeder and upgrade 132kV feeders 910 and 911 to 400MVA

Section 5 present the results of Net Present Cost (NPC) and sensitivity analysis and the options ranked.

Section 6 concludes that the most cost effective strategy within the regulatory test is 'Option 1 – Establishment of two new 200MVA feeders from Kurnell to Bunnerong and retire 908 & 909'.

The conclusion to replace feeders 908 & 909 with feeders from Kurnell to Bunnerong is made based on the least cost test (in accordance with the regulatory test) to provide increased future capacity and to meet EnergyAustralia's reliability standard. EnergyAustralia's recommended action is to install the Kurnell to Bunnerong feeders for an estimated nominal cost of $160 million.

1. BACKGROUND

1.1 Purpose and Scope

This Final Report has been prepared to provide advice to Registered Participants and Interested Parties of EnergyAustralia's recommended action for the replacement of 132kV feeders 908 & 909 from Canterbury Sub-transmission Substation (STS) to Bunnerong STS.

It includes:

- a discussion of the supply system limitations identified by EnergyAustralia that have led to the necessity to identify feasible options for replacement and augmentation of the network;
- a discussion of the service standard that has been adopted for planning purposes;
- a description of potential options which have been identified for development of the electricity supply in the area; and
- a detailed preliminary cost effectiveness analysis in net present value (NPV) of each of these options, carried out in accordance with the requirements of the regulatory test.

1.2 Electricity Supply Network

The 132kV supply to the Sydney Metropolitan Region is provided by a radial 132kV distribution network supplied from Sydney East Bulk Supply Point (BSP) and an interconnected 132kV transmission network linking Beaconsfield West BSP, Haymarket BSP, Sydney North BSP and Sydney South BSP. The 330kV supply to Beaconsfield West BSP and Haymarket BSP are each provided by a single underground feeder.

Figure 1 indicates the coverage of EnergyAustralia's 132kV assets. However, only part of the 132kV network indicated is classified as transmission for the purposes of this report, the remainder is classified as distribution.

The area of concern in this final report is the transmission 132kV cables 908 and 909 linking Bunnerong STS and Canterbury STS. These are two 132kV gas pressure insulated cables that were installed by the Electricity Commission in 1956 and are now obsolete technology. Each feeder has a route length of 15.4km and an emergency rating of 90MVA.

These feeders provide part of the 132kV supply to Bunnerong STS and provide transmission capacity between TransGrid's Beaconsfield West BSP and Sydney South BSP (through Canterbury STS and Peakhurst STS).

Bunnerong STS supplies the southern part of the eastern Sydney load area, (more than 30 suburbs) and has a peak load of more than 300MVA.

1.3 Supply Strategy

In order to provide a safe and reliable supply of electricity, a long term strategy must satisfy the need to:

- Replace and/or retire ageing infrastructure
- Provide additional supply system capacity to enable existing infrastructure to be reconstructed and meet projected load growth

An integrated replacement and augmentation strategy is required to provide:

- sufficient spare capacity to enable infrastructure to be decommissioned for replacement or retirement
- low cost capacity to meet long term growth

