CONSULTATION PAPER

DEVELOPMENT OF

RATHMINES 132/11kV ZONE SUBSTATION

19th May 2008

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EXECUTIVE SUMMARY

This paper has been prepared to provide a basis for EnergyAustralia to consult with registered and interested parties on the possible options for the development of the electricity supply network in the West Lake Macquarie area to address limitations of that part of EnergyAustralia's distribution system. EnergyAustralia have conducted an economic analysis of options that satisfy regulatory test.

Section 1 of the paper provides a description of the West Lake Macquarie load area.

Section 2 presents EnergyAustralia's service standards for the area and describes, in detail, the nature of the increasing 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 and demand management. Three supply side strategies are discussed:

Strategy 1 – Permanent Rathmines 132/11kV ZS and future Woodrising 33/11kV ZS

Strategy 2 – Awaba 132/11kV ZS

Strategy 3 – Myuna 33/11kV ZS and future Woodrising 33/11kV ZS

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

Section 5 concludes that the most cost effective solution within the regulatory test is

Strategy 1 – Permanent Rathmines 132/11kV ZS and future Woodrising 33/11kV ZS.

Thus, EnergyAustralia's recommended action is Strategy 1: development of the permanent Rathmines 132/11kV zone substation (ZS) and future Woodrising 33/11kV ZS. The first stage of this strategy involves the development of a permanent 132/11kV ZS at Rathmines and associated 132kV and 11kV feeder works. The total capital cost of the first stage is estimated to be $24.6M with a net present cost (NPC) of $23.3M. The estimated capital cost for the Strategy 1 is $50.7M with a NPC of $43.5M.

1. INTRODUCTION

1.1. Purpose and Scope

This paper has been prepared to provide a basis for EnergyAustralia to participate with and consult registered and interested parties so as to identify possible options to address projected loads and limitations of the electricity supply network in the West Lake Macquarie 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 West Lake Macquarie area is bounded by Boolaroo to the north, Wyee to the south and is situated between Lake Macquarie and the F3 freeway. There are a number of existing and future supply issues in the northern part of the West Lake Macquarie area including:

- Toronto zone substation firm capacity constraints and aged assets,
- Boolaroo zone substation aged assets,
- Wangi 11kV distribution issues,
- Awaba STS aged assets.

In order to address these various capacity and asset condition issues, the long term strategy is to construct a permanent 132/11kV zone substation at Rathmines. However, the previously planned development of the Rathmines ZS was delayed due to potential future mine subsidence issues at the previously selected site. A temporary 132/11kV single-transformer zone substation has recently been commissioned at Rathmines as a short-term solution to address the immediate supply issues at the Toronto zone substation.

A recent investigation has recommended an alternative site for the development of the proposed permanent Rathmines ZS. The proposed development of permanent Rathmines 132/11kV zone substation is part of the preferred long term strategy for the West Lake Macquarie area.

