FINAL REPORT

PROPOSED NEW LARGE TRANSMISSION NETWORK ASSET

REINFORCEMENT OF ELECTRICITY SUPPLY WITHIN THE SYDNEY CENTRAL BUSINESS DISTRICT (CBD)

Table of Contents

Executive Summary

This final report is published in accordance with Clause 5.6.6(h) of the National Electricity Rules. It relates to a proposal for a new large transmission network asset that would address emerging transmission and distribution network limitations affecting the electricity network supply within the Sydney Central Business District (CBD) area.

The proposal is addressing reliability requirements in NSW and is evaluated in accordance with the "least cost" test for reliability augmentations in accordance with the Australian Energy Regulator's regulatory test.

Section 1 provides the context of this final report within the regulatory process and summarises the outcomes of that process.

Section 2 describes in detail the regulatory requirements relating to proposals for new large transmission network assets, the existing supply arrangements and nature of the growing load in the Sydney CBD and the network limitations that give rise to a need to augment supply to the area. The agreed network performance requirements (planning criterion) against which the need and effectiveness of augmentation options are assessed and non-network options are also described.

In Section 3 the feasible augmentation options are described. The options include a set of developments that address the limitations over a number of years. Each option consists of a mix of developments over a range of different commissioning dates to achieve the desired outcomes. The developments considered consist of works such as duplication of 132 kV cable feeders from TransGrid bulk supply points to EnergyAustralia zone substations and between bulk supply points. The end of serviceable life retirement of two EnergyAustralia cables from Lane Cove to Dalley Street described in Section 2 exacerbates the limitation. Options to either replace these cables on a like for like basis or to not replace the cables are considered.

The options considered also involve the formation of a new 132 kV circuit from Haymarket 330/132 kV substation to Beaconsfield West 330/132 kV substation for summer 2012/13. This circuit would be achieved through the advancement of construction by TransGrid of a 330 kV cable from Haymarket 330/132 kV substation to the Sydney Park MetroGrid cable tunnel portal. EnergyAustralia would then construct a short section of 132 kV cable from the cable tunnel portal to Beaconsfield West 330/132 kV substation. A cable joint and cable connections to the Beaconsfield West and Haymarket 132 kV busbars would then complete the new circuit.

In Section 4 the results of an application of the regulatory test considering the three options are presented. The results indicate that Option 1 consisting of, among other developments as detailed, works by EnergyAustralia and TransGrid to form a 132 kV circuit from Haymarket to Beaconsfield West including TransGrid advancing the installation of a 330 kV cable in the MetroGrid tunnel and EnergyAustralia retiring two 132 kV cables, has the lowest net present value of costs in all of the cases considered except one.

In Section 5 it is concluded that Option 1 is the lowest cost option in all cases considered except one and satisfies the regulatory test. On this basis the proposed actions are for TransGrid and EnergyAustralia to proceed with the construction of the network solution described in the option for completion over a number of years beginning summer 2011/12. The cost estimates and the works involved for this option are detailed as follows. The works described here are only the works for which this final report concludes the regulatory consultation process. Other works are included in the option but their regulatory consultation is already obtained or proposed through other processes.

<u>Works by EnergyAustralia:-</u>

- Summer 2011/12, Beaconsfield West – Green Square second 132 kV cable, $5.1 million
- Summer 2012/13
    - retire 92L and 92M Lane Cove – Dalley Street 132 kV cables, not replaced, $2.9 million
    - 9S4 Haymarket – Beaconsfield West 700 m 132 kV cable, EA component $7.8 million

<u>Works by TransGrid:-</u>

- Summer 2012/13, 9S4 Haymarket – Beaconsfield West 3.5 km 330 kV cable operating at 132 kV, TG component $30 million (includes $3 million for advancement of tunnel remediation works)

The total value of the works proposed is $45.8 million with the break up between EnergyAustralia and TransGrid as detailed above.

1. Introduction

1.1. Purpose and Scope

TransGrid owns the majority of the transmission network within NSW and is responsible inter alia for planning and developing its network to meet the requirements of customers within the State and to facilitate operation of the National Electricity Market (NEM). As part of its planning responsibilities and the requirements of the National Electricity Rules (the Rules) TransGrid consults with NEM registered participants, AEMO and interested parties on emerging limitations within its transmission network and options being considered to relieve them.

EnergyAustralia owns the subtransmission and distribution networks and some transmission facilities within the Sydney CBD area and is responsible for planning and developing those networks.

TransGrid and EnergyAustralia have responsibilities under the Rules to carry out joint planning to facilitate the optimal development of connections between the transmission and distribution networks within EnergyAustralia's network area.

This final report has been prepared in accordance with Clauses 5.6.6 (h) of the Rules. It relates to a proposal for a new large transmission network asset that would address the requirements of providing an agreed level of reliability of supply for the Sydney CBD area.

It includes:

- A summary of the load forecast for the area;
- A description of the network reliability criterion that has been adopted for planning purposes;
- A description of the network limitations identified by TransGrid and EnergyAustralia that have led to a necessity for augmentation of the transmission network supplying the Sydney CBD area;
- A description of all reasonable network and non-network options that have been identified to meet these limitations;
- An analysis of the ranking of these options in accordance with the Australian Energy Regulator's (AER's) regulatory test;
- An assessment of the outcome of the regulatory test and proposed actions; and
- Information that may be relevant to persons who may wish to dispute any aspect of this final report.

1.2. Outline of Consultation Process

EnergyAustralia has published a description of limitations affecting the transmission network between Haymarket and Beaconsfield West in its Annual Planning Reports (APRs) for the last several years.

In July 2010 TransGrid and EnergyAustralia published an application notice covering a proposal for a new large transmission network asset that would address the network limitations described in Section 2.6. A summary of the application notice was published on AEMO's website on 30th July 2010. Interested parties were invited to make submissions in the period to 10th September 2010. No submissions to the application notice were received.

TransGrid and EnergyAustralia have applied the regulatory test to all known reasonable options to meet the network limitations described in this final report and have determined the option that satisfies the test.

Accordingly TransGrid and EnergyAustralia have completed their obligations under clause 5.6.6(b) of the Rules and will proceed in accordance with the proposed actions detailed in Section 5 of this final report.

Person's wishing to dispute any aspect of this final report are referred to Section 6.

A summary of this final report has been posted on AEMO's website.

2. Identification of a Necessity for Augmentation

2.1. Regulatory Requirements

2.1.1. Requirements of the National Electricity Rules

This final report covers a proposal for a new large transmission network asset.