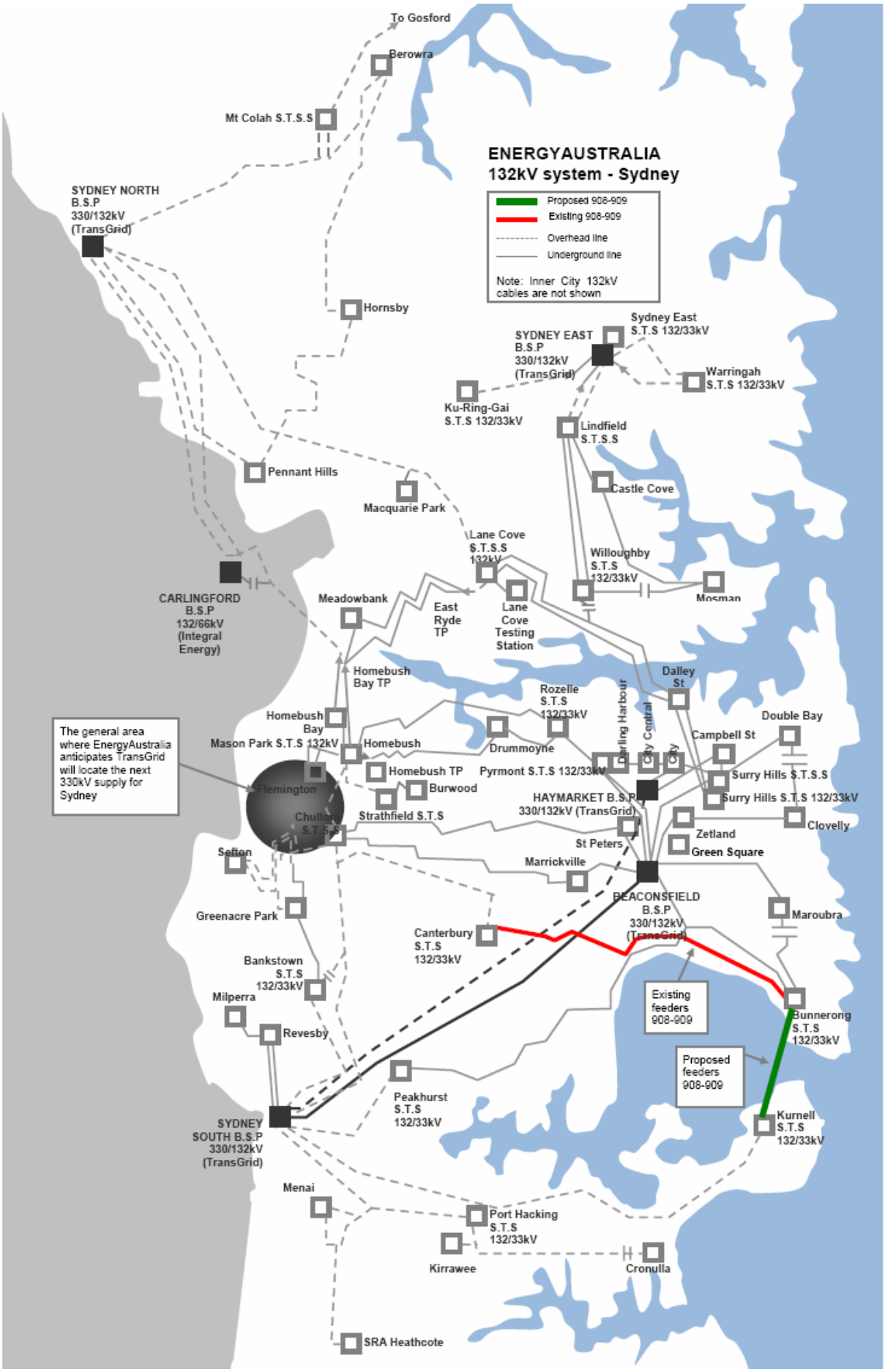


Figure 1: EnergyAustralia Sydney 132kV System

The majority of Sydney's Inner Metropolitan area is supplied by an interconnected 132kV transmission network linking Beaconsfield West BSP, Haymarket BSP, Sydney North BSP and Sydney South BSP. Peak demand on this area is more than 3100MW and demand growth is expected to average 3.3% p.a. over the next 10 years. As demand growth continues the failure of either of the 330kV cables from Sydney South to Beaconsfield or Haymarket) and any of approximately thirty other feeders may result in loads exceeding the rating of some remaining network elements.

It is forecast that in the medium term it will be necessary to establish a new 330/132kV BSP in the Chullora area to provide additional 330kV capacity. As the expected cost of this supply point is substantial there are significant economic benefits arising from the deferral of this investment. It is expected that it should be possible to cost effectively defer the next 330/132kV BSP until 2012/13 through the implementation of a number of staged smaller investments.

Feeders 908 and 909 are an important component of the Inner metropolitan transmission system. The cables have a history of failure, resulting in prolonged outages of these feeders. EnergyAustralia has decided to replace these two cables due to their condition and associated history of long periods of being out of service. The replacement of these feeders provides an opportunity to cost effectively provide additional capacity. The provision of this increased capacity is one of the key components of the strategy to defer the next 330/132kV BSP.

As an alternative to like for like replacement of feeders 908 & 909, EnergyAustralia has identified through analysing several system options, an option to replace the Canterbury-Bunnerong cables with two feeders between Kurnell and Bunnerong, which involves a substantial reduction in route length. The Kurnell-Bunnerong option would have added advantages in that it would improve the security of supply to the Kurnell peninsula and facilitate major refurbishment of the double feeder tower line presently supplying Kurnell, which is required within the next 5 years.

2. ISSUES

2.1 Applied Service Standard

EnergyAustralia and TransGrid have jointly agreed to an enhanced N-1 criterion for the inner metropolitan transmission network. The jointly developed target reliability standard for the transmission system is that the system will be capable of meeting the peak demand under the following contingencies:

a) The simultaneous outage of a single 330kV cable and any 132kV feeder or 330/132kV transformer; or

b) An outage of any section of 132kV busbar.

This means that:

- Under normal system conditions, all elements must be loaded within their recurrent cyclic ratings;
- System loadings under first contingency outages will remain within equipment recurrent cyclic ratings without corrective switching other than for automatic switching or "auto-closing";
- Cyclic load shedding (in areas other than the CBD) may be required in the short term following a simultaneous outage of a single 330kV cable and any 132kV transmission feeder or 330/132kV transformer in the inner metropolitan area until corrective switching is carried on the 330kV or 132kV systems;
- The system should be designed to remove the impact of a bus-section outage at existing transmission substations. New transmission substations should be designed to cater for bus-section outages;

2.2 Replacement of feeders 908 & 909

Feeders 908 & 909 are two 132kV BI Callender Cable (BICC) gas pressure insulated cables that were installed by the Electricity Commission of NSW in 1956 (and transferred to EnergyAustralia in 1990) between Bunnerong and Canterbury subtransmission substations via Sydney Airport. The total route length of each feeder is 15.4km.

Approximately 20% (3km) of the route length is located within the boundary of Sydney Airport, running along/across service roads, taxiways, and road tunnels. Any work in this area requires supervision by an airport safety observer, security clearance for all personnel, and severe restrictions on work activities/hours. These conditions greatly extend repair times and costs.

Approximately 800m of the cable route is direct-buried under traffic lanes in General Holmes Drive, and the cables cross General Holmes Drive in a tunnel alongside two sewer outfall channels.

2.2.1 Asset Condition

Feeder 908 & 909 are EnergyAustralia's oldest 132kV cables (over 50 years old), and are the only remaining examples of this type of obsolete gas cable technology on the EnergyAustralia system. The only other similar 132kV gas cables installed in Sydney were feeders 901 & 902 (Homebush-Rozelle 9km, installed in 1953) and 918 (Pyrmont-Rozelle 6km, installed in 1958), which were all abandoned in the early 1980s following repeated faults and gas leaks.

