CONSULTATION PAPER

DEVELOPMENT OF NEW BALGOWLAH ZONE SUBSTATION

12th May 2008

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EXECUTIVE SUMMARY

This paper has been prepared to provide a basis for EnergyAustralia to consult with registered participants and interested parties on the possible options for the development of the electricity supply network in the Balgowlah load area (part of Manly/Warringah area) to address projected limitations of that part of EnergyAustralia's distribution system.

Section 1 of the paper provides a description of the Manly/Warringah 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 outlines the possible options to address the issues affecting the supply network including options for supply system development. Three feasible augmentation options are described:

Option 1 – Development of a 33/11kV Balgowlah zone substation

Option 2 – Development of a 132/11kV Balgowlah zone substation

Option 3 – Development of a hybrid 132/33/11kV Balgowlah zone substation

Section 4 presents the results of a preliminary application of the regulatory test and ranks the options.

Section 5 concludes that the most cost effective strategy within the regulatory test is Option 3 – Development of hybrid 132/33/11kV Balgowlah zone substation, ultimately converted to full 132/11kV operation.

EnergyAustralia's recommended action is the development of a hybrid 132/33/11kV Balgowlah zone substation at an estimated cost of $54.8m which includes feeder connection, decommissioning of the existing zone and sale of the existing site. The total estimated cost including the full conversion of the hybrid zone to 132/11kV operation is $77.2M. The feeder route investigation is in progress and the final estimate of the option may vary depending upon the outcome of this feeder investigation. This recommendation is made based on the least cost test to provide increased future capacity and condition issues of existing equipment.

1. INTRODUCTION

1.1. Purpose and Scope

This paper has been prepared to provide a basis for EnergyAustralia to participate with and consult registered participants and interested parties so as to identify possible options to address projected limitations of the electricity supply network in the Balgowlah load area (part of Manly/Warringah area). It includes:

- A discussion of supply system limitations identified by EnergyAustralia that have led to the necessity of identifying possible options for augmentation of the distribution network in the area;
- A discussion of the service standard that has been adopted for planning purposes;
- A description of possible options which have currently been identified for development of the electricity supply in the area; and
- A detailed preliminary cost effectiveness analysis of each of these options, carried out in accordance with the requirements of the regulatory test.

1.2. Background

The Manly Warringah area is bordered on two sides by Middle Harbour and the Tasman Sea. It is separated from the adjoining Pittwater area by Narrabeen Lakes and bushland. The network supplies Manly and the majority of the Warringah Shire.

The Balgowlah load area is part of the Manly/Warringah area, and is currently supplied by Sydney East Bulk Supply Point (BSP) via Warringah Subtransmission Substation (STS). The load transfers of an initial 10MVA from Balgowlah to Harbord zone substation was completed in May 2007 and this has offered short-term load relief and the Balgowlah zone substation is currently operating above its firm capacity in winter system peak, with load forecast to exceed the EnergyAustralia's design planning limit (in line with licence conditions imposed by Minister of Energy) in winter 2012.

Further, Warringah STS is forecast to exceed firm capacity in winter 2010. Hence, action is required to reduce the risk of loss of supply in the Balgowlah area at times of peak load. Load growth in Warringah load area is in the order of 1.8% pa in winter and 3.3% pa in summer. Load on the system at times of peak demand is at a level where action is necessary to address loading issues.

As per the condition assessment report, Balgowlah is a heritage listed substation constructed in 1920s and is in reasonable condition for its age. However, a substantial proportion of the substation equipment is in a deteriorated state and in need replacement within the next five years.

EnergyAustralia has carried out minor works in the past to optimise the capacity of its existing network in the area. These works are:

- 11kV load transfers aimed at relieving the constraints at Balgowlah zone.
- Emergency 11kV replacement due to fire damage at Balgowlah zone.

Figure 1 indicates the geographic overview of the area and the relative locations of the proposed development.