Following consultation undertaken in accordance with the National Electricity Rules, the Australian Energy Market Commission (AEMC) made the National Electricity Amendment (Regulatory Investment Test for Transmission) Rule 2009 No.15 which commenced operation in July 2009[1]. The intention of this Rule is to replace the Regulatory Test and the associated consultation process undertaken by Network Service Providers for solutions to network constraints. Transitional provisions set out in Chapter 11 grandfather the key elements of the old rule for consultations commenced prior to 1st August 2010 including the consultation process and applicable economic test.

In accordance with those transitional provisions, this final report being part of a current application as at 1st August 2010 and associated consultation is based on:

- Version 29 of the National Electricity Rules;
- Version 3 of the Australian Energy Regulator's Regulatory Test; and
- The Australian Energy Regulator's Regulatory Test Guidelines issued November 2007.

The requirements of the National Electricity Rules for new large transmission network asset proposals are set out in Clause 5.6.6. This requires applicants (in this case TransGrid and EnergyAustralia), inter-alia, to:

- Set out the reasons for proposing the new large transmission network asset, including the actual or potential constraint or inability to meet network performance requirements;
- Describe all reasonable network and non-network options to address the constraint;
- Rank the options in accordance with the principles of the AER's regulatory test including detailed analysis of why the applicant considers the new large transmission network asset satisfies the regulatory test;
- Where relevant, provide analysis of why the applicant considers the new large transmission network asset is a reliability augmentation; and
- Provide an augmentation technical report or consents to proceed from affected TNSPs if the new large transmission network asset is likely to have a material inter-network impact.

These requirements are underpinned by Clauses 5.6.2 (a), (b) and (c) of the Rules, which requires network service providers to:

- Analyse their networks and conduct annual joint planning reviews to identify necessities for *augmentation* or *extension* of those networks; and
- Undertake joint planning in order to determine plans that can be considered by registered participants, AEMO and interested parties.

2.1.2. Requirements of the Regulatory Test

The regulatory test may be applied in either one of two ways. The regulatory test states that an option satisfies the test if:

(a) in the event the option is necessitated principally by inability to meet the service standards linked to the technical requirements of schedule 5.1 of the NER or in applicable regulatory instruments - the option minimises the costs of meeting those requirements, compared with alternative option/s in a majority of reasonable scenarios;

(b) in all other cases - the option maximises the expected net economic benefit to all those who produce, consume and transport electricity in the national electricity market compared to the likely alternative option/s in a majority of reasonable scenarios. Net economic benefit equals the market benefit less costs.

[1] The Rule As Made and Determination is published on the AEMC's website at http://www.aemc.gov.au/Electricity/Rule-changes/Completed.html

The Rules define a reliability augmentation as:

> A transmission network augmentation that is necessitated principally by inability to meet the minimum network performance requirements set out in schedule 5.1 or in relevant legislation, regulations or any statutory instrument of a participating jurisdiction.

Thus for reliability augmentations clause (a) of the test should be used. That is for reliability augmentations the option that satisfies the regulatory test is the one that minimises the cost of meeting the minimum network performance requirements set out in schedule 5.1 of the Rules or via a jurisdictional or customer requirement.

2.2. Jurisdictional Requirements

2.2.1. Requirements of the Energy Services Corporations Act

TransGrid's and Energy Australia's enabling legislation is the Energy Services Corporation Act 1995. Section 6B of the Act sets out the five principal objectives which in summary are:

1. To be a successful business. This includes:
    a. To operate at least as efficiently as any comparable business;
    b. To maximise the net worth of the State's investment in it;
    c. To exhibit a sense of social responsibility by having regard to the interest of the community in which it operates;
2. To protect the environment by conducting its operations in compliance with the principles of ecologically sustainable development;
3. To exhibit a sense of responsibility to regional development;
4. To operate efficient, safe and reliable facilities; and
5. To promote effective access.

It is important to note that the Act explicitly identifies that each of these objectives is of equal value, and thus a balanced approach must be taken in decision making to reflect this obligation. In particular it is worth noting that efficiency is not superior to the environment or the community.

When developing options to overcome actual or potential network constraints, TransGrid and EnergyAustralia initially assess possible options against the above requirements and then apply the regulatory test to those which satisfy them.

2.2.2. Reliability Criterion

As stated in its Annual Planning Report, TransGrid is expected by the NSW jurisdiction to plan and develop its transmission network on an "N-1" basis. That is, unless specifically agreed otherwise by TransGrid and the affected distribution network owner or major directly connected end-use customer, there will be no inadvertent loss of load (other than load which is interruptible or dispatchable) following an outage of a single circuit (a line or a cable) or transformer, during periods of forecast high load.

In fulfilling this obligation, TransGrid must recognise specific customer requirements as well as AEMO's role as system operator for the NEM. To accommodate this, the standard "N-1" approach can be modified in the following circumstances:

- Where agreed between TransGrid and a distribution network owner or major directly connected end-use customer, agreed levels of supply interruption can be accepted for particular single outages, before augmentation of the network is undertaken (for example the situation with radial supplies).
- Where requested by a distribution network owner or major directly connected end-use customer and agreed with TransGrid there will be no inadvertent loss of load (other than load which is interruptible or dispatchable) following an outage of a section of busbar or coincident outages of agreed combinations of two circuits, two transformers or a circuit and a transformer (for example supply to the CBD and Inner Metropolitan area of Sydney).
- The main transmission network, which is operated by AEMO, should have sufficient capacity to accommodate AEMO's operating practices without inadvertent loss of load (other than load which is interruptible or dispatchable) or uneconomic constraints on the energy market. At present AEMO's operational practices include the re-dispatch of generation and ancillary services following a first

contingency, such that within 30 minutes the system will again be "secure" in anticipation of the next critical credible contingency.

These requirements are underpinned by mandatory licence conditions for New South Wales Distribution Network Service Providers. The licence conditions specify N-1, one minute reliability levels at connection points supplying load greater than minimum values that range from 5-15 MVA depending on the type of load.

The decision to adopt a reliability criterion for the transmission network supplying the CBD and Inner Metropolitan area that is more onerous than N-1 was made jointly by TransGrid and EnergyAustralia after consideration of:

- The importance and commercial sensitivity of the Sydney area load to supply interruptions;
- The high cost of applying a full N-2 reliability criterion to the transmission network;
- The large number of elements in the 132 kV network;
- The past performance of the cable system; and
- The long times to repair cables should they fail.

In addition EnergyAustralia's licence conditions will require the Sydney CBD to meet N-2 reliability levels by 2014 highlighting the appropriateness of a more onerous criterion for the Inner Metropolitan network.