Gas leaks have occurred at joints and sealing ends, or on the cable. On a long cable route, locating a gas leak is a difficult and time-consuming exercise. The repair time of these feeders is at least 4 months and hence failures seriously impact on supply security of the Inner Metropolitan area.

EnergyAustralia currently has limited spare cable, dating from the original 1956 contract, plus four straight joints. A simple fault repair will typically require 10m of cable and two joints. Spare cable can no longer be sourced and joints would need to purpose designed and manufactured.

In the last 4 years, six outages have been required to rectify gas leaks or other faults. Due to the large number of outages and the extended repair times the availability of these feeders has reached a level where replacement of these feeders is required.

As a result of the above operating history EnergyAustralia has determined the need to replace these two feeders.

2.3 Description of Network Constraints

It is forecast that the 132kV inner metropolitan network will exceed the applied service standard within the next 5 years, requiring the installation of a new 330/132kV BSP. Hence the options for replacing feeders 908/909 need to consider economic benefits arising from the deferral of the new BSP.

2.3.1 Load Forecast

EnergyAustralia has previously published details of its load forecasts in its Annual Electricity System Development Review and the Transmission Annual Planning Report.

The following table presents EnergyAustralia's 2004/2005 forecast load (MW) on the Inner Sydney Metropolitan 132kV network, as published in the Application Notice of October 2006.

Table 1: Inner Metropolitan Transmission Demand Forecast (MW) 2004/2005

Actual 2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
2967	3139	3283	3288	3471	3568	3651	3742	3822	3904	3990

The above forecast was used as an input to the original load flow studies carried out on each option, the results of which where presented in the Application Notice of October 2006.

These studies were reviewed in February 2007 using EnergyAustralia's 2005/2006 forecast (shown in Table 2) the results of which are shown in Figure 3. The results are similar to the one presented in the Application Notice except additional work is required under some options to install a 5th transformer at Sydney North BSP.

Table 2: Inner Metropolitan Transmission Demand Forecast (MW) 2005/2006

Actual 2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
3169	3373	3507	3608	3708	3812	3929	4037	4152	4266	4385

The common works under each option has been excluded from the economic analysis, as these are independent of the strategy chosen.

3. APPLICABLE NATIONAL ELECTRICITY RULES REQUIRMENTS

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.

Feeders 908 and 909 are classified as transmission system assets by the National Electricity Rules (the Rules). In addition, the preferred option considered involves the construction of a new interconnection between TransGrid 330/132kV BSP and would change asset classifications at Kurnell from distribution to transmission.

The proposed works involve both a replacement and an augmentation component. The overall timing of the proposed work is driven by the need to replace existing 908 & 909 feeders due to their condition, whilst the increase in system capacity is required to meet minimum network performance standards and is thus regarded as a reliability augmentation.

Consequently, as the proposed replacement option for feeders 908 and 909 involves augmentation expenditure in excess of $10 million it is regarded by the Rules as a new large transmission network asset.

A network service provider is required to consult on proposals to construct a new large transmission network asset. Accordingly, EnergyAustralia released an Application Notice on the 5th October 2006 to consult on possible options. No submissions were received in response to this Application Notice. This Final Report has been prepared to advise on EnergyAustralia's recommended action. Note that EnergyAustralia has consulted separately over the community aspects of the proposed development and has received planning approval to proceed on the basis outlined in this report.

EnergyAustralia does not consider the proposed works will have any material Inter-Network Impact. It does impact TransGrid's network; however this has been addressed through joint planning.

4. OPTIONS CONSIDERED

EnergyAustralia has investigated a number of options through a series of studies to identify the least cost solution of replacing feeders 908 & 909 either utilising existing network arrangement from Canterbury to Bunnerong or by forming a new arrangement from Kurnell to Bunnerong. The possible options are impacted by:

- The crossing of Botany Bay
- Cable routes from Canterbury to Bunnerong
- Sydney Airport
- Capacity of the feeders

A number of construction options were consider including cable routes around Sydney Airport and the crossing of Botany Bay by submarine cable, horizontal directional drilling and tunnels.

The following section describes the final options considered, including non-network options.

4.1 Consideration of Demand Management

EnergyAustralia does not consider that it is possible to avoid or defer the retirement of the existing 908 and 909 feeders. A review of the potential for demand management to defer the need for the proposed cable replacement was undertaken in May 2006 and reviewed, on the basis of revised information, in March 2008.

The analysis considered the situation after retirement of 908 & 909 without the cable replacement. For the system to meet the applicable design criteria, it found that demand would need to be reduced by at least 200MVA, including at least 100MVA located at Bunnerong STS. It evaluated the economic benefits over a longer timeframe including consequent effects on the timing of the Chullora bulk supply point investment. While the potential savings were reasonably high, it was considered unreasonable to expect that such a large reduction could be identified and developed in the required locations.

A joint EnergyAustralia / TransGrid investigation is currently underway to develop a cost effective demand management strategy that will enable the need for the Chullora BSP to be deferred. This will have no effect on this project.

4.2 Original Options – Application Notice

The Application Notice in October 2006 presented the potential options to address the issues affecting the supply network including non-network options. The following three augmentation options were presented at the time.