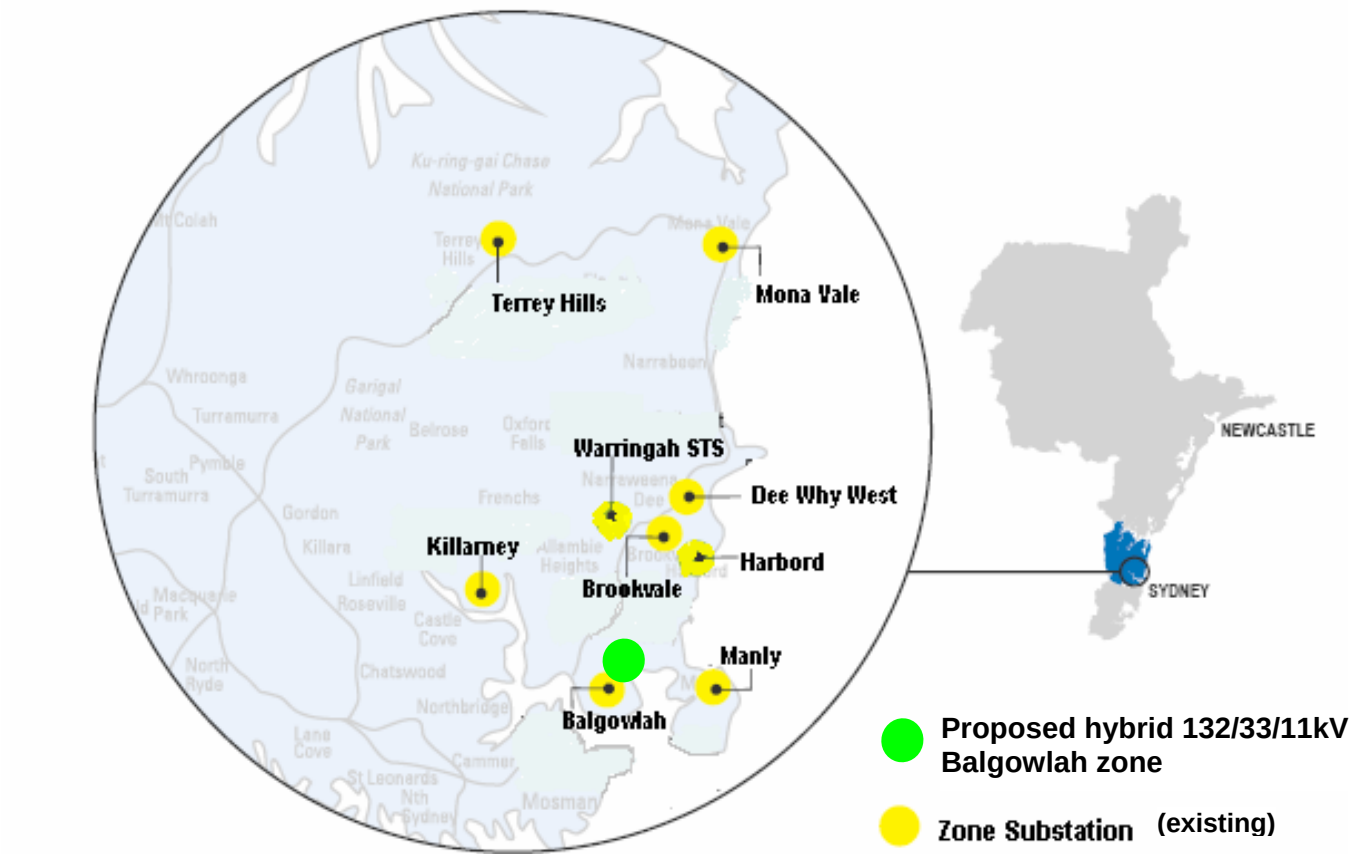


Figure 1 – Geographical Overview of the Area

1.3. Supply Arrangements

1.3.1. Zone Substations

Supply to the Balgowlah load area is normally provided by the following zone substations:

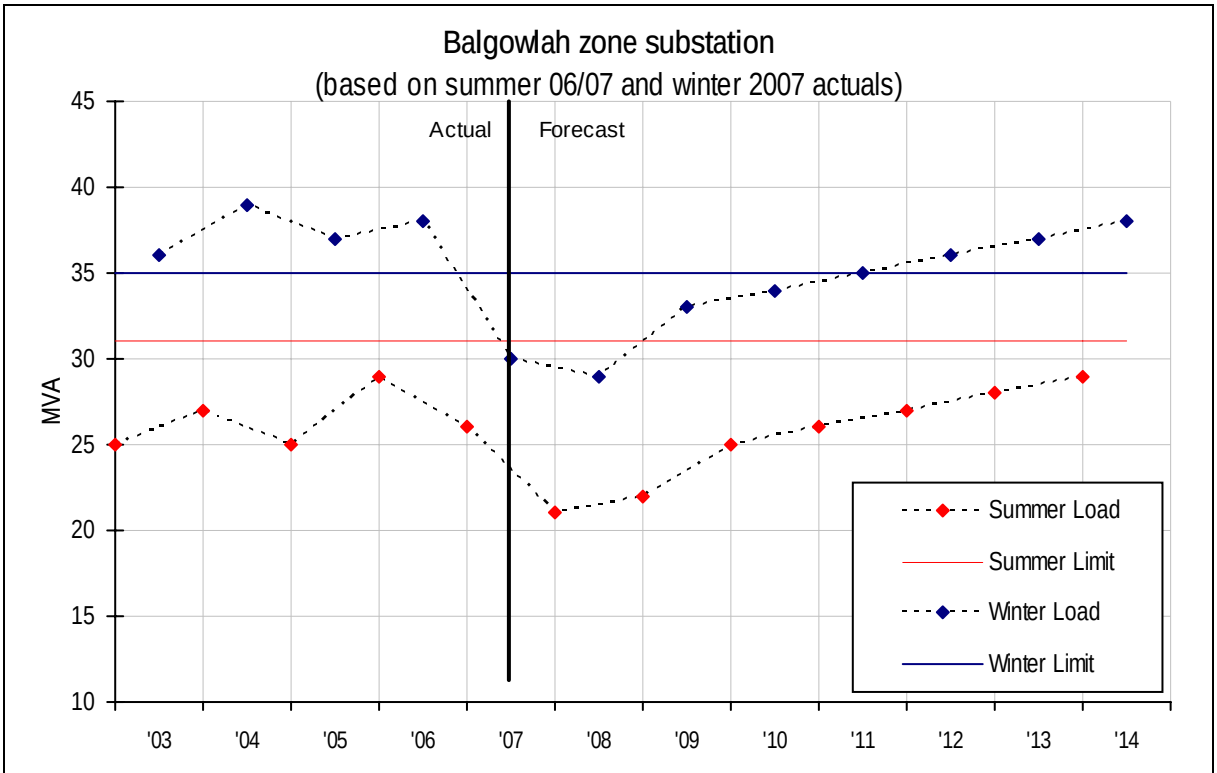
Balgowlah Zone Substation
Balgowlah zone substation was commissioned in 1955 with the building dating to 1920. The zone is a 33/11kV substation consisting of two 19MVA 33/11kV transformers. The zone has a summer and winter firm capacity of 28.9MVA, limited by the transformers. It is supplied by Warringah sub-transmission substation via two 33kV overhead feeders, S01 and S10. The applicable design planning limit for Balgowlah zone is 30.6MVA in summer limited by the 33kV feeder and 34.6MVA in winter limited by 120% of the firm capacity of the zone