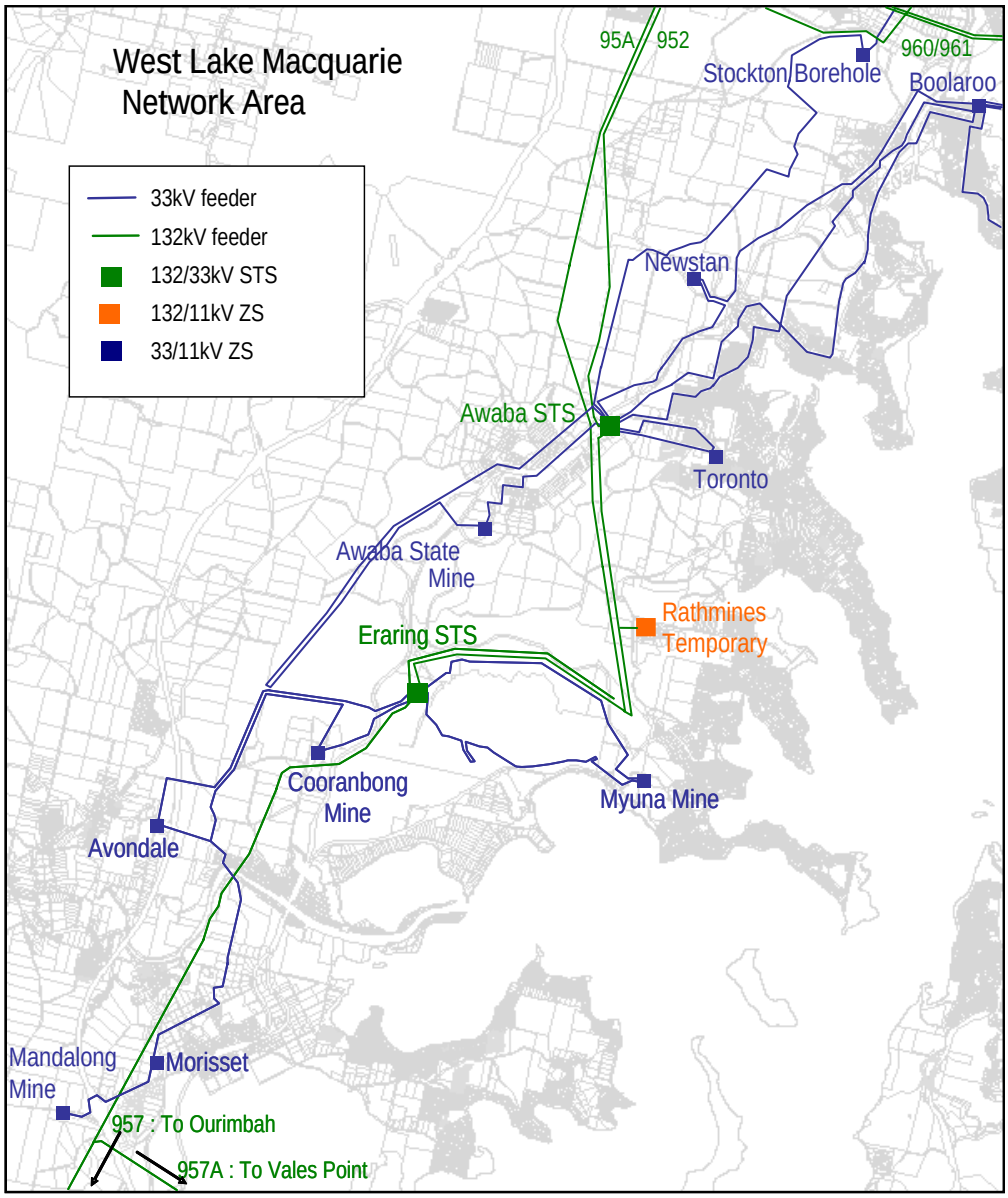


Figure 1.0 – Geographic overview of West Lake Macquarie area

1.2.1. Supply Arrangements

Current supply arrangement to the northern part of the West Lake Macquarie area is as follows:

Awaba Subtransmission Substation

Awaba 132/33kV Subtransmission Substation (STS) supplies Boolaroo and Toronto 33/11kV zone substations as well as Newstan Colliery and Awaba State Mine 33/11kV zone substations. The Awaba STS is supplied from TransGrid's Newcastle Bulk Supply Point (BSP) via two 132kV overhead feeders 95A and 952.

Eraring Subtransmission Substation

Eraring 132/33kV STS supplies Avondale and Morisset 33/11kV zone substations as well as Cooranbong, Mandalong and Myuna mines at 33kV. The Eraring STS is supplied from TransGrid's Newcastle BSP via a 132kV overhead feeder 952, and also has 132kV connections with Ourimbah STS and Delta Electricity's Vales Point Power Station via feeder 957.

Boolaroo Zone Substation

Boolaroo ZS is supplied from Awaba STS via three 33kV feeders. There are significant aged asset issues at the Boolaroo ZS. It is envisaged that Boolaroo zone substation will be decommissioned in 2009/10 after the commissioning of Argenton 132/33/11kV substation (to the north) anticipated in 2008. All of the Boolaroo 11kV feeders are planned to be transferred to Argenton.

Toronto Zone Substation

Toronto ZS is supplied from Awaba STS via two 33kV feeders. In order to address the capacity issues at the Toronto ZS, a proportion of 11kV load from Toronto ZS has recently been transferred to Rathmines temporary ZS.

Rathmines Temporary Zone Substation

Rathmines 132/11kV temporary ZS has recently been commissioned as a short-term solution to address the capacity issues at Toronto ZS and the delay of the permanent Rathmines ZS. The Rathmines temporary ZS is supplied from TransGrid's Newcastle BSP via a tee connection to feeder 952.

The West Lake Macquarie network is summarised in the figure below.