The criterion applied to the area is consistent with that applied in electricity supply to major cities throughout the world. Many developed countries use a full N-2 reliability criterion. However, some countries apply an N-1 criterion with some selected N-2 contingencies that commonly include two cables sharing the one trench or a double circuit line.

With the above considerations the reliability criterion that has been jointly agreed by TransGrid and EnergyAustralia for the transmission network supplying the Sydney CBD and Inner Metropolitan area is as follows:

a. Under normal system conditions, all elements must be loaded within their recurrent cyclic rating (assigned "Planning Rating");

b. System loadings under first contingency outages will remain within equipment recurrent cyclic ratings without corrective switching other than for automatic switching or "auto-changeover";

c. Cyclic load shedding (in areas other than the Sydney CBD) may be required in the short term following a simultaneous outage of a single 330 kV cable and any 132 kV transmission feeder or 330 kV transformer in the Inner Metropolitan area until corrective switching is carried out on the 330 kV and 132 kV systems;

d. 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;

e. The load forecast to be considered is based on "50 per cent probability of exceedence";

f. Loading is regarded as unsatisfactory when 330/132 kV transformers and 330 kV or 132 kV cables are loaded beyond their recurrent cyclic rating; and

g. Fault interruption duty must be contained to within equipment ratings at all times.

In the remainder of this document this criterion is described as the "modified N-2" reliability criterion.

2.3. Supply Arrangements in the Sydney Area

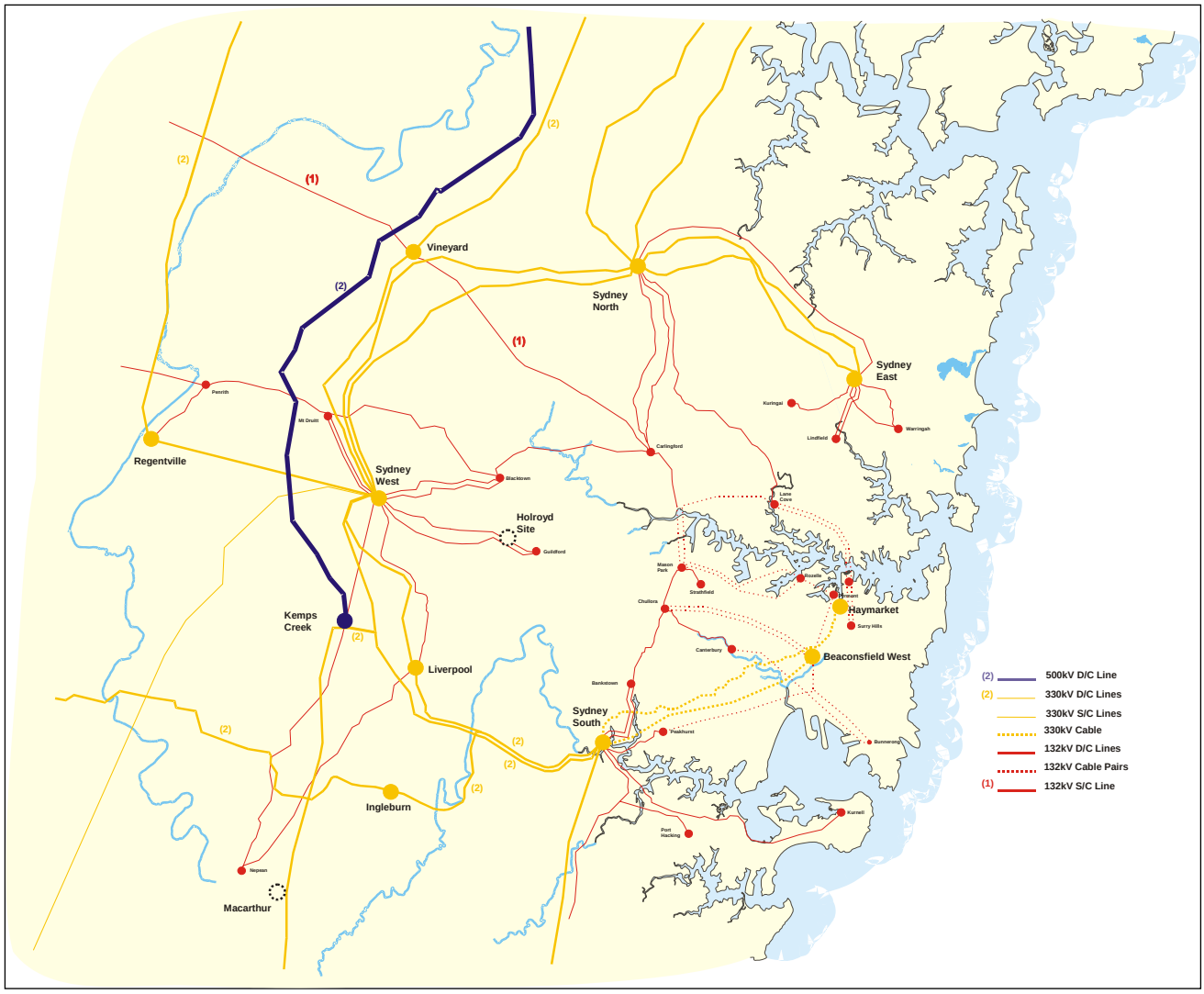


Figure 1 Main Network Elements supplying the Greater Sydney Area

Approximately half of the New South Wales power demand occurs within the Greater Sydney area. The main elements of the network supplying the area are shown in Figure 1 above.

Supply to the area is provided via 500 kV at Kemps Creek and ten 330 kV substations at Sydney East, Sydney North, Sydney West, Sydney South, Beaconsfield West, Haymarket, Vineyard, Regentville Liverpool and Ingleburn. These substations are interconnected with the State's power stations to the north and west of Sydney and the main grid to the south and supply lower voltage networks owned by EnergyAustralia and Integral Energy.

An overview of the 330/132 kV network supplying the Sydney CBD and Inner Metropolitan area is shown in Figure 1. The 132 kV network is supplied from four 330/132 kV substations at Sydney North, Sydney South, Beaconsfield West and Haymarket. Beaconsfield West and Haymarket substations are supplied via two 330 kV cables from Sydney South. The 132 kV network is comprised of both transmission and distribution components. This 132 kV network is complex however its salient features can be described as follows:

- The 132 kV transmission network comprises a meshed network interconnecting the four TransGrid 330/132 kV substations;
- The 132 kV distribution network is composed of a predominantly radial network with normally open points to:

- Control fault levels;
- Simplify protection and network operation; and
- Prevent equipment loading exceeding licence criteria during emergencies;

The normally open points and other features allow the distribution network to be reconfigured in emergencies to re-establish supply within a load area. The 132 kV transmission network however provides limited ability to influence loading on the 132 kV distribution network via load transfers or network switching.