The peak load was 26.5MVA in summer 2006/07 and 29.9MVA in winter 2007. Balgowlah zone is currently operating above its firm capacity in winter, and is forecast to exceed the EnergyAustralia's design planning limit in winter 2012. Sustained load growth is expected to continue.

The zone has 11kV interconnections to Harbord and Manly zones. As mentioned in Section 1.2, in order to provide short term load relief, 11kV works was carried out to transfer I0MVA load from Balgowlah to Harbord zone substation. However, this load transfer is considered a temporary measure as it only caters for current load constraints and is not sufficient to cater for future load growth in the Balgowlah load area.

To address 33kV feeder S01 constraint during an outage of feeder S02, a new feeder S14 was constructed in February 2008 to operate in parallel with the S01 feeder section. The new feeder is directly connected to Killarney and the tee from the existing S01 feeder was disconnected. The

final configuration allows the supply to Balgowlah and Killarney zones to be independent of each other, improving reliability of supply to both substations.

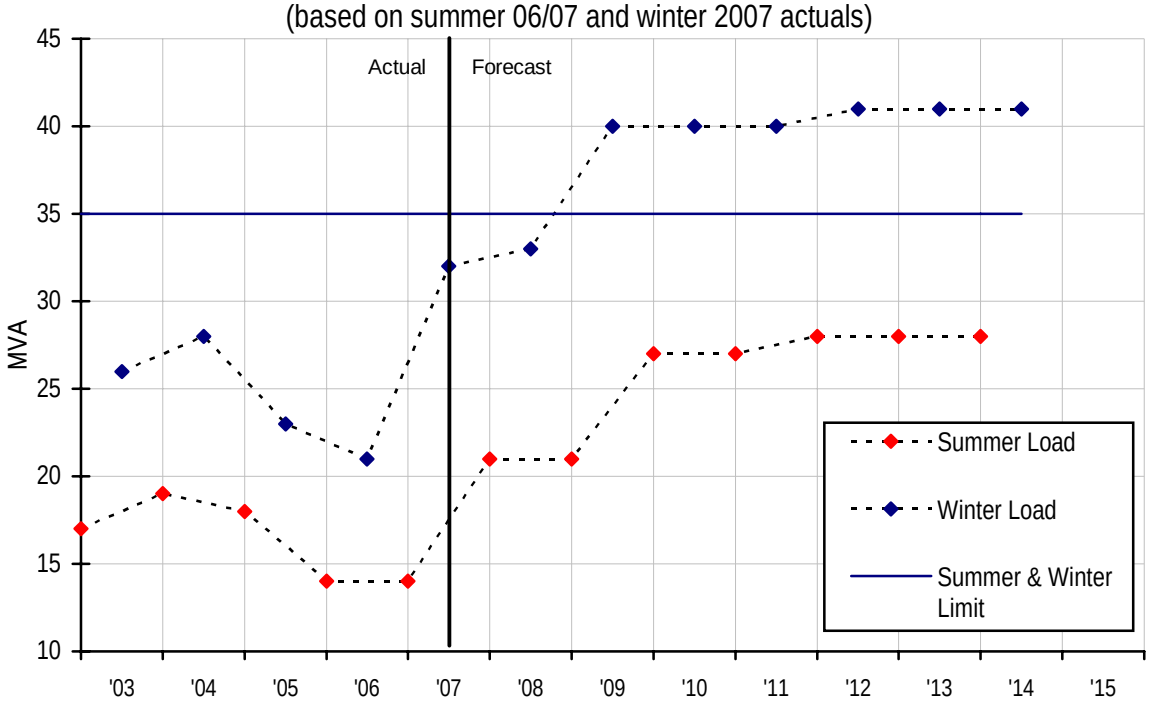


	Actual					Forecast						
SUMMER	**02/03**	**03/04**	**04/05**	**05/06**	**06/07**	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**
Load	25.1	27.4	24.5	29.2	26.5	21.2	21.9	25.4	26.2	26.9	27.8	28.6
Limit	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6
WINTER	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Load	35.6	38.6	36.7	37.6	29.9	29.2	32.9	33.8	34.6	35.6	36.5	37.5
Limit	34.6	34.6	34.6	34.6	34.6	34.6	34.6	34.6	34.6	34.6	34.6	34.6

Harbord Zone Substation

Harbord zone substation is a 33/11kV zone substation that was commissioned in 1971. It is supplied by Warringah STS, via three 33kV feeders, 307, S08 and S18. The substation is equipped with two 25MVA transformers and the firm capacity of the substation is limited by the 33kV switchgear rating.