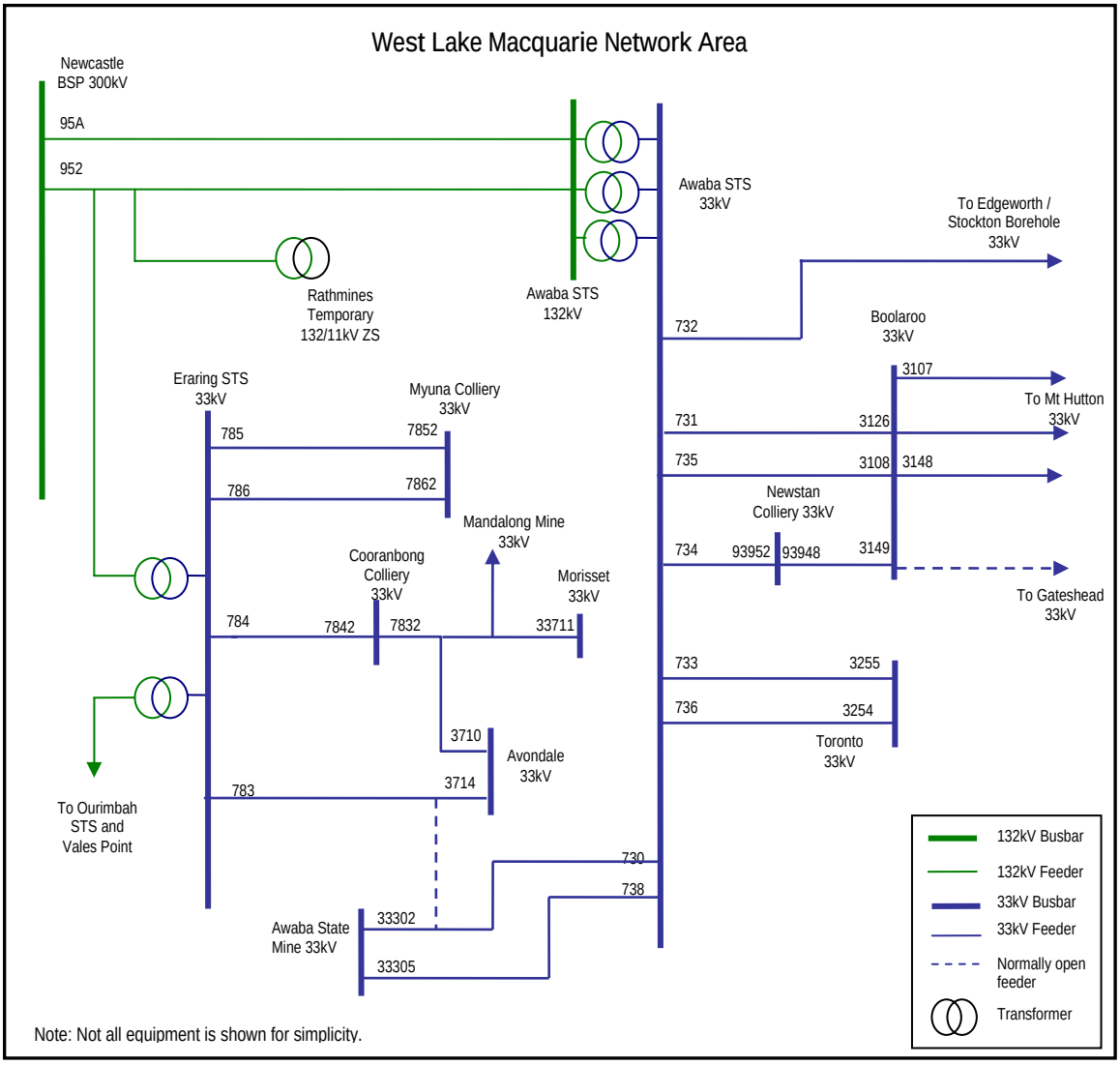


Figure 2.0 –West Lake Macquarie area network

1.2.2. National Electricity Rules Requirements

Most of the EnergyAustralia network in the West Lake Macquarie area, including the aforementioned three zone substations 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 must notify any affected Registered Participants of these limitations and the expected time for corrective action and consult with affected Registered Participants and interested parties on the possible options to address the projected limitations of the relevant distribution system.

The timing of the proposed work is driven by both the aged asset issues and the need to provide increased system capacity to meet minimum network performance standards required by EnergyAustralia Licence conditions and would thus be regarded as a reliability augmentation. EnergyAustralia has provided notification of these limits in its Annual Electricity System Development Review (AESDR) and is consulting with registered participants and interested parties in accordance with the rules due to the increased capacity which will result from the strategies.

The proposed development strategy for the West Lake Macquarie area involves expenditure in excess of $10 million and is regarded by the Rules as a new large network asset.

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. The development of options is necessitated solely by the future inability to meet the minimum network performance requirements set out in Schedule 5.1 of the Rules and by EnergyAustralia Licence conditions. 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 which 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.

2. IDENTIFICATION OF NEED FOR AUGMENTATION

2.1. Applied Service Standard

The service standards that are applicable to a consideration of supply constraints affecting the West Lake Macquarie load area are summarised below:

Applicable to all Network Elements

The minimum requirement for any network element is that, with all elements in service, the thermal capacity is required to meet at least 115% of forecast demand. The requirements described in the following sections are additional to this requirement.

Subtransmission substations

For a failure of a single critical element (i.e. N-1 conditions) within a subtransmission substation, the forecast demand is not to exceed the thermal capacity. Recovery of load should be within one minute.

The upper voltage level on the underground 132kV system is restricted to 1.05 per unit. Marginally higher voltages may be possible in some areas with overhead connection. The lower voltage limit is determined by the requirement during first contingency outages for: Transformers in sub-transmission substations to maintain regulation; and voltage levels on the 132kV system should not fall below 90% of their nominal voltage (0.9 pu).

The voltage regulation range of the 33kV system is determined by the requirement for zone transformers: to maintain regulation under normal system conditions; and be less than 4% below their set voltage level (allowing for line drop compensation) during first contingency outages.

Zone substations and Overhead Subtransmission Feeders

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 Feeders

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

11kV distribution network

For a distribution feeder in urban[1] area, 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

2.2.1. Capacity Limitations

Toronto Zone Substation

Toronto ZS is equipped with two 25MVA transformers and has a firm capacity of 26.9MVA in summer and 29.0MVA in winter. The area of Toronto has limited distribution capacity on all the feeders and has very limited interconnection capacity to surrounding zones.