2.4. Load Forecast

Forecast summer maximum demands at the 330 kV substations[2] supplying the Inner Metropolitan area are shown in Table 1.

Table 1 Inner Metropolitan Area Forecast Summer Maximum Demands (MW)

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
Beaconsfield West	466	480	493	467	489	496	506	516	526	535
Haymarket	555	585	601	576	600	612	619	627	636	647
Totals	1021	1065	1094	1043	949	1108	1125	1143	1162	1182

2.5. Transmission Network Limitations

This document covers network limitations that are forecast to emerge in the network supplying the Sydney CBD that will require major network reinforcement by summer 2011/12. Further major increments in transmission network capacity in the period to 2030 are covered by other documents.

2.5.1. Augmentations that Address Limitations Emerging in the Period to 2013/14

Other transmission network limitations have emerged or are expected to emerge in the period to 2013/14 and are being addressed by small scale network augmentations. These are discussed below. Proposals for these augmentations have been covered by previous regulatory processes.

Beaconsfield West 3rd 330/132 kV Transformer

An outage of either 330/132 kV transformer at Beaconsfield West 330 kV substation and the Sydney South – Haymarket 330 kV cable under high load conditions would impose excessive loading on the other 330/132 kV transformer at Beaconsfield West. To meet this limitation a third 375 MVA 330/132 kV transformer is being installed at Beaconsfield West on land adjacent to the existing substation. These works are expected to be completed by 2011/12. The 132 kV busbar and associated equipment at TransGrid's Beaconsfield West Substation will be required to be replaced in the period 2012 – 2014. Due to space limitations at the site and the need to reconnect existing 132 kV cables this is expected to be carried out in a staged manner.

2.5.2. Replacement of Existing Network Elements

A number of existing network elements need to be replaced for asset condition reasons. These are discussed below.

EnergyAustralia intends to undertake the following asset replacement works:

- The sections of 132 kV feeders 92L and 92M (between Lane Cove and Dalley St) are approaching the end of their serviceable lives and are planned to be retired by 2012. This exacerbates the network capacity limitation that is the subject of this final report. The sections of 132 kV feeders 928 and 919/929 (between Lane Cove and Dalley St) are approaching the end of their serviceable lives and are planned to be retired by 2017.

[2] The network studies used the forecast loads at EnergyAustralia substations which underpin the forecast loads at 330 kV substations published in the APR 2010.

- The sections of 132 kV feeders 919/929, 928, 92L and 92M (between Dalley St and Surry Hills) are approaching the end of their serviceable lives and are planned to be retired by 2017. This work will be done in conjunction with the replacement of EnergyAustralia's City East zone substation.

2.5.3. Limitations Emerging in Summer 2011/12

System studies carried out by TransGrid and EnergyAustralia predict that the EnergyAustralia Haymarket BSP to Beaconsfield West BSP 132 kV cables (9S2, 9SE, 90T and 9SA) will be constrained during an outage of TransGrid's 42 Sydney South to Haymarket BSP 330 kV cable and any one of the above cables in summer 2011/12.

In addition, a condition based assessment indicates that the EnergyAustralia 92L and 92M Lane Cove – Dalley Street 132 kV cables are approaching the end of their serviceable lives and are planned to be retired prior to summer 2012/13. This will exacerbate the limitation described above.

In section 3, a number of solutions to these limitations have been identified. As a general rule, the low or moderate cost solutions are assumed to be carried out first to defer expenditure on significant network upgrades.

Thus by summer 2011/12 the following situation is forecast to have emerged with respect to the 330 kV and 132 kV network suppling the Sydney CBD and Inner Metropolitan area despite the low or moderate cost solutions having been carried out:

- In the absence of network augmentation or demand management initiatives it will no longer be possible in all cases during high load periods and combinations of outages that fall within the modified N-2 criterion to prevent cable loading exceeding licence criteria in the network.

2.6. Joint Planning

TransGrid and EnergyAustralia have jointly planned the 330 kV and 132 kV networks supplying the Sydney CBD and Inner Metropolitan area for many years. The works described in Section 2.5.1 and Section 2.5.2 are outcomes from the joint planning process.

TransGrid and EnergyAustralia have carried out annual joint planning reviews as required by Clause 5.6.2 (b) of the Rules. As required by Clause 5.6.2(c) they have identified that the network limitations outlined in Section 2.5 give rise to a need for network augmentations and have carried out joint planning to determine options for these augmentations.

2.7. Reliability Augmentation

It follows from Sections 2.1 – 2.5 that the proposals covered by this final report constitute a reliability augmentation and that the regulatory test should be applied in accordance with Clause 1(a) of the test.

2.8. Material Inter-network Impact

The Rules require assessment as to whether a proposed new large transmission network asset is reasonably likely to have a material inter-network impact.

EnergyAustralia and TransGrid each own and operate certain transmission assets in the Sydney area and these transmission networks adjoin each other.

TransGrid has determined that none of the options described in Section 3 will impose power transfer constraints or adversely impact on the quality of supply to any transmission networks[3].

EnergyAustralia and TransGrid each provide consent to the other to proceed with works that will alleviate the limitations described in Section 2.5[4].

2.9. Consideration of Demand Management

2.9.1. General

The projects described in this final report comprise of two parts. The first responding to the constraint in summer 2011/12 and the second in 2012/13 arising from the condition of feeders 92L and 92M.

The network constraint in 2011/12 was considered in a Demand Management screening test completed by EnergyAustralia in June 2009 (entitled "New 132kV feeder from Green Square to Beaconsfield West"), which identified that a reduction of 33 MVA would be required to enable the network to meet the reliability criteria in

[3] In accordance with the NER definition of Material Inter-network Impact.

[4] This satisfies the requirement of Clause 5.6.6(c)(5) that no Augmentation Technical Report is required.

summer 2011/12 without augmentation. It concluded that it would not be reasonable to expect Demand Management alternatives to provide a cost effective solution. The constraint has not changed, but the proposed network solution (Beaconsfield West to Green Square Feeder) is now less costly ($5.1 million compared to $5.7 million). On this basis the conclusions of the original screening test are robust.

The constraints in 2012/13 are driven by the need to retire cables 92L and 92M. This part of the proposed investment is therefore driven by replacement needs and demand management consideration would not normally be required. The only way that demand management could offer a less costly solution would be if demand could be reduced sufficiently to allow the retirement of the existing cables without replacement. Latest forecasts show the load supplied by these cables would be 144 MVA in summer 2012/13. A reduction of this magnitude would be extremely difficult to achieve and, given the component project cost of $40.7 million it is not reasonable to consider that Demand Management alternatives could be found that would cost effectively defer or avoid this need.