The planned augmentation work of replacing the 11kV switchgear and also changing the operating arrangements such that both transformers will be normally energised are completed. The firm capacity of the zone after the augmentation is 29.2MVA both in summer and winter. The peak load was 31.7MVA in winter 2007 and 14.3MVA in summer 2006/07. The applicable design planning limit for Harbord zone is 120% of the firm capacity, or 35.0MVA. The zone has already reached its firm capacity in winter mainly due to temporary 11kV load transfer of 10MVA from Balgowlah zone substation. The zone is forecast to exceed the EnergyAustralia's design planning limit in winter 2009. Load growth is expected to be sustained in the medium term.



	Actual					Forecast						
SUMMER	**02/03**	**03/04**	**04/05**	**05/06**	**06/07**	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**
Load	16.9	18.6	17.8	13.6	14.3	21.2	21.3	27.2	27.3	27.5	27.7	27.8
WINTER	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Load	25.7	27.8	22.6	21.2	31.7	32.8	40.0	40.2	40.3	40.5	40.7	40.8
Summer & winterLimit	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0

1.3.2. Subtransmission Substations

Supply to Balgowlah load area is normally provided from Warringah STS.

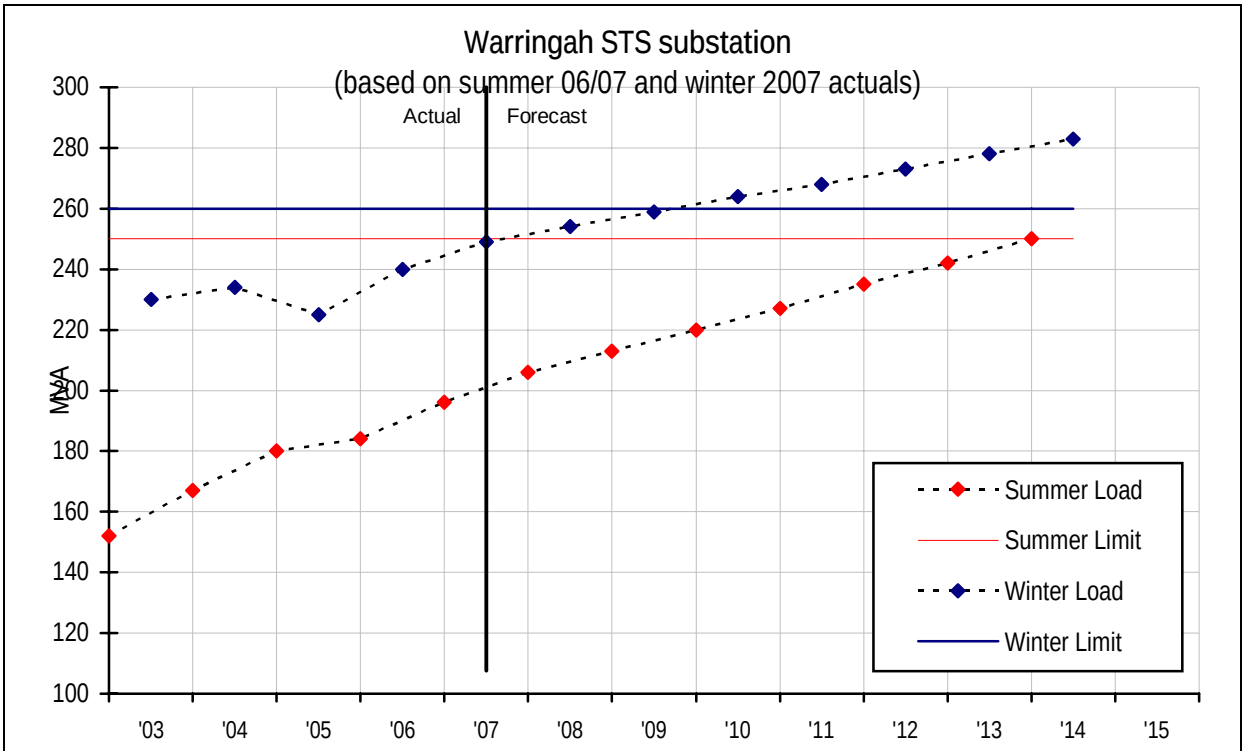
Warringah Subtransmission Substation (STS)
Warringah STS is supplied from TransGrid's Sydney East BSP via four 132kV feeders 9M1, 9M2, 9M3 and 9M4 and is equipped with two 120MVA and two 60MVA, 132/33kV transformers. The firm capacity of Warringah STS is 250MVA in summer and 260MVA in winter. The peak load for summer 2006/07 and winter 2007 was 195.6MVA and 248.7MVA and no constraint is forecasted until winter 2010.