Toronto zone substation peak load exceeded 120% of the zone firm capacity in summer 2006/2007. Loads have been recently transferred to Rathmines Temporary zone substation in order to maintain the Toronto ZS load within the 120% utilisation level. Toronto ZS summer peak load is forecast to exceed the 120% of the firm capacity level in summer 2011/2012.

Rathmines Temporary Zone Substation

The Rathmines temporary ZS is equipped with one 25/37.5MVA transformer and hence has the 'N' network security standard. The Rathmines temporary ZS was recently installed as a short-term solution to address the capacity issues at Toronto ZS and the delay of the permanent Rathmines ZS.

Under the Licence condition, the zone substations supplying loads greater than or equal to 10MVA are required to provide 'N-1' security standard. The Rathmines temporary zone substation peak load is forecast to exceed 10MVA in summer 2010/2011.

[1] Urban, for EnergyAustralia, means an area where the majority of land is zoned for residential and/or commercial and/or industrial use within a town or city type of area which is contiguous with other similar town or city areas with an aggregated population of at least 5,000 people.

Furthermore, the Wangi peninsula area load was previously supplied from Toronto ZS but is now supplied from the Rathmines temporary ZS. Previously, the 11kV feeders from Toronto ZS to the Wangi area are up to 13km long and had voltage regulation issues.

The Toronto ZS is geographically the closest zone substation from Rathmines temporary ZS, however it is not feasible to transfer load from Rathmines temporary ZS to Toronto ZS due to the various capacity and aged asset issues at the Toronto ZS. Load transfers to other adjacent zone substations, Avondale and Boolaroo, are not feasible or cost-effective due to various capacity and aged asset issues as well as significant distances between Rathmines temporary ZS and those zone substations.

2.2.2. Asset Issues

Toronto Zone Substation

Toronto ZS is approximately 47 years old and no significant refurbishment work has been undertaken since commissioning. Majority of the assets at Toronto zone are reaching the end of their serviceable life and require replacement within five years.

Recently the 11kV switchroom at the substation suffered from land subsidence related damage, requiring the installation of temporary strung bus and decommissioning of part of the 11kV switchboard. The zone substation is located within an established residential area and has very limited available room to accommodate any significant expansion or redevelopment. The two 25MVA Tyree transformers presently installed at Toronto zone were commissioned in 1974 and no issues have been identified with the transformers. However, the capacity benefits of replacing the transformers with larger units are very limited given the other asset and capacity limitations that exist at the site.

Boolaroo Zone Substation

Boolaroo ZS is approximately 50 years old. The site is located next to the recently closed Pasminco smelter. Prior to the closure of Pasminco this area was regarded as a high pollution area due to the smelter emissions. This has caused increased degradation of the substation equipment, particularly the circuit breaker bushings.

It is envisaged that Boolaroo zone substation will be decommissioned in 2009/10 after the commissioning of Argenton 132/33/11kV substation (to the north) anticipated in 2008. All of Boolaroo 11kV feeders are planned to be transferred to Argenton.

Awaba STS

Awaba STS is approximately 48 years old. The substation utilises an outdoor 132kV bus, outdoor transformers and outdoor 33kV switchgear. The 33kV circuit breakers are Westinghouse 345GCN type requiring ongoing monitoring of the bushing condition. These units will require replacement in the near future.

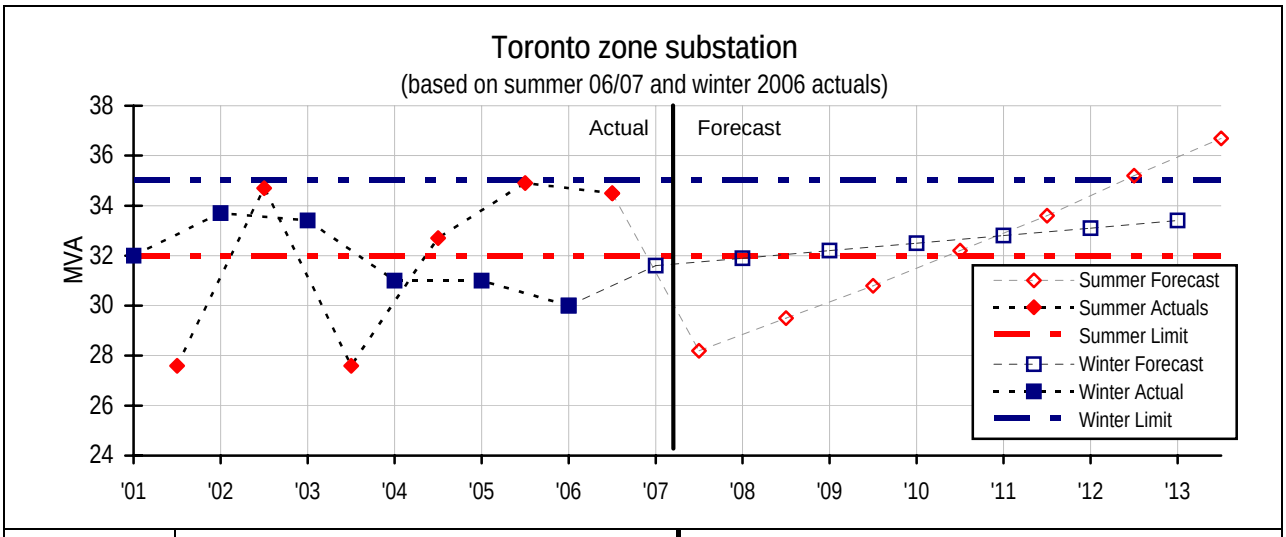
A majority of the original equipment is still in service. The 132kV and 33kV isolators are old and deteriorating, and now require increased level of maintenance.