- Option 1: Establishment of a new double feeder 2 x 200MVA feeder from Kurnell to Bunnerong and retire 908 & 909
- Option 2A: Replacement of feeders 908 & 909 Canterbury to Bunnerong with a single feeder 180MVA feeder
- Option 2B: Replacement of feeder 908 & 909 Canterbury to Bunnerong with a single feeder 180MVA feeder and upgrade feeder 910 and 911 to 400MVA

4.3 Recent Developments

Since the publication of the Application Notice in October 2006 there have been a number of developments which have affected the options.

4.3.1 Kurnell Sub transmission Station

EnergyAustralia has committed to the replacement of the Kurnell Sub-transmission Station 132kV busbar due to an increased number of 132kV connections required in the Kurnell Peninsula area. These 132kV connections are required for Customer Connections and local asset replacement strategies. As a result the refurbishment of Kurnell STS as presented in the original options is now considered to be common to all options.

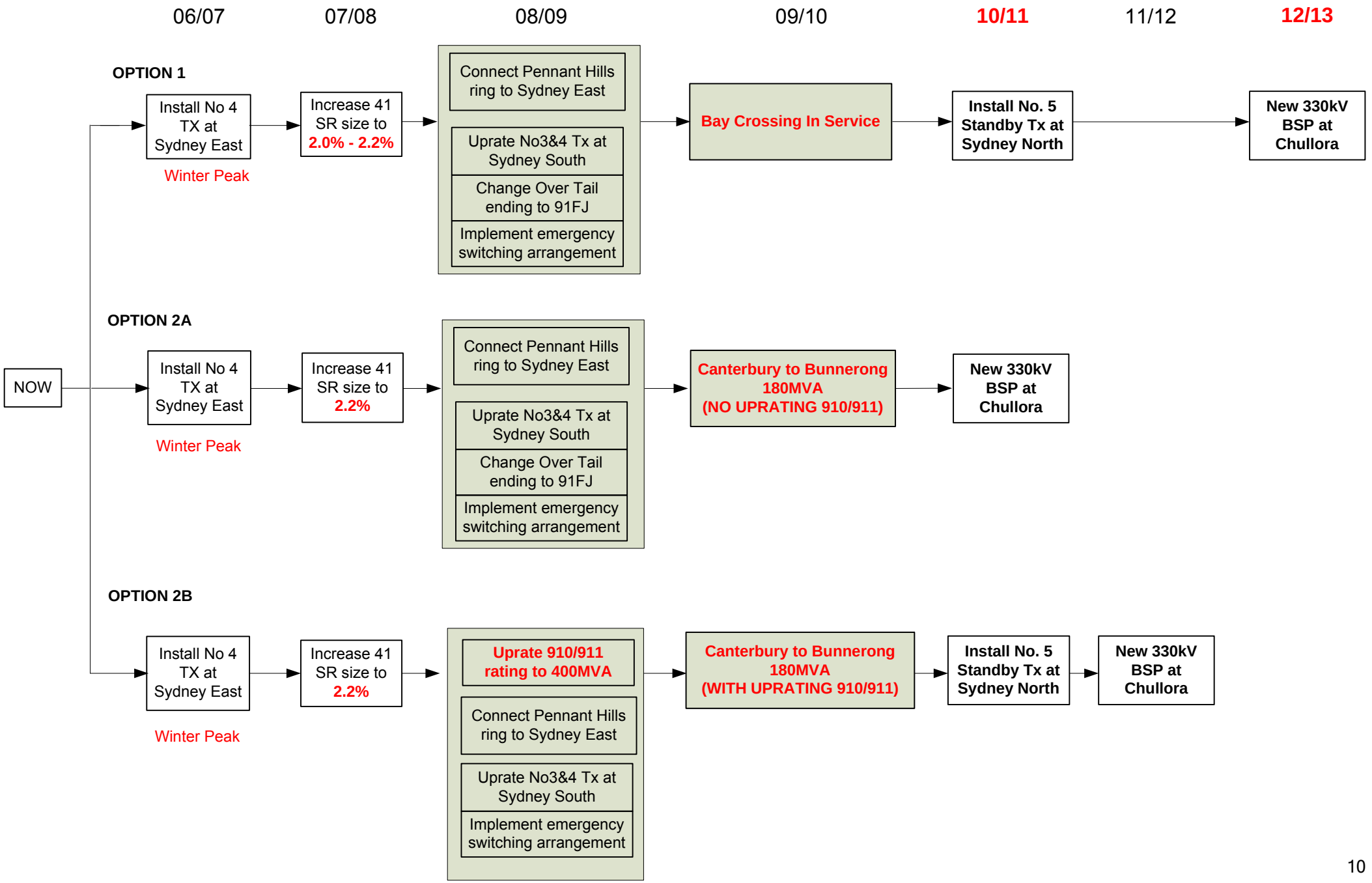
4.3.2 Contingent Project Application

EnergyAustralia commenced discussion with the AER about a contingent project application in late 2006 for Option 1. The options study presented in the Application Notice was reviewed as part of this process. This resulted in additional work under option 1 and option 2B to install a 5th transformer at Sydney North BSP.

The AER also requested additional information on the following options, and asked if EnergyAustralia had considered Network requirements after the installation of the next BSP. This is discussed in the strategic planning section below.