The supply capacity to the area is limited by the capacity of individual zone substations and the 33kV network supplying these substations. The 33kV feeder network is comprised of a number of teed feeders and configured such that two zone substations may be impacted by an outage of any given feeder.

Warringah STS 132kV circuit breakers are currently being replaced. In addition to this, the 132/33kV transformers Tx1 & Tx3 are scheduled for replacement with commissioning expected in October 2009.

Figure 2 below shows the Warringah STS supply network area.

Fig 2 – Warringah STS Supply Network Area



	Actual					Forecast						
SUMMER	**02/03**	**03/04**	**04/05**	**05/06**	**06/07**	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**
Load	152.1	166.7	180.2	183.5	195.6	205.9	212.7	219.8	227.0	234.5	242.2	250.2
Limit	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0
WINTER	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Load	230.3	234.3	224.9	240.2	248.7	254.4	258.9	263.6	268.3	273.2	278.1	283.1
Limit	260.0	260.0	260.0	260.0	260.0	260.0	260.0	260.0	260.0	260.0	260.0	260.0

2. IDENTIFICATION OF NEED FOR AUGMENTATION

2.1. Applied Service Standard

The service standards, in line with the licence conditions imposed by Minister of Energy, that are applicable to a consideration of supply constraints affecting the Balgowlah load area are summarised below.

2.1.1. Zone substations and Subtransmission network

Overhead Subtransmission Lines and Zone Substations:

- For a failure of a single critical element (i.e. N-1 conditions) within zone substations supplying greater than 10MVA of load and for overhead subtransmission network, the forecast demand is not to exceed the thermal capacity for more than 1% of the time i.e. a total aggregate time of 88 hours per annum; up to a maximum of 20% above the thermal capacity. Recovery of load should be within one minute.
- Under normal conditions (i.e. N conditions), the thermal capacity is required to meet at least 115% of forecast demand.

Underground Subtransmission Line

- For an underground subtransmission line, any overhead section should be designed as if it was a subtransmission overhead line, providing the forecast demand does not exceed the thermal capacity of the underground section at any time under N-1 conditions.

2.1.2. 11kV distribution network

For urban feeders[1], the expected demand is to be no more than 80% of feeder thermal capacity (under system normal operating conditions), with switchable interconnection to adjacent feeders to enable restoration following an unplanned failure of a single network element (i.e. N-1 conditions). The 11kV network where in a number of feeders forms an interrelated system, the limits apply to the average loading of the feeders within the one system.

For 11kV networks, voltage drops of up to 5% are regarded as satisfactory. Higher voltage drops are permissible provided that the network connection provided to low voltage customers is within the limits specified in Australian Standard AS2926.

2.2. Description of Network Issues

If all elements of the network supplying this area are in service, the network has adequate capacity. However, the network is expected to be constrained during the first contingency outages in the near future. These constraints are described in the following sections and involve:

- Operational issues in Manly/Warringah area.
- Capacity constraint at Balgowlah zone substation (refer section 1.3.1 for details)
- Age and condition of network assets at Warringah STS and Balgowlah zone substation.

2.2.1. Operational Issues

A range of operational issues apply to the Manly Warringah network area.

- The Manly Warringah 33kV system is complex in operational terms. Supply to eight of the nine zone substations is provided by two meshed 33kV networks. Most 33kV feeders are tee-connected to at least three zone substations. A large portion of the network must be radially split in the event of an outage. This requires extensive and complex switching.

- A large proportion of zone substations in the area have limited numbers of 11kV feeder panels, and accordingly, double banking (ie. two feeders on a single circuit breaker) is adapted to provide 11kV connections when the loading of the circuit breaker is adequate. This has the disadvantage that an outage of one feeder results in the outage of the other. The result of this is that there is then:
  - Greater load (per circuit breaker) to transfer on to other 11kV feeders than would otherwise be the case with a single feeder circuit breaker; or
  - The risk of an interruption to a greater number of customers than would otherwise be the case for non-double banked panels.