Commissioning of proposed Argenton 132/33/11kV substation in the area will provide an opportunity to retire a majority of substation equipment at Awaba STS.

2.3. Load Forecast

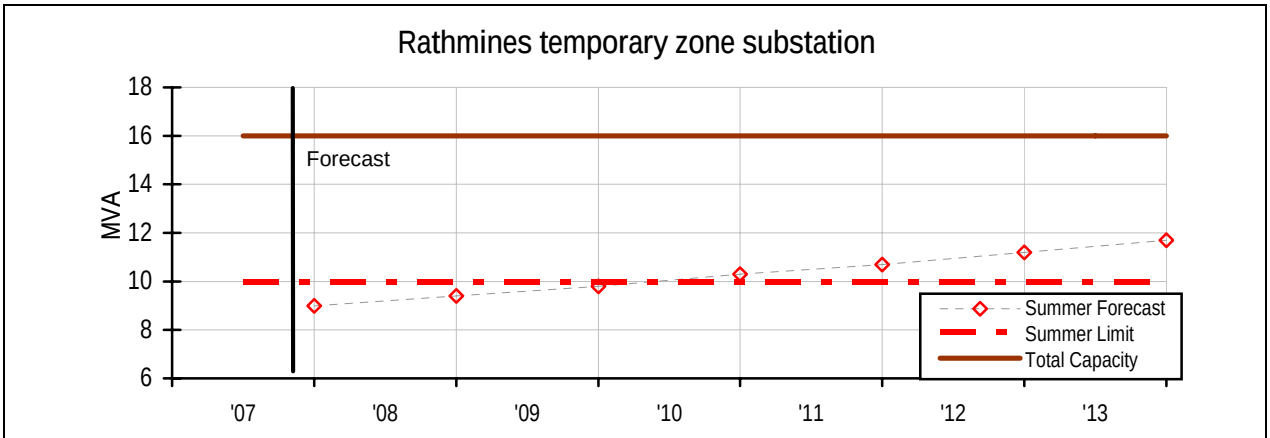
Load forecast for Toronto and Rathmines temporary zone substations are shown in the following tables. Load forecast data for summer and winter is based on actual loads for summer 2006/2007 and winter 2006 respectively.

Summer 2007 indicates Summer 2006/07.



	Actual						Forecast						
SUMMER	**01/02**	**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 [MVA]	27.6	34.7	27.6	32.7	34.9	34.5	28.2	29.5	30.8	32.2	33.6	35.2	36.7
Firm Capacity (FC) [MVA]	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9
Limit (120% of FC) [MVA]	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3
Utilisation (Load/FC)	103%	129%	102%	122%	130%	128%	105%	110%	115%	120%	125%	131%	137%
WINTER (See Note 1)	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Load [MVA]	32.0	33.7	33.4	31.1	31.0	30.0	31.6	31.9	32.2	32.5	32.8	33.1	33.4
Firm Capacity (FC) [MVA]	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0
Limit (120% of FC) [MVA]	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8
Utilisation (Load/FC)	110%	116%	115%	107%	107%	103%	109%	110%	111%	112%	113%	114%	115%

Note 1: The load transfer from Toronto ZS to Rathmines temporary ZS has not been included in the Toronto winter load forecast data. Approximately 8MVA of winter peak load would be transferred to Rathmines temporary ZS from 2007.



	Forecast						
SUMMER	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**
Load [MVA]	9.0	9.4	9.8	10.3	10.7	11.2	11.7
Total Capacity [MVA]	16.0	16.0	16.0	16.0	16.0	16.0	16.0
Limit[#] [MVA]	10.0	10.0	10.0	10.0	10.0	10.0	10.0

: 10MVA limit for 'N' network security standard under the Licence conditions.
Note: Approximately 8MVA of winter peak load would be transferred from Toronto ZS to Rathmines temporary ZS.

3. OPTIONS

The following section describes Demand Management and supply side strategies considered to address various capacity and aged asset issues in the West Lake Macquarie area. Supply side strategies considered include:

- Strategy 1: Permanent Rathmines 132/11kV ZS and future Woodrising 33/11kV ZS.
- Strategy 2: Awaba 132/11kV ZS.
- Strategy 3: Myuna 33/11kV ZS and future Woodrising 33/11kV ZS.

Note: The cost estimates indicated in this section are for the projects that relate to the issues discussed above and those that are within the West Lake Macquarie area strategies.

3.1. Consideration of Demand Side Management and Local Generation

Investigation of demand management opportunities in the West Lake Macquarie area was carried out previously in 2006 with the Demand Management Screening Test (DMST) concluding that it is not considered cost-effective to defer the proposed Rathmines permanent ZS by implementing DM solutions. The DMST is currently being reviewed considering the new circumstances since 2006. It is anticipated that the review of the DMST will be completed in the near future.