2.9.2. Conclusion

Taking into account the Demand Management assessments conducted by EnergyAustralia it is not reasonable to expect that Demand Management would cost effectively defer this project.

3. Options to Relieve the Network Limitations

3.1. General Requirements for Options

TransGrid and EnergyAustralia have developed three network options to address the network limitations described in Section 2.5 over a planning horizon to summer 2017/18 that also meet the requirements described in this Section.

Each option consists of a combination of similar component projects with the main difference being that Options 2 and 3 include a replacement of the 92L and 92M retired cable sections with similar assets. The similarities are that each option begins with the construction of a second Beaconsfield West – Green Square 132 kV cable as this is a low cost solution and is consistent with the general rule of doing the low or moderate cost solutions first to defer expenditure on significant network upgrades.

A comparison of the common component projects of the three options is included in Table 2 below and a general discussion about the component projects follows.

Table 2 Common Component Projects

Rank of Component Project Cost	Component Project Description	Cost ($M)	Comment
Least expensive	Beaconsfield West – Green Square ZS second 132 kV cable by EA	$5.1M	This is the only feasible option able to be implemented in the timeframe available
Medium expensive	9S4 Haymarket – Beaconsfield West	$30M for TG component (includes $3.0M tunnel remediation) $7.8M for EA component	Consistent with the longer term plans of developing a second 330 kV supply to Beaconsfield West and to Haymarket
Most expensive	Replace 92L and 92M with equivalent to the existing assets	$90M	Not consistent with long term plans

3.2. Description of Component Projects

Each of the project options set out in section 3.3 consists of a number of component projects. The following information is provided to outline key details of the component projects.

Beaconsfield West – Green Square ZS second 132 kV cable by EA

A low cost component project that is the only feasible option to relieve the constraint described in section 2.5.3 in summer 2011/12 in the timeframe available but it is only a short term solution.

Retire 92L and 92M

A condition based assessment indicates that the EnergyAustralia 92L and 92M Lane Cove – Dalley Street 132 kV cables are approaching the end of their serviceable lives and are planned to be retired prior to summer 2012/13 which exacerbates the constraint described in section 2.5.3.

New 92L and 92M

A high cost component project, the efficiency of which is analysed and tested in Options 2 and 3 below.

9S4 Haymarket – Beaconsfield West 132 kV cable by EA and TG

A medium cost component project that is consistent with EnergyAustralia's and TransGrid's long term strategy to develop additional 330 kV capacity to the Sydney CBD and inner metropolitan area. The proposed circuit would consist of a 132 kV cable section by EnergyAustralia from Beaconsfield West – Sydney Park and a 330 kV cable section (operated at 132 kV) by TransGrid from Haymarket to Sydney Park. The need for the 132 kV circuit would drop away on establishment of the second 330 kV supply to the Sydney CBD. However, it is anticipated that the 132 kV section would be used as part of future EnergyAustralia 132 kV developments. The 330 kV section would be reconnected to operate at 330 kV when required to form the second 330 kV CBD supply. The

remaining 132 kV cable section would be utilised by EnergyAustralia as an additional outlet from Beaconsfield West.

Haymarket to Belmore Park second 132 kV cable by EA

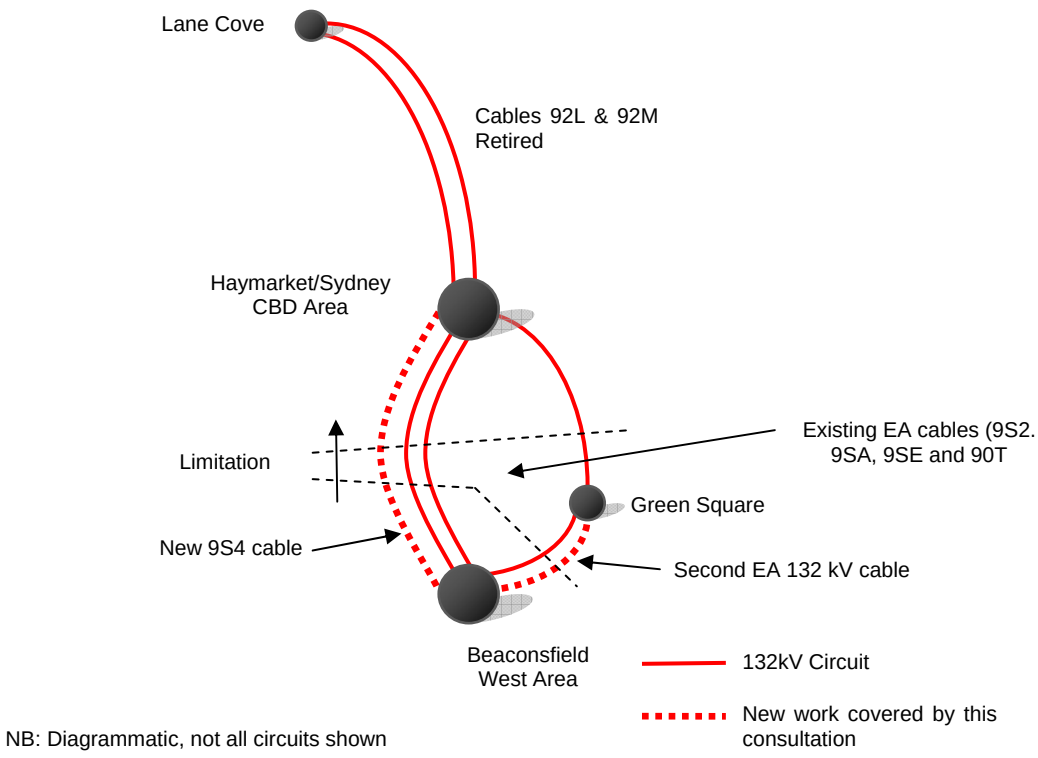
A low cost component project to ease the limitation exacerbated by the retirement of the EA 132 kV cables but it is only a short term solution. EnergyAustralia has already obtained regulatory approval for the second Haymarket – Belmore Park 132 kV cable project.

Inner Metropolitan stage 2, 330 kV proposal

The stage 2 component of the 330 kV long term development strategy. Stage 1 of these works is the subject of a Final Report, Development of Electricity Supply to the Sydney CBD and Inner Metropolitan Area, issued in March 2010. The regulatory consultation process for the stage 2 works has not yet been commenced. However, for the purposes of this analysis the timing of this development in Option 1 has been taken to be summer 2016/17 as described in the Final Report. In Options 2 and 3 its timing is summer 2017/18 for the base case load growth scenario as these options involve replacement of cables 92L and 92M.