- There are operational issues at Balgowlah zone substation including:
  - Some 11kV switchgear is operating close to its fault level ratings and this requires the 33kV network to be operated radially, reducing security of supply;
  - Each transformer is connected via two 11kV transformer circuit breakers of unequal rating, and loads must be carefully distributed between busbar sections and
  - Work at Balgowlah is limited by the width of transformer roadways.

- Some 33kV overhead feeders cross bush reserve areas and have difficult access. This increases restoration times following outages caused by fauna and vegetation. These feeders are also subject to damage from bushfires.

[1] An urban feeder is defined as a feeder with actual maximum demand greater than 0.3MVA/km

2.2.2. Age and Condition of network asset

Warringah STS

- The existing two 60MVA 132/33kV transformers are in the process of being replaced with a single 120MVA transformer and is scheduled for completion in October 2009.

Balgowlah zone substation

- The existing Balgowlah zone substation building dates from the 1920s and is heritage-listed and hence redevelopment of the existing site would be difficult and costly due to space limitations.. The transformer entrance to the substation is too small to accommodate current transformer designs.
- The 33kV indoor bulk oil circuit breakers need to be replaced within the next five years.
- The 11kV switchgear has been prioritised for replacement in the period 2009-11. The J & P circuit breakers have a history of overheating and failure.
- The underground cable sections of 33kV feeders S01 have been prioritised for replacement in the period 2017-27.

Whilst the building is in reasonable condition for its age, it was built to 1920's standards and there are significant issues associated with on site refurbishment. In particular, the building does not comply with current fire management standards, there is no segregation between 33kV and 11kV oil circuit breakers.

The majority of equipment at Balgowlah zone substation indicates a history of poor performance.. The poor condition of 11kV switchgear is evident by a recent circuit breaker failure which resulted in a minor fire. Transformers 1 & 2 at Balgowlah zone substation also require replacement within 5 years and 5-10 years respectively.

Harbord zone substation

- The 33kV circuit breakers at Harbord zone substation require replacement within the next 5 years.

2.3. Consideration of Demand Side Management and Local Generation

The proposed investment is driven by Warringah STS (33kV network loading) and zone substation capacity issues. Demand management has also recently been investigated in the Manly/Warringah areas. Under the revised circumstances, a 3.6MVA demand reduction in winter evening load would be required in winter 2010 to defer the supply side option for one year.

The age and condition of some of the equipment at Balgowlah zone substation means that it will need to be replaced at the end of 2010 in any case. Because of this, it is very unlikely that the project could be deferred for more than one year. The magnitude of the demand reductions required to defer augmentation is such that deferral may be feasible. Demand Management has engaged a program for the reduction of 3.6MVA through diesel generator sets, and power factor correction until 2011.

2.4. National Electricity Rules Requirements

Balgowlah zone substation and its associated feeders are classified as distribution system assets by the National Electricity Rules (the Rules).

The Rules (Clauses 5.6.2(e) and (f)) requires that, where analysis indicates that any relevant technical limits of a distribution system will be exceeded, that the Distribution Network Service Provider (DNSP) must notify any affected Participants of these limitations and of the expected time for corrective action and consult with affected Participants and interested parties on the possible options to address the projected limitations of the relevant distribution system. The proposed options for the Balgowlah load area (to address the projected limitations of the system) include new distribution network asset options that involve expenditure in excess of $10 million. These

options are classed as new large network assets and consequently Energy Australia has an obligation to consult on these options.

EnergyAustralia has previously published details of its load forecasts and the timing of loads exceeding technical limits of the system in its Annual Electricity System Development Reviews of 2004, 2005, 2006 & 2007.

Clause 5.6.2(g) of the Rules requires DNSPs to include the economic analysis of possible options in their consultation on options. This paper has been prepared to consult on identified options which satisfy the regulatory test and meet the network performance standards set out in Schedule 5.1 of the Rules and limb (a) of the regulatory test must be applied to determine the option that satisfies the regulatory test. Under limb (a) of the regulatory test, the option that meets the test is the one that minimises the present value of costs compared with a number of alternative options in the majority of reasonable scenarios.

3. OPTIONS

The major options considered are described in the following sections. The estimate is based on the combination of underground and overhead configuration for feeders. The feeder route investigation is under progress and the final estimate of the option may vary depending upon the outcome of feeder investigation.

3.1. Option 1 – Development of a 33/11kV Balgowlah Zone Substation

Development of 33/11kV Balgowlah zone substation and associated 33kV feeders is one of the feasible options considered for the future supply of the load area. After the commissioning of the zone, the existing Balgowlah zone will be decommissioned.

This option provides for a three 33MVA 33/11kV transformer substation arrangement with three incoming 33kV feeders from Warringah STS. The firm capacity of the 33/11kV Balgowlah zone substation would be 68MVA. The two existing feeders to the current Balgowlah zone substation would be extended and an additional 33kV feeder from the new Balgowlah zone to Warringah STS would be constructed.

However, with this option Warringah STS will still be loaded above its firm capacity and is forecast to be constrained in winter 2010. Hence, there is a requirement to install a fourth 120MVA transformer at Warringah STS before winter 2010.