3.2. Strategy 1: Permanent Rathmines 132/11kV ZS and Future Woodrising 33/11kV ZS

This strategy involves development of permanent Rathmines 132/11kV zone substation as well as Woodrising 33/11kV zone substation in the future to address various issues in the West Lake Macquarie area.

Major components of this strategy include the following projects:

Project	Commission Date
Rathmines 132/11kV ZS	2010
Decommission Rathmines Temporary ZS	2010
Woodrising 33/11kV ZS	2012
Decommission Toronto ZS	2013
Decommission Awaba STS 33kV bus and Transformers	2014

The development of the proposed permanent Rathmines 132/11kV zone substation in the vicinity of the existing Rathmines temporary zone substation is the first stage of this strategy. The proposed Rathmines 132/11kV zone substation and associated feeder works will:

- Provide the required load relief for Toronto ZS;
- Enable the retirement of Rathmines temporary ZS;
- Address 11kV distribution network issues in the Wangi peninsula and surrounding areas;
- Provide an opportunity (along with the future development of Woodrising ZS) to retire Toronto ZS and Awaba STS to address their aged asset issues; and
- Enable the reconfiguration of the 132kV network which will significantly reduce load flow through Eraring STS transformers.

The estimated capital cost for this entire strategy is $50.7M with a Net Present Cost (NPC) of $43.5M.

3.3. Strategy 2: Awaba 132/11kV ZS

This strategy involves development of Awaba 132/11kV zone substation. This strategy involves maintaining the Rathmines temporary ZS in service until 2013 by transferring load to the proposed Awaba ZS via the Toronto ZS, in order to maintain the load below 10MVA at the Rathmines temporary ZS.

Major components of this strategy include the following projects:

Project	Commission Date
Awaba 132/11kV ZS	2010
Decommission Rathmines Temporary ZS	2013
Decommission Toronto ZS	2013
Awaba ZS additional 11kV switchgear	2014
Decommission Awaba STS 33kV bus and Transformers	2014

This strategy provides similar benefits as those of the Strategy 1.

The estimated capital cost for this entire strategy is $56.3M with a NPC of $48.3M.

3.4. Strategy 3: Myuna 33/11kV ZS and Future Woodrising 33/11kV ZS

This strategy involves development of two 33/11kV zone substations: Myuna and Woodrising. The 33/11kV ZS at Myuna will enable the retirement of the Rathmines temporary ZS and will also address the capacity issues at the Toronto ZS. The proposed Myuna ZS will be supplied from Eraring STS and this will result in the need for augmentation of Eraring STS in the future.

Major components of this strategy include the following projects:

Project	Commission Date
Myuna 33/11kV ZS	2010
Decommission Rathmines Temporary ZS	2010
Woodrising 33/11kV ZS	2012
Decommission Toronto ZS	2013
Decommission Awaba STS 33kV bus and Transformers	2014
Eraring STS transformer uprating	2018
Myuna ZS 33kV feeder uprating	2022

This strategy provides similar benefits as those of the Strategy 1.

The estimated capital cost for this entire strategy is $61.8M with a NPC of $47.6 M.

4. APPLICATION OF THE REGULATORY TEST

A preliminary economic analysis has been carried out. It involves the comparison of options on an economic basis by carrying out NPC analysis for each of the three options.

The economic analysis incorporates:

- Capital costs.
- Operation and Maintenance (O&M) costs.
- Sensitivities to changing:
    - Substation construction costs.
    - Transmission mains costs.
    - Distribution mains costs.
    - Discount Factor.
    - Load growth rate.

The unserved energy benefits do not vary materially between options and have thus been excluded from analysis.

4.1. Base Case Analysis

The results of the base case economic analysis using a discount factor of 8.5% are summarised in Table 1 below.

Table 1 - Comparison of Options – Base Case

Options	Description	Capital Cost ($M)	NPC[1] of Costs ($M)
Strategy 1	Permanent Rathmines 132/11kV ZS and future Woodrising 33/11kV ZS	**50.7**	**43.5**
Strategy 2	Awaba 132/11kV ZS	56.3	48.3
Strategy 3	Myuna 33/11kV ZS and future Woodrising 33/11kV ZS	61.8	47.6

The analysis above indicates that Options 1 has the least Net Present Cost.

4.2. Sensitivity Analysis

The base case and the range over which sensitivity checks were conducted are shown in Table 2.

Table 2 - Base Case Values and Range of Values Used in Sensitivity Checks

Parameter	Base Case Value	Sensitivity Checks at
Substation Costs	100%	75% and 125%
Transmission Mains Costs	100%	75% and 125%
Distribution Mains Costs	100%	75% and 125%
Discount Factor	8.5%	7.0% and 10.0%
Growth Rate	100%	75% and 125%[2]

The results of sensitivity analysis are displayed in Table 3 below.

[1] NPC also includes operation and maintenance costs.
[2] Variation in annual load growth rate from the base rate.