- 2 x 200MVA option from Canterbury to Bunnerong
- 1 x 200MVA option from Kurnell to Bunnerong

Figure 2: Staging of Options for decommissioning of 908/909 feeders that were considered under Application Notice



4.3.3 Development of the future Chullora Bulk Supply Point

TransGrid have further developed the next Bulk Supply Point, to be located in the Chullora area and the latest estimates have been incorporated into this final report. TransGrid have also undertaken preliminary investigations and have advised that it is not considered feasible to advance the Chullora BSP from 2012/13. Hence Options 2A and 2B are not considered feasible in terms of time. As a result Option 2A has been ruled out as not feasible, as it requires the BSP to be advanced 2 years, and an economic analysis has not been undertaken on this option. Option 2B, while considered not feasible in terms of time, has been included in the economic assessment as a hypothetical benchmark for completeness.

4.3.4 Tenders for the Kurnell to Bunnerong Feeders

Tenders have been received for the installation of the Kurnell to Bunnerong Feeders. These prices have been incorporated into this Final Report.

4.3.5 Development of strategic planning

EnergyAustralia has advanced its strategic planning of the Inner Metropolitan Transmission Network until 2020. This includes various 132kV cable replacements and joint planning with TransGrid regarding future transmission capacity. These strategic plans are based on the installation of 2 x 200MVA feeders from Kurnell to Bunnerong (Option 1), as this was the preferred option as presented in the Application Notice of October 2006. As a result of this planning, following the installation of the next BSP at Chullora in 2012, another 330kV solution is required in 2016 to support the Inner Metropolitan System.

Due to higher than anticipated tender prices for the Bay crossing option, a review of the Canterbury to Bunnerong options (2A and 2B) was undertaken to determine if these would support EnergyAustralia's strategic plans. The review found that while the installation of a single 180MVA feeder would be required prior to the commissioning of the Chullora BSP, (which would be required by 2011/12, under Option 2B), a 2nd 132kV feeder would be required between Canterbury and Bunnerong to support the Inner Metropolitan transmission system after the Chullora BSP. In addition to utilise this additional feeder, the overhead feeders 910 and 911 would have to be upgraded to 400MVA capacity each.

Similarly it is considered that a Kurnell to Bunnerong 1 x 200MVA feeder would not provide sufficient capacity after the installation of the Chullora BSP, which would be required by 2010/11 under this scenario, which is not feasible.

Hence Option 2B Canterbury to Bunnerong has been changed to a new Option 2 so that the network will function until about 2016. This is when the next 330kV supply, following the Chullora BSP, is planned to be commissioned. This new option includes:

- upgrading of overhead feeders 910 and 911
- installation 2 x 200MVA feeders (equivalent to the capacity of Option 1)

4.4 Revised Options – Final Report

The options considered in this Final Report are detailed below.

4.4.1 Option 1: Establish a new Kurnell to Bunnerong 400MVA feeder

The scope of this option is identical to the one presented in the Application Notice.

This option would require the installation of 2 x 200MVA feeders across Botany Bay from Kurnell STS to Bunnerong STS by 2009/10. The new feeder would consist of sections of land cable and submarine cable as shown in Figure 3.

Details of the route are:

- Route Length of 7.25kms consisting of 4.65kms of land route and 2.6kms of submarine route.
- Land route: 2 feeders comprising 200MVA cable in trench

- Submarine route: 2 feeders each comprising of 200MVA submarine cable
- Cable buried 3m deep under the shipping channel for protection from anchor drag
- HDD bore used for 0.5kms under the La Perouse headland

Additional works would also be required under this option to install new feeder bays at Bunnerong STS.

The replacement of Kurnell STS has been authorised and is now considered common to all options as discussed above. Hence additional work is no longer required for Kurnell STS for connections and fault level issues.

The nominal cost of this option is estimated at $160 million ($151.5 million real) for the feeders, based on

- $153 million Kurnell – Bunnerong feeders and reactors.
- $5 million for connections at Bunnerong STS.
- $2 million for connections at Kurnell STS.

The augmentation component of this project has been estimated at approximately $28 million (nominal). This solution avoids the need to install a new feeder for the refurbishment of 916/917 tower line.

Figure 3: Cable Route Kurnell to Bunnerong

This option defers the installation of the new 330/132kV BSP until 2012 as shown in Figure 2.

Since the publication of the Application notice in October 2006 this option formed the basis of EnergyAustralia's longer term plans, beyond the next BSP.

4.4.2 Option 2: Replace 908/909 from Canterbury to Bunnerong with 2 x 200MVA feeders

This option would involve the replacement of the 132kV feeder 908/909 Canterbury to Bunnerong with 2 x 200MVA feeders by 2009/10, in conjunction with an upgrade of the 910/911 tower line (Sydney South – Canterbury) to 400MVA per feeder. The cable would follow as closely as possible the existing routes shown below in Figure 4. Details of the route are:

- Route Length of 13.6kms,
- Consist of 2 feeder of 200MVA cable installed in conduit,
- Route crosses some sensitive areas including Sydney Airport, Kogarah Golf Course and Foreshore Drive,
- Directional Bores under rivers, creeks, major roads and railway lines.