This option consists of following stages:

Stage 1 - Construction of new 33/11kV Balgowlah zone substation in 2010.
Stage 2 – Installation of fourth transformer at Warringah STS in 2010.

The estimated capital cost for Stage 1 – Development of 33/11kV Balgowlah zone substation is $56.9M which includes 33kV & 11kV feeder works and also decommissioning of the existing Balgowlah zone. The total estimated capital cost including Sage 1 & 2 is $60.3M. The Net Present Cost (NPC) is $57.7M.

3.2. Option 2 – Development of a 132/11kV Balgowlah Zone Substation

Option 2 provides for a 132kV development option with two 50MVA 132/11kV transformers. The firm capacity of the 132/11kV Balgowlah zone substation will be 68MVA limited by the emergency rating of the transformers. The supply to the zone substation will require two 132kV feeders from Warringah STS to Balgowlah zone substation. This option will also facilitate the decommissioning of the existing Balgowlah zone and provide load relief for Warringah STS.

With this option, Warringah STS will no longer be constrained till 2020+.

The estimated total capital cost for Option 2 – Development of 132/11kV Balgowlah zone substation is $66.8M which includes 132kV & 11kV feeder works and also decommissioning of the existing Balgowlah zone. The Net Present Cost (NPC) is $60.0M.

3.3. Option 3 – Development of a Hybrid 132/33/11kV Balgowlah Zone Substation

Option 3 presents a hybrid 132/33/11kV Balgowlah zone substation with main supply at 132kV and standby supply at 33kV. The firm capacity of the hybrid Balgowlah zone would be 49.5MVA limited by the emergency rating of the 33kV feeder. The hybrid zone is to be constructed such that eventual conversion to full 132/11kV operation is possible. This option will address the following constraints;

- The issue of aging 11kV and 33kV switchgear at Balgowlah zone substation.
- Capacity constraints on Balgowlah and surrounding zones.
- Capacity constraint on Warringah STS in winter 2010.
- Security of supply and reliability issues.
- The need to offload Manly zone in the medium term to facilitate replacement of 11kV and 33kV switchgear.

Under this option Balgowlah zone substation would initially be equipped with two 33MVA 33/11kV and one 50MVA 132/11kV transformers. The hybrid zone is anticipated to be commissioned in early 2011.

As per the current forecast, the full 132/11kV operation of the zone is only anticipated in 2025.

This option consists of following stages:

Stage 1 - Construction of new hybrid 132/33/11kV Balgowlah zone substation in 2011.
Stage 2 - Conversion of hybrid Balgowlah zone to full 132/11kV operation in 2025.

The estimated capital cost for Stage 1 – Development of hybrid 132/33/11kV Balgowlah zone substation is $54.8M which includes 132kV, 33kV & 11kV feeder works and also decommissioning of the existing Balgowlah zone. The total estimated capital cost including Stage 1 & 2 is $77.2M. The Net Present Cost (NPC) is $55.0M.

4. APPLICATION OF THE REGULATORY TEST

A preliminary economic analysis has been carried out for the period 2007/08 to 2025/26. This analysis involves the comparison of options on an economic basis by carrying out NPC analysis for each of the three options.

EnergyAustralia has included a range of issues in comparison of options such as change in discount rates and variations in 132kV or 33kV feeder costs. In summary, the three options as presented are technically and economically comparable, given due consideration to all capital costs and operating costs that are able to be defined and quantified.

4.1. Base Case Analysis

In terms of increasing cost the options considered are ranked in the following order considering 8.5% discount rate as the base case:

Options	Stage 1 Capital Cost ($M)	Total Capital** Cost ($M)	NPC ($M)
Option 3 – Development of Hybrid 132/33/11kV Balgowlah zone substation	54.8	77.2	**55.0**
Option 1 – Development of 33/11kV Balgowlah zone substation	56.9	60.3	57.7
Option 2 – Development of 132/11kV Balgowlah zone substation	66.8	66.8	60.0

** Total capital cost includes all the stages in the option considered.

Detailed analysis is provided in Section 7.0 Appendix – A.

The analysis above indicates that under base case conditions, the NPC of Option 3 is the least cost solution.

4.2. Sensitivity Analysis

The base case and the range over which sensitivity checks were conducted are shown in the following table;

Parameter	Base Case Value	Sensitivity Checks at
Real Discount Rate	8.5%	7% and 10%
Asset Costs 132kV or 33kV Feeder Costs	100%	50% and 150%

Sensitivity Analysis was carried out to consider the impact of different discount factors and to consider scenarios of equipment cost. The results of sensitivity analysis are provided in the following table:

Sensitivity Factor	NPC ($m) Option 1	NPC ($m) Option 2	NPC ($m) Option 3
Base Case 8.5% Discount Rate	57.7	60.0	**55.0**
7% Discount Rate	59.5	62.6	**58.7**
10% Discount rate	56.1	57.7	**51.8**
50% increase in 132kV or 33kV feeder cost	74.6	75.4	**67.2**
50% decrease in 132kV or 33kV feeder cost	42.3	42.1	**41.3**

The results of the sensitivity analysis indicate that Option 3 – Development of hybrid 132/33/11kV Balgowlah zone substation is the least cost option under all sensitivity scenarios.