Table 3 - Sensitivity Analysis: Comparison of Options

Scenario	Net Present Cost ($M)		
	Strategy 1	Strategy 2	Strategy 3
25% reduction in substation costs	**35.9**	42.5	39.8
25% increase in substation costs	**51.0**	54.2	55.3
25% reduction in transmission mains costs	**41.1**	46.4	45.0
25% increase in transmission mains costs	**45.8**	50.3	50.1
25% reduction in distribution mains costs	**42.4**	44.0	45.9
25% increase in distribution mains costs	**44.5**	52.7	49.2
7% discount factor	**45.4**	50.5	50.3
10% discount factor	**41.7**	46.3	45.1
25% reduction in anticipated load	**43.5**	48.3	47.2
25% increase in anticipated load	**43.5**	48.3	48.0

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

5. CONCLUSION

Strategy 1 has the lowest NPC and has the least cost under all sensitivity scenarios. Therefore, the Strategy 1 is the preferred option.

The first stage of this strategy is the development of Rathmines permanent 132/11kV zone substation and associated 132kV feeder works as well as 11kV works to transfer all loads from Rathmines temporary ZS and a proportion of load from Toronto ZS.

The estimated capital cost for the development of the Rathmines permanent zone substation and its associated 132kV and 11kV feeder works is $24.6M with a NPC of $23.3M.

The estimated capital cost for the entire Strategy 1 is $50.7M with a NPC of $43.5M.

6. CONTACT DETAILS FOR SUBMISSIONS AND ENQUIRIES

This report recommends the construction of a new large network asset. In accordance with the National Electricity Rules, EnergyAustralia seeks written submission from interested parties on this consultation paper. The closing date for submissions is 19th July 2008.

Submissions or enquires should be directed to:

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7. APPENDIX A – ECONOMIC ANALYSIS OF BASE CASE

WACC = 8.5%

Strategy 1 – Permanent Rathmines 132/11kV ZS and Future Woodrising 33/11kV ZS

	Actions	NPC* [$K]	CAPEX [$K]	2007/ 2008	2008/ 2009	2009/ 2010	2010/ 2011	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021	2021/ 2022	2022/ 2023
Stage 1	Rathmines 132/11kV ZS	19,842	22,599	-	10,162	11,107	1,330	-	-	-	-	-	-	-	-	-	-	-	-
	Substation works		17,949	-	10,139	7,453	357	-	-	-	-	-	-	-	-	-	-	-	-
	132kV fdr works		2,003	-	23	1,209	771	-	-	-	-	-	-	-	-	-	-	-	-
	11kV fdr works		2,647	-	-	2,445	202	-	-	-	-	-	-	-	-	-	-	-	-
	O&M	1,662		-	-	-	-	234	282	282	282	282	282	282	282	282	282	282	282
	Load Transfer from Toronto & RathminesTemp to Rathmines132kV	1,673	1,969	-	-	1,969	-	-	-	-	-	-	-	-	-	-	-	-	-
	O&M	148	314	-	-	-	7	24	24	24	24	24	24	24	24	24	24	24	24
	Stage 1 Total	***23,324***	***24,568***																
	Decommission Rathmines Temp	-233	-367	-	-	37	33	-	-437	-	-	-	-	-	-	-	-	-	-
Stage 2	Woodrising 33/11kV 33kV Connections and transfers to Woodrising from Argenton & Toronto	5,133	7,547	-	-	-	37	1,938	5,573	-	-	-	-	-	-	-	-	-	-
	O&M	168		-	-	-	-	-	-	2	42	42	42	42	42	42	42	42	42
	Woodrising ZS	11,484	15,082	-	-	2,096	5,805	6,784	396	-	-	-	-	-	-	-	-	-	-
	O&M	909		-	-	-	-	-	-	187	198	198	198	198	198	198	198	198	198
	Stage 2 Total	***17,695***	***22,629***																
	Decommission Toronto 33kV Zone	57	81	-	-	-	5	43	31	3	-	-	-	-	-	-	-	-	-
Stage 3	Awaba STS 33kV feeder network augmentation	2,252	3,197	-	-	-	43	2,138	1,016	-	-	-	-	-	-	-	-	-	-
	O&M	71		-	-	-	-	-	-	1	18	18	18	18	18	18	18	18	18
	Decommission Awaba STS 33kV Busbar , Tx's	105	178	-	-	-	-	-	-	89	89	-	-	-	-	-	-	-	-

* Including future works covering the long term strategy for the area. The NPC also includes operation & maintenance costs.

	Actions	NPC* [$K]	CAPEX [$K]	2007/ 2008	2008/ 2009	2009/ 2010	2010/ 2011	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021	2021/ 2022	2022/ 2023
	Stage 3 Total	***2,428***	***3,375***																
	Woodrising 33kV ZS - Cap bank	194	409	-	-	-	-	-	-	-	-	-	344	65	-	-	-	-	-
	O&M	11		-	-	-	-	-	-	-	-	-	-	-	5	5	5	5	5
	TOTAL	**43,475**	**50,696**																

All values are in 2007 real dollars [$K].