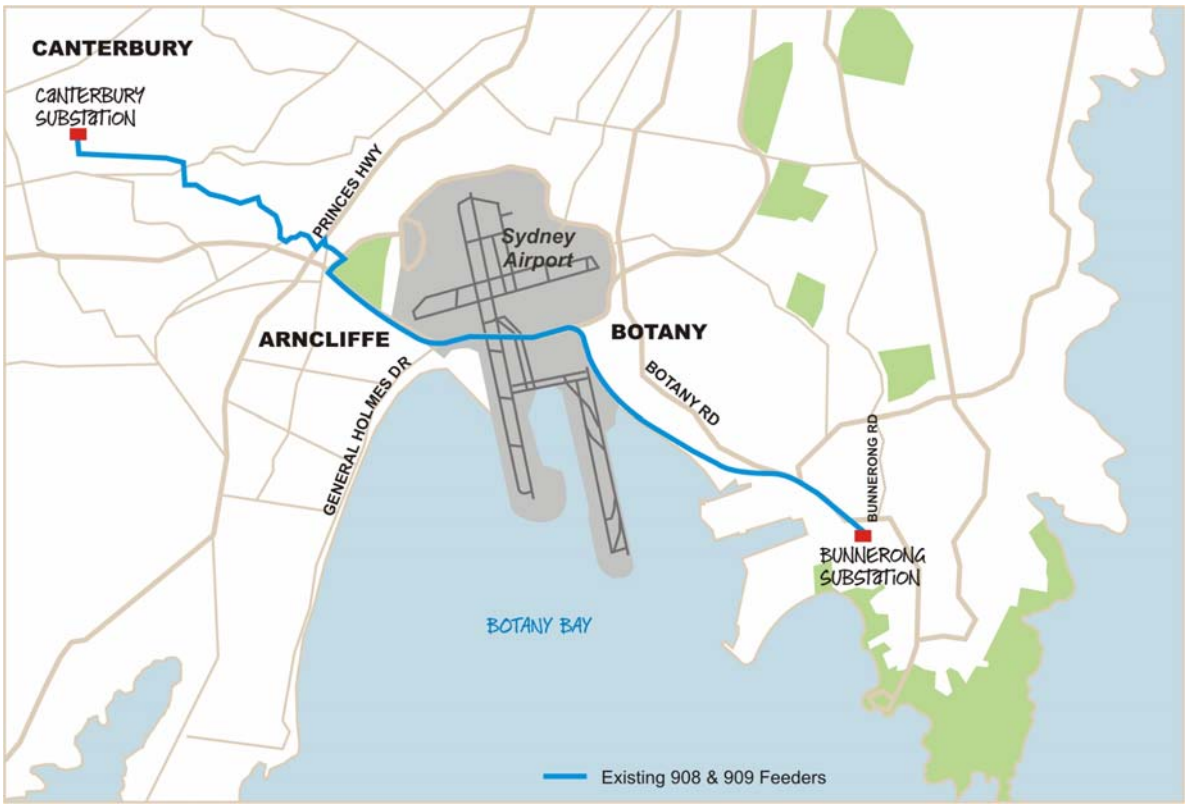


Figure 4: 908/909 Cable Route

Additional works for feeder bays to connect the 2 x 200MVA feeder would also be required at Bunnerong STS and Canterbury STS.

New feeder bays would also be required at Canterbury for the connection of the upgraded 910/911 feeders

The nominal cost of this option is estimated at $170 million, ($162.4 million real) based on

- $132.9 million Canterbury – Bunnerong feeders.
- $5 million for connections at Bunnerong STS.
- $3.7 million for connections at Canterbury STS.
- $28.4 million to upgrade 910/911

The augmentation component of this project has been estimated at approximately $75 million, which is the incremental cost of providing a 2nd feeder and the cost of the 910/911 upgrade.

The airport lease costs advised in the Application Notice, no longer apply under this option due to recent agreements now in place.

Under this strategy a new BSP would need to be established in 2011, which TransGrid has advised is not feasible.

Under this option it would be necessary to install a new 132kV feeder to Kurnell STS to facilitate the future refurbishment of the 916/917 tower line. Additionally the refurbishment of Kurnell STS is now considered common as previously discussed.

5. ANALYSIS OF OPTIONS

5.1 Application Notice - October 2006

It was concluded in the Application Notice dated 5th October 2006 that construction of a new feeder between Kurnell and Bunnerong (Option 1) was the least cost option (as shown in Table 3). Accordingly, EnergyAustralia favoured Option 1 and it was decided to continue with the development of tunnel and call for tenders.

No submissions were received after the publication of the Application Notice.

Table 3 – Application Notice Summary October 2006

Option	Description	Initial Capital Cost ($m)	NPV of Costs ($m)
Option 1	Establish a new Kurnell to Bunnerong 400MVA feeder	102.0	272.2
Option 2A	Replace 908/909 with a single feeder 180MVA feeder	73.4	294.0
Option 2B	Replace 908/909 with a single feeder 180MVA feeder and upgrade 910/911 feeders to 400MVA	105.5	305.1

5.2 Final Report - April 2008

Since the Application Notice was published in October 2006 there have been a number of developments as discussed in section 4.3, which has resulted in modifications being made to the options previously presented. This Final Report refers to the revised options as presented in section 4.3 using the latest costs obtained from TransGrid and from the market for the Bay crossing.

Further analysis of the schedules found that:

- Option 1 has been granted planning approval and has completed environmental assessments;
- It is not feasible to install the Canterbury – Bunnerong feeders by the required time of summer 2009/2010; and
- TransGrid have advised that it is not feasible to advance the Chullora BSP to 2011.
- Upgrade of 910/911 is not considered feasible.

Hence Option 2 is no longer considered viable in terms of time.

This option has been included in the economic assessment as a hypothetical benchmark for completeness.

5.3 Base Case Analysis

The analyses of the options presented in this report are based on the costs incurred by each strategy until the new BSP is established.

The works common to all strategies, as indicated in the option study (Figure 2), have been excluded from this analysis as they equally affect each option and are hence considered independent projects. This includes the installation of the 4th transformer at Sydney East, Feeder 41 reactor changes, Sydney South transformer changes and the rearrangement of the Pennant Hills 132kV ring.