5. CONCLUSION

The development of hybrid 132/66/11kV Balgowlah zone substation ultimately converted to 132/11kV design is the least cost option under all sensitivity scenarios. Accordingly, subject to comments received during consultation, EnergyAustralia favours Option 3.

6. CONTACT DETAILS

Comments on this consultation paper, including proposals for alternative options must be in the form of written submissions, which may be in hard copy or suitable electronic format and must be provided by 8th July 2008. Proposals or other enquiries should be directed to the contact listed below:

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GPO Box 4009
Sydney 2001

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Phone: 02 9269 2862
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7. APPENDIX A – ECONOMIC ANALYSIS OF BASE CASE

Discount Factor 8.5%

Option 1 - Development of a 33/11kV Balgowlah North zone substation

Description	NPC ($m)	Capex ($m)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Construct new Balgowlah zone at 33/11kV	19.41	21.10	3.67	12.92	4.51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Decommissioning of existing Balgowlah	-1.18	-2.14	0	0.21	1.35	-0.48	0	-3.21	0	0	0	0	0	0	0	0	0	0	0	0	0
Three 33kV Feeder Works & Connections	29.81	35.08	0	1.87	31.34	1.87	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11kV works	2.29	2.80	0	0	1.40	1.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (Stage 1)	**50.33**	**56.85**	3.67	15.00	38.60	2.79	0	-3.21	0	0	0	0	0	0	0	0	0	0	0	0	0
Installation of fouth Tx at Warringah STS	3.02	3.41	0	1.71	1.71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O&M Costs	4.39		0	0	0	0.03	0.45	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
TOTAL	**57.74**	**60.26**	**3.67**	**16.71**	**40.30**	**2.81**	**0.45**	**-2.51**	**0.70**	**0.70**	**0.70**	**0.70**	**0.70**	**0.70**	**0.70**	**0.70**	**0.70**	**0.70**	**0.70**	**0.70**	**0.70**

Option 2 - Development of a 132/11kV Balgowlah zone substation

Description	NPC ($m)	Capex ($m)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Construct Balgowlah zone at 132/11kV	22.18	26.97	0.33	2.32	10.58	13.21	0.53	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Decommissioning of existing Balgowlah	-0.89	-1.81	0	0.54	1.09	-0.23	0	-3.21	0	0	0	0	0	0	0	0	0	0	0	0	0
Two 132kV Feeder Works & Connections	31.63	38.83	0	0	18.47	20.36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11kV works	2.29	2.80	0	0	1.40	1.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (Stage 1)	**55.21**	**66.79**	0.33	2.86	31.54	34.74	0.53	-3.21	0	0	0	0	0	0	0	0	0	0	0	0	0
O&M Costs	4.83		0	0	0	0	0.49	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
TOTAL	**60.04**	**66.79**	**0.33**	**2.86**	**31.54**	**34.74**	**1.03**	**-2.44**	**0.77**	**0.77**	**0.77**	**0.77**	**0.77**	**0.77**	**0.77**	**0.77**	**0.77**	**0.77**	**0.77**	**0.77**	**0.77**

Note: The estimates are in real dollars based on 2006/07. Year 2008 refers 2007/08.

Option 3 - Development of a Hybrid 132/33/11kV Balgowlah substation

Description	NPC ($m)	Capex ($m)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Construct Balgowlah Hybrid zone at 132/33/11kV	22.39	27.24	0.33	2.32	10.58	13.52	0.49	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Decommisioning of existing Balgowlah zone	-1.18	-2.14	0	0.21	1.35	-0.48	0	-3.21	0	0	0	0	0	0	0	0	0	0	0	0	0
33kV and 132kV Feeder Works & Connections	21.29	26.93	0	0	3.15	23.77	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11kV works	2.29	2.80	0	0	1.40	1.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (Stage 1)	**44.79**	**54.83**	0.33	2.53	16.48	38.21	0	-3.21	0	0	0	0	0	0	0	0	0	0	0	0	0
Coversion of Balgowlah to full 132/11kv zone - 2nd feeder	5.53	20.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.02	18.36	1.02	0
Replace 33kVTx with 132kV Tx	0.54	2.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.00	0.0	0
O&M Costs	4.15		0	0	0	0	0.46	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66
TOTAL	**55.01**	**77.23**	**0.33**	**2.53**	**16.48**	**38.21**	**0.95**	**-2.55**	**0.66**	**0.66**	**0.66**	**0.66**	**0.66**	**0.66**	**0.66**	**0.66**	**0.66**	**1.68**	**21.02**	**1.68**	**0.66**

Note: The estimates are in real dollars based on 2006/07. Year 2008 refers 2007/08.