These component projects have been combined into the three options which address the limitations for further analysis and application of the regulatory test. The key component projects are shown diagrammatically in Figure 2.

Figure 2 Key Component Projects



3.2.1. Option 1: Retire Cables but do not Replace

This option is made up of component projects with the objective of retiring EnergyAustralia's 132 kV cables without like for like replacement. The new works required for Option 1 are detailed below.

Works to be completed prior to summer 2011/12:

- Construction of a second 132 kV cable circuit by EnergyAustralia from Beaconsfield West – Green Square ZS; and

- 132 kV cable connections at Beaconsfield West 330/132 kV substation and at Green Square ZS to form the new circuit.

Works to be completed prior to summer 2012/13:

- Retire EnergyAustralia's 132 kV cable sections 92L and 92M from Lane Cove – Dalley Street;
- Construction of a new 700 m 132 kV cable section by EnergyAustralia from Beaconsfield West to Sydney Park;
- Construction of a new 3.5 km 330 kV (operated at 132 kV) cable section by TransGrid from Sydney Park to Haymarket, cable to be laid in TransGrid's existing MetroGrid tunnel;
- 132 kV cable connections at Beaconsfield West 330/132 kV substation, connection of the 330 kV cable to the 132 kV busbar at Haymarket 330/132 kV substation and jointing of the 132 kV cable section to the 330 kV cable section at Sydney Park to form the new 9S4 Haymarket – Beaconsfield West 132 kV cable circuit;
- Construction of a second 132 kV cable by EnergyAustralia from Haymarket – Belmore Park ZS; and
- 132 kV cable connections at Haymarket 330/132 kV substation and at Belmore Park 132/11 kV zone substation to form the new circuit.

Works to be completed prior to summer 2016/17:

- Construction of the Inner Metropolitan stage 2, 330 kV proposal.

3.2.2. Option 2: Retire Cables and Replace with Similar Cables Later

This option is made up of component projects with the objective of retiring EnergyAustralia's 132 kV cables and delaying their like for like replacement by four years. The new works required for Option 2 are detailed below.

Works to be completed prior to summer 2011/12:

- Construction of a second 132 kV cable circuit by EnergyAustralia from Beaconsfield West – Green Square ZS; and
- 132 kV cable connections at Beaconsfield West 330/132 kV substation and at Green Square ZS to form the new circuit.

Works to be completed prior to summer 2012/13:

- Retire EnergyAustralia's 132 kV cable sections 92L and 92M from Lane Cove – Dalley Street;
- Construction of a new 700 m 132 kV cable section by EnergyAustralia from Beaconsfield West to Sydney Park;
- Construction of a new 3.5 km 330 kV (operated at 132 kV) cable section by TransGrid from Sydney Park to Haymarket, cable to be laid in TransGrid's existing MetroGrid tunnel;
- 132 kV cable connections at Beaconsfield West 330/132 kV substation, connection of the 330 kV cable to the 132 kV busbar at Haymarket 330/132 kV substation and jointing of the 132 kV cable section to the 330 kV cable section at Sydney Park to form the new 9S4 Haymarket – Beaconsfield West 132 kV cable circuit;
- Construction of a second 132 kV cable by EnergyAustralia from Haymarket – Belmore Park ZS; and
- 132 kV cable connections at Haymarket 330/132 kV substation and at Belmore Park 132/11 kV zone substation to form the new circuit.

Works to be completed prior to summer 2016/17:

- Construction of new 132 kV cables by EnergyAustralia to replace 92L and 92M from Lane Cove – Dalley Street; and
- 132 kV cable connections at EnergyAustralia's Lane Cove 132 kV switching station and Dalley Street 132/11 kV substation to form the new circuits.

Works to be completed prior to summer 2017/18:

- Construction of the Inner Metropolitan stage 2, 330 kV proposal.

3.2.3. Option 3: Retire Cables and Replace with Like for Like at the Same Time

This option is made up of component projects with the objective of retiring EnergyAustralia's 132 kV cables and making like for like replacement at that time. The new works required for Option 3 are detailed below.

Works to be completed prior to summer 2011/12:

- Construction of a second 132 kV cable circuit by EnergyAustralia from Beaconsfield West – Green Square ZS; and
- 132 kV cable connections at Beaconsfield West 330/132 kV substation and at Green Square ZS to form the new circuit.

Works to be completed prior to summer 2012/13:

- Retire EnergyAustralia's 132 kV cable sections 92L and 92M from Lane Cove – Dalley Street;
- Construction of new 132 kV cables by EnergyAustralia to replace 92L and 92M from Lane Cove – Dalley Street; and
- 132 kV cable connections at EnergyAustralia's Lane Cove 132 kV switching station and Dalley Street 132/11 kV substation to form the new circuits.

Works to be completed prior to summer 2014/15:

- Construction of a new 700 m 132 kV cable section by EnergyAustralia from Beaconsfield West to Sydney Park;
- Construction of a new 3.5 km 330 kV (operated at 132 kV) cable section by TransGrid from Sydney Park to Haymarket, cable to be laid in TransGrid's existing MetroGrid tunnel;
- 132 kV cable connections at Beaconsfield West 330/132 kV substation, connection of the 330 kV cable to the 132 kV busbar at Haymarket 330/132 kV substation and jointing of the 132 kV cable section to the 330 kV cable section at Sydney Park to form the new 9S4 Haymarket – Beaconsfield West 132 kV cable circuit;
- Construction of a second 132 kV cable by EnergyAustralia from Haymarket – Belmore Park ZS; and
- 132 kV cable connections at Haymarket 330/132 kV substation and at Belmore Park 132/11 kV zone substation to form the new circuit.

Works to be completed prior to summer 2017/18:

- Construction of the Inner Metropolitan stage 2, 330 kV proposal.