The results of the base case economic analysis, shown in Appendix A, are summarised in Table 4

Table 4 – Final Report Base Case Economic Analysis

Option	Description	Initial Capital Cost ($m real July '07)[1]	NPC of Costs ($m real July '07)[2]
Option 1	Establish a new Kurnell to Bunnerong 400MVA feeder	151.5	494.9
Option 2	Replace 908/909 with a 2 x 200MVA feeder and upgrade 910/911 feeders to 400MVA	162.4	545.1

Detailed analysis is provided in Section 8.0

The analysis above indicates that the NPC of Option 1 is the least cost solution.

5.4 Sensitivity Analysis

The base case and the range over which sensitivity checks were conducted are shown in Table 5. The results of sensitivity analysis are contained in Appendix B.

Table 5: Base Case Values and Range of Values Used in Sensitivity Checks

Parameter	Base Case Value	Sensitivity Checks at
Discount Rate	8.5%	7% and 11%
Growth Rate – new BSP timing		BSP 1 year earlier BSP 1 year later
BSP Costs	100%	75% and 125%
Underground Feeder Costs	100%	75% and 125%
Submarine/Tender Costs	100%	125%

The results from the sensitivity analysis indicate that Option 1 remains the least cost option under all sensitivity checks.

6. CONCLUSION

This report recommends the replacement of feeders 908 & 909 with feeders from Kurnell to Bunnerong. This recommendation is made based on the least cost test (in accordance with the regulatory test) to provide increased future capacity and to meet EnergyAustralia's reliability standard.

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.

[1] Capital cost of work proposed by this Application Notice. Includes 132kV feeders and connections
[2] Including future works and 3rd party costs covering the long term strategy for the area, shown in Appendix A

7. CONTACT DETAILS FOR ENQUIRIES

Persons wishing to dispute the contents, assumptions, findings, or recommendations of this Final Report are referred to clause 5.6.6 (j) of the Rules.

Disputing parties must lodge a notice of the dispute in writing to the AER and provide a copy of the dispute notice to EnergyAustralia within 30 business days of the publication of the Summary of this final report on NEMMCO's website.

EnergyAustralia's copies of the dispute notices regarding this Final Report should be forwarded to:

Executive Manager Asset and Investment Management
Email: Network_Investment@energy.com.au

Or in writing to:
570 George St,
SYDNEY 2000

8. APPENDIX A – ECONOMIC ANALYSIS OF BASE CASE

Notes: All figures in the table below are quoted in July 2007 real dollars [millions]

Option 1: Establish a new Kurnell to Bunnerong 400MVA feeder										
Proposed Projects	**NPC ($m)**	**Capital ($m)**	**2006/07**	**2007/08**	**2008/09**	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**
Reconfigure 91F & 91J	0.2	0.2	-	-	0.2	-	-	-	-	-
Sydney South emergency switching arrangement	0.2	0.2	-	-	0.2	-	-	-	-	-
Install 2 x 200MVA feeders Kurnell to Bunnerong	126.2	146.6	-	4.1	38.8	103.7	-	-	-	-
Additional (3) Bays at Bunnerong South	4.7	4.9	-	2.4	2.3	0.1	-	-	-	-
Sydney North 5th Transformer	8.6	10.9	-	-	-	0.8	10.1	-	-	-
Holroyd to Chullora cables	101.1	150.5	-	-	-	-	-	11.3	139.1	-
Establishment of Chullora BSP	220.9	328.8	-	-	-	-	-	24.7	304.1	-
BSP connection at Chullora	7.1	10.7	-	-	-	-	-	0.8	9.9	-
Removal of Sunk Costs	(3.0)	(3.1)	-	(3.1)	-	-	-	-	-	-
Total Proposed Capital Cost	**466.0**	**649.8**	**-**	**3.5**	**41.6**	**104.6**	**10.1**	**36.9**	**453.1**	**-**
Committed Projects										
Kurnell STS refurbishment	-	32.6	-	6.5	23.6	2.1	0.4	-	-	-
Total Committed Projects	-	**32.6**	**-**	**6.5**	**23.6**	**2.1**	**0.4**	**-**	**-**	**-**
Operating expenses (incremental)										
Operating expenses (incremental)	28.9	-	-	-	-	0.1	8.7	1.4	-	35.9
Total Operating expenses (incremental)	**28.9**	**-**	**-**	**-**	**-**	**0.1**	**8.7**	**1.4**	**-**	**35.9**
Total Cost	**494.9**	**682.4**	**-**	**10.0**	**65.2**	**106.8**	**19.2**	**38.3**	**453.1**	**35.9**

Notes: All figures in the table below are quoted in July 2007 real dollars [millions]

Option 2: Replace 908/909 with a 2 x 200MVA feeder and upgrade 910/911 feeders to 400MVA

Proposed Projects	NPC ($m)	Capital ($m)	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Sydney South emergency switching arrangement	0.2	0.2	-		0.2	-	-	-	-	-
Upgrade 910/911 to 400MVA	25.8	27.6	-	12.3	15.3	-	-	-	-	-
Additional (3) Bays at Bunnerong South	4.7	4.9	-	2.4	2.3	0.1	-	-	-	-
Install 2 x 200MVA feeders Canterbury to Bunnerong	112.9	129.9	-	1.9	66.6	61.4	-	-	-	-
3rd Feeder to Kurnell STS	6.8	8.1	-	-	0.9	7.2	-	-	-	-
Sydney North 5th Transformer	8.6	10.9	-	-	-	0.8	10.1	-	-	-
Holroyd to Chullora cables	108.4	148.7	-	-	-	-	11.3	137.4	-	-
Establishment of Chullora BSP	236.9	325.0	-	-	-	-	24.6	300.4	-	-
BSP connection at Chullora	7.6	10.7	-	-	-	-	0.8	9.9	-	-
Total Proposed Capital Cost	**511.9**	**666.0**	**-**	**16.6**	**85.4**	**69.6**	**46.8**	**447.7**	**-**	**-**
Committed Projects										
Kurnell STS refurbishment	-	32.6	-	6.5	23.6	2.1	0.4	-	-	-
Total Committed Projects	-	**32.6**	**-**	**6.5**	**23.6**	**2.1**	**0.4**	**-**	**-**	**-**
Operating expenses (incremental)										
Operating expenses (incremental)	33.2	-	-	-	-	3.1	8.6	1.4	35.9	-
Total Operating expenses (incremental)	**33.2**	**-**	**-**	**-**	**-**	**3.1**	**8.6**	**1.4**	**35.9**	**-**
Total Cost	**545.1**	**698.6**	**-**	**23.1**	**109.0**	**74.7**	**55.8**	**449.0**	**35.9**	**-**

9. APPENDIX B – SENSITIVITY ANALYSIS

Table 6: Comparison of Options – 7% Discount Rate

Option	Description	Initial Capital Cost ($m real)	NPC of Costs ($m real)
Option 1	Establish a new Kurnell to Bunnerong 400MVA feeder	151.5	530.7
Option 2	Replace 908/909 with a 2 x 200MVA feeder and upgrade 910/911 feeders to 400MVA	162.4	578.1

Table 7: Comparison of Options – 11% Discount Rate

Option	Description	Initial Capital Cost ($m real)	NPC of Costs ($m real)
Option 1	Establish a new Kurnell to Bunnerong 400MVA feeder	151.5	445.3
Option 2	Replace 908/909 with a 2 x 200MVA feeder and upgrade 910/911 feeders to 400MVA	162.4	499.4

Table 8: Comparison of Options – Reduction in Demand Growth (BSP 1 year later)

Option	Description	Initial Capital Cost ($m real)	NPC of Costs ($m real)
Option 1	Establish a new Kurnell to Bunnerong 400MVA feeder	151.5	475.2
Option 2	Replace 908/909 with a 2 x 200MVA feeder and upgrade 910/911 feeders to 400MVA	162.4	521.2

Table 9: Comparison of Options – Increase in Demand Growth (BSP 1 year earlier)

Option	Description	Initial Capital Cost ($m real)	NPC of Costs ($m real)
Option 1	Establish a new Kurnell to Bunnerong 400MVA feeder	151.5	518.8
Option 2	Replace 908/909 with a 2 x 200MVA feeder and upgrade 910/911 feeders to 400MVA	162.4	572.0

Note: It is not considered feasible to advance the BSP earlier than the summer of 2012/13.

Table 10: Comparison of Options – 25% Reduction in BSP Cost

Option	Description	Initial Capital Cost ($ M real)	NPC of Costs ($m real)
Option 1	Establish a new Kurnell to Bunnerong 400MVA feeder	151.5	409.3
Option 2	Replace 908/909 with a 2 x 200MVA feeder and upgrade 910/911 feeders to 400MVA	162.4	543.2

Table 11: Comparison of Options – 25% Increase in BSP Costs

Option	Description	Initial Capital Cost ($m real)	NPC of Costs ($m real)
Option 1	Establish a new Kurnell to Bunnerong 400MVA feeder	151.5	580.5
Option 2	Replace 908/909 with a 2 x 200MVA feeder and upgrade 910/911 feeders to 400MVA	162.4	636.9

Table 12: Comparison of Options – 25% Decrease in Underground Feeder Costs

Option	Description	Initial Capital Cost ($m real)	NPC of Costs ($m real)
Option 1	Establish a new Kurnell to Bunnerong 400MVA feeder	115.0	462.3
Option 2	Replace 908/909 with a 2 x 200MVA feeder and upgrade 910/911 feeders to 400MVA	131.3	517.1

Note: While an increase in feeder excavation costs will affect both options, option 1 will not be affected as much as option 2 as only a portion of the project involves land excavation. However in this case the NPC for Option 2 is still higher than NPC for the Option 1 base case.

Table 13: Comparison of Options – 25% Increase in Underground Feeder Costs

Option	Description	Initial Capital Cost ($m real)	NPC of Costs ($m real)
Option 1	Establish a new Kurnell to Bunnerong 400MVA feeder	187.9	527.5
Option 2	Replace 908/909 with a 2 x 200MVA feeder and upgrade 910/911 feeders to 400MVA	193.5	573.1

Note: While an increase in feeder excavation costs will affect both options, option 1 will not be affected as much as option 2 as only a portion of the project involves land excavation. In this case this would further advantage Option 1.

Table 14: Comparison of Options – Increase in submarine feeder Costs

Option	Description	Initial Capital Cost ($m real)	NPC of Costs ($m real)
Option 1	Establish a new Kurnell to Bunnerong 400MVA feeder	187.9	527.5
Option 2	Replace 908/909 with a 2 x 200MVA feeder and upgrade 910/911 feeders to 400MVA	162.4	545.1

Note: This case is test if there is a 25% increase in the Kurnell to Bunnerong feeder costs for contract variations, due to submarine cable risks, which are unique to option 1.