3.2.4. Notes and Comparison of Options 1, 2 and 3

Notes on Options 1, 2 and 3

1. The construction of the 330 kV cable section by TransGrid in forming a possible Beaconsfield West – Haymarket 132 kV cable circuit is the only feasible option of achieving this connection. Consideration was given to installing a 132 kV cable in the MetroGrid tunnel but this was rejected. The tunnel has a significant section which is not lined and the tunnel was not designed with the intention of installing additional 132 kV cables. Investigations have confirmed that the presence of a 132 kV cable in the tunnel would create significant difficulties in the future when the second 330 kV cable has to be installed. Installing a section of 330 kV cable would be the advancement of these works that would otherwise have been required as part of the Inner Metropolitan stage 2 development described above.
2. The cost estimate for the TransGrid cable work includes a $3 million amount for MetroGrid tunnel remediation works that would otherwise be required to be carried out prior to the stage 2, 330 kV works. This would be an advancement of these works.
3. The Beaconsfield West – Green Square second 132 kV circuit for summer 2011/12 is a common element in the three options as it is the only feasible option to address the limitation which is achievable in the timeframe available and it is consistent with EnergyAustralia's long term plans for the development of the system.
4. EnergyAustralia has already obtained regulatory approval for the second Haymarket – Belmore Park 132 kV cable project.

4. Application of the AER's Regulatory Test

An application of the regulatory test considering Options 1, 2 and 3 has been carried out. A summary of the results is provided in the following sections.

4.1. Form of the Regulatory Test

As discussed in Section 2 the options covered by this final report are a reliability augmentation and the regulatory test is to be applied in accordance with clause 1(a) of the test:

(a) in the event the option is necessitated principally by inability to meet the service standards linked to the technical requirements of schedule 5.1 of the Rules or in applicable regulatory instruments - the option minimises the costs of meeting those requirements, compared with alternative option/s in a majority of reasonable scenarios;

TransGrid and EnergyAustralia's interpretation of the regulatory test for reliability augmentations is as follows.

The following costs should be included:

- Capital costs of options;
- O&M costs of options; and
- Costs of complying with laws, regulations and applicable administrative requirements in relation to the option;

The following avoided costs should not be included:

- Reductions in electrical losses;
- Reductions in unserved energy;
- Deferrals or avoidance of generation or transmission investment elsewhere in the NEM (ie not associated with the option); and
- Avoided fuel costs elsewhere in the NEM.

Market development scenarios are only relevant to the extent that they affect the timing of the onset of network limitations and/or the ability of options to meet those limitations.

4.2. Regulatory Test Application – Summary

4.2.1. Costs

For the regulatory test application only the capital and operating & maintenance costs of options have been explicitly included.

There are no known existing or anticipated government tax or subsidy schemes that would apply materially differently to any option.

There are no known emerging network limitations in the area (other than those described in Section 2.5) for which the solution would be differently affected by either of these options.

Estimated capital costs of each option are given in Table 3 below.

Table 3 Estimated Capital Costs

Component Project	Cost $M
Beaconsfield West – Green Square second 132 kV cable (EA)	$5.1
Retire 92L and 92M (EA)	$2.9
9S4 Haymarket – Beaconsfield West 132 kV cable	
• Energy Australia component (EA)	$7.8
• TransGrid component (includes $3 M tunnel remediation) (TG)	$30
Haymarket – Belmore Park second 132 kV cable (EA)	$4.5
Replace 92L and 92M (for options 2 & 3 only) (EA)	$90.3
Inner Metropolitan stage 2, 330 kV proposal (TG)	$284.7

These costs are derived from estimates of the capital costs of individual component projects.

4.2.2. Scenarios Considered

The Regulatory Test for reliability augmentations requires that options to address network requirements be assessed against a number of reasonable scenarios. In considering reasonable scenarios, TransGrid and EnergyAustralia considered the following key parameters:

- Existing Network
- Future Network Developments
- Variations in load growth
- Existing and Committed Generators and demand side development
- Potential generation and demand side developments

Existing Network and Future Network Developments

As discussed in sections 2.5.1 and 2.5.2 of this final report, existing and future network developments that have the potential to impact supply to the Sydney CBD area have been included as anticipated projects in the underlying analysis.

Variations in Load Growth

To test the impact of demand growth varying from the forecast, lower and higher growth scenarios were considered. Table 4 shows the commissioning dates for the component projects of each option for low, medium and high growth cases. The component projects of each option and the base case commissioning dates are fully described in section 3.

Table 4 Commissioning Dates for Growth Scenarios

Growth Scenario	Option 1	Option 2	Option 3
Medium (base case)	**11/12** Green Square **12/13** Retire 92L & 92M 9S4 Hay – Beaco Belmore Park **16/17** 330 kV stage 2	**11/12** Green Square **12/13** Retire 92L & 92M 9S4 Hay – Beaco Belmore Park **16/17** New 92L & 92M **17/18** 330 kV stage 2	**11/12** Green Square **12/13** Retire 92L & 92M New 92L & 92M **14/15** 9S4 Hay – Beaco Belmore Park **17/18** 330 kV stage 2
Low	**11/12** Green Square **12/13** Retire 92L & 92M 9S4 Hay – Beaco Belmore Park **18/19** 330 kV stage 2	**11/12** Green Square **12/13** Retire 92L & 92M 9S4 Hay – Beaco Belmore Park **18/19** New 92L & 92M **19/20** 330 kV stage 2	**11/12** Green Square **12/13** Retire 92L & 92M New 92L & 92M **15/16** 9S4 Hay – Beaco Belmore Park **19/20** 330 kV stage 2
High	**11/12** Green Square **12/13** Retire 92L & 92M 9S4 Hay – Beaco Belmore Park **15/16** 330 kV stage 2	**11/12** Green Square **12/13** Retire 92L & 92M 9S4 Hay – Beaco Belmore Park **15/16** New 92L & 92M **16/17** 330 kV stage 2	**11/12** Green Square **12/13** Retire 92L & 92M New 92L & 92M **13/14** 9S4 Hay – Beaco Belmore Park **16/17** 330 kV stage 2

Notes:
1. It is not possible to advance the near term works in the high growth scenario.
2. The retirement of 92L and 92M and the consequent need to reinforce the network between Beaconsfield West and Haymarket is independent of the load growth scenarios.

The purpose of this approach is to test the present value of costs of the options evaluated under a range of plausible growth scenarios. The results of the analysis are included in section 4.2.4 with the other sensitivity tests carried out.

Existing and Committed Generators and demand side development

TransGrid and EnergyAustralia are not aware of any existing or committed generation projects that will directly impact the supply to the Sydney CBD area. Demand side developments are analysed in section 2.9 of this final report.

Potential generation and demand side developments

TransGrid and EnergyAustralia are not aware of any committed or new generation projects that will directly impact the supply to the Sydney CBD area. Demand side developments are analysed in section 2.9 of this final report.

4.2.3. Sensitivity Tests

Sensitivity tests of the variability of the ranking of options with respect to the reasonable variations to major financial and technical assumptions are carried out in accordance with Table 4 below.

Table 4 Base Case Values and Range of Values Used in Sensitivity Tests

Parameter	Base Case Value	Sensitivity Tests at
Real Discount Rate	9%	6% and 12%
Annual O&M Cost	2% of Capital Cost	1% and 3% of Capital Cost
Asset Lifetimes	45 years	30 and 60 years
Capital Costs	Nominal Value	±25%

4.2.4. Results

The present value of the costs of each option has been calculated for a base case of financial and technical assumptions and the options ranked accordingly. The results are included in Appendix 1.

Sensitivity tests have been carried out for variations to the major financial and technical assumptions for the medium scenario values as described in Section 4.2.3 and are summarised in Table 5.

Table 5 Sensitivity Tests

	Option 1		Option 2		Option 3	
Case	PV of Costs ($M)	Rank	PV of Costs ($M)	Rank	PV of Costs ($M)	Rank
Base Case	$105	1	$111	2	$132	3
Low Growth Rate	$70	2	$68	1	$95	3
High Growth Rate	$123	1	$135	2	$151	3
Disc Rate 6%	$105	1	$112	2	$130	3
Disc Rate 12%	$101	1	$106	2	$128	3
O&M Costs 1%	$98	1	$104	2	$123	3
O&M Costs 3%	$112	1	$119	2	$141	3
Asset Life 30 Y	$113	1	$119	2	$141	3
Asset Life 60 Y	$101	1	$107	2	$127	3
Costs – 25%	$79	1	$83	2	$99	3
Costs + 25%	$132	1	$139	2	$165	3

Table 4 illustrates that reasonable variations of financial and technical parameters do not affect the ranking of options. The results indicate that Option 1 is the highest ranked option in all cases except one.

5. Conclusions and Proposed Actions

The results in Section 4.2.4 indicate that Option 1 is the highest ranked option in all of the cases considered except one. TransGrid and EnergyAustralia conclude that Option 1 satisfies the regulatory test.

The proposed actions therefore are for the following works to be completed by the dates shown:

- EnergyAustralia to construct a second 132 kV cable circuit from Beaconsfield West – Green Square ZS by summer 2011/12;
- EnergyAustralia to retire it's 132 kV cable sections 92L and 92M from Lane Cove – Dalley Street by summer 2012/13;
- EnergyAustralia to construct a new 700 m 132 kV cable section from Beaconsfield West to Sydney Park by summer 2012/13;
- TransGrid to construct a new 3.5 km 330 kV (operated at 132 kV) cable section from Sydney Park to Haymarket, cable to be laid in TransGrid's existing MetroGrid tunnel by summer 2012/13; and
- 132 kV cable connections at Beaconsfield West 330/132 kV substation, connection of the 330 kV cable to the 132 kV busbar at Haymarket 330/132 kV substation and jointing of the 132 kV cable section to the 330 kV cable section at Sydney Park to form the new 9S4 Haymarket – Beaconsfield West 132 kV cable circuit.

The cost of the works is estimated to be $45.8 million of which $30 million would be for works to be carried out by TransGrid and $15.8 million would be for works to be carried out by EnergyAustralia. The $30 million of TransGrid works includes a component of $3 million for MetroGrid tunnel remediation works required to be advanced prior to the installation of the new cable. The remaining $27 million is the advancement of works that otherwise would be required in 2016 for the Inner Metropolitan stage 2, 330 kV works in any case.

6. Notice of Disputes

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

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

TransGrid copies of dispute notices regarding this final report should be forwarded to:

Mr Garrie Chubb
Tel: 02 9284 3553
Fax: 02 9284 3456
Email: garrie.chubb@transgrid.com.au

Appendix 1: Example of Net Present Value Calculations

The following pages contain details of the net present value calculations for the base case of financial and technical parameters.

Reinforcement of Electricity Supply within the Sydney Central Business District (CBD): Application of the Regulatory Test: Option 1

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Residual
2nd EA Beaco'fld West - Green Square 132kV cable		5.1										-4.0
EA retire 92L & 92M cables			2.9									-2.3
EA 700m 132 kV cable Beaco'fld West - Sydney Park			7.8									-6.2
TG 3.5 km 330 kV cable Sydney Park - Haymarket			30.0									-24.0
2nd EA Haymarket - Belmore Park 132 kV cable			4.5									-3.6
Inner Metropolitan stage 2 330 kV works							284.7					-253.1
O+M Costs			0.10	1.01	1.01	1.01	1.01	6.70	6.70	6.70	6.70	
Total Expenditure		5.10	45.30	1.0	1.0	1.0	285.7	6.7	6.7	6.7	6.7	-293.2
PV of Costs ($Million)	**105.2**											
Total Capex Costs ($Million)	**335.0**											

Reinforcement of Electricity Supply within the Sydney Central Business District (CBD): Application of the Regulatory Test: Option 2

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Residual
2nd EA Beaco'fld West - Green Square 132kV cable		5.1										-4.0
EA retire 92L & 92M cables			2.9									-2.3
EA 700m 132 kV cable Beaco'fld West - Sydney Park			7.8									-6.2
TG 3.5 km 330 kV cable Sydney Park - Haymarket			30.0									-24.0
2nd EA Haymarket - Belmore Park 132 kV cable			4.5									-3.6
EA construct new 92L & 92M							90.3					-80.3
Inner Metropolitan stage 2 330 kV works								284.7				-259.4
O+M Costs			0.10	1.01	1.01	1.01	1.01	2.81	8.51	8.51	8.51	
Total Expenditure		5.10	45.30	1.0	1.0	1.0	91.3	287.5	8.5	8.5	8.5	-379.8
PV of Costs ($Million)	**111.3**											
Total Capex Costs ($Million)	**425.3**											

Reinforcement of Electricity Supply within the Sydney Central Business District (CBD): Application of the Regulatory Test: Option 3

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Residual
2nd EA Beaco'fld West - Green Square 132kV cable		5.1										-4.0
EA retire 92L & 92M cables			2.9									-2.3
EA construct new 92L & 92M			90.3									-72.2
EA 700m 132 kV cable Beaco'fld West - Sydney Park					7.8							-6.6
TG 3.5 km 330 kV cable Sydney Park - Haymarket					30.0							-25.3
2nd EA Haymarket - Belmore Park 132 kV cable					4.5							-3.8
Inner Metropolitan stage 2 330 kV works								284.7				-259.4
O+M Costs			0.10	1.97	1.97	2.81	2.81	2.81	8.45	8.45	8.45	
Total Expenditure		5.1	93.3	2.0	44.3	2.8	2.8	287.5	8.4	8.4	8.4	-373.6
PV of Costs ($Million)	**131.9**											
Total Capex Costs ($Million)	**425.3**											