Strategy 2 – Awaba 132/11kV ZS

	Actions	NPC* [$K]	CAPEX [$K]	2007/ 2008	2008/ 2009	2009/ 2010	2010/ 2011	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021	2021/ 2022	2022/ 2023
Stage 1	Awaba 132/11kV zone	25,600	29,336	-	11,686	15,198	2,452	-	-	-	-	-	-	-	-	-	-	-	-
	Substation works		23,013	-	11,541	10,790	681	-	-	-	-	-	-	-	-	-	-	-	-
	132kV fdr works		6,323	-	144	4,407	1,771	-	-	-	-	-	-	-	-	-	-	-	-
	O&M	2,013		-	-	-	-	289	340	340	340	340	340	340	340	340	340	340	340
	Load transfer from Toronto to Awaba 132	9,280	11,371	-	-	5,675	5,696	-	-	-	-	-	-	-	-	-	-	-	-
	O&M	751		-	-	-	-	39	136	136	136	136	136	136	136	136	136	136	136
	Load Transfer from Argenton & Rathmines temp to Awaba 132	6,832	10,693	-	-	-	-	-	5,335	5,358	-	-	-	-	-	-	-	-	-
	O&M	464		-	-	-	-	-	-	-	36	128	128	128	128	128	128	128	128
	Stage 1 Total	***44,940***	***51,399***																
	Decommission Rathmines Temp ZS	-266	-359	-	-	-	-	-437	41	37	-	-	-	-	-	-	-	-	-
	Decommission Toronto 33kV ZS	57	81	-	-	-	5	43	31	3	-	-	-	-	-	-	-	-	-
Stage 2	Awaba STS 33kV feeder network augmentation	2,252	3,197	-	-	-	43	2,138	1,016	-	-	-	-	-	-	-	-	-	-
	O&M	71		-	-	-	-	-	-	1	18	18	18	18	18	18	18	18	18
	Decommission Awaba STS 33kB Busbar , Tx's	105	178	-	-	-	-	-	-	89	89	-	-	-	-	-	-	-	-
	Stage 2 Total	***2,357***	***3,375***																
	Awaba 132/11 additional 11x11kV SG panels	1,098	1,809	-	-	-	-	-	-	1,581	228	-	-	-	-	-	-	-	-
	O&M	81		-	-	-	-	-	-	-	-	22	24	24	24	24	24	24	24
	TOTAL	**48,308**	**56,305**																

All values are in 2007/2008 real dollars [$K].

* Including future works covering the long term strategy for the area. The NPC also includes operation & maintenance costs.

Strategy 3 – Myuna 33/11kV ZS and Future Woodrising 33/11kV ZS

	Actions	NPC* [$K]	CAPEX [$K]	2007/ 2008	2008/ 2009	2009/ 2010	2010/ 2011	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021	2021/ 2022	2022/ 2023
Stage 1	Myuna 33/11kV ZS	14,962	16,942	-	8,305	8,205	433	-	-	-	-	-	-	-	-	-	-	-	-
	Substation works		15,323	-	8,305	6,709	309	-	-	-	-	-	-	-	-	-	-	-	-
	132kV fdr works		1,619	-	-	1,496	124	-	-	-	-	-	-	-	-	-	-	-	-
	O&M	1,248		-	-	-	-	190	210	210	210	210	210	210	210	210	210	210	210
	Load Transfer from Toronto & RathminesTemp to Myuna ZS	6,138	7,226	-	-	7,226	-	-	-	-	-	-	-	-	-	-	-	-	-
	O&M	541		-	-	-	25	87	87	87	87	87	87	87	87	87	87	87	87
	Stage 1 Total	***22,890***	***24,168***																
	Decommission Rathmines Temp	-233	-367	-	-	37	33	-	-437	-	-	-	-	-	-	-	-	-	-
Stage 2	Woodrising 33/11kV 33kV Connections and transfers to Woodrising from Argenton & Toronto	5,133	7,547	-	-	-	37	1,938	5,573	-	-	-	-	-	-	-	-	-	-
	O&M	168		-	-	-	-	-	-	2	42	42	42	42	42	42	42	42	42
	Woodrising ZS	11,484	15,082	-	-	2,096	5,805	6,784	396	-	-	-	-	-	-	-	-	-	-
	O&M	909		-	-	-	-	-	-	187	198	198	198	198	198	198	198	198	198
	Stage 2 Total	***17,695***	***22,629***																
	Decommission Toronto 33kV Zone	57	81	-	-	-	5	43	31	3	-	-	-	-	-	-	-	-	-
Stage 3	Awaba STS 33kV feeder network augmentation	2,252	3,197	-	-	-	43	2,138	1,016	-	-	-	-	-	-	-	-	-	-
	O&M	71		-	-	-	-	-	-	1	18	18	18	18	18	18	18	18	18
	Decommission Awaba STS 33kB Busbar , Tx's	105	178	-	-	-	-	-	-	89	89	-	-	-	-	-	-	-	-
	Stage 3 Total	***2,428***	***3,375***																
	Woodrising 33kV ZS - Cap bank	194	409	-	-	-	-	-	-	-	-	-	344	65	-	-	-	-	-

* Including future works covering the long term strategy for the area. The NPC also includes operation & maintenance costs.

	Actions	NPC* [$K]	CAPEX [$K]	2007/ 2008	2008/ 2009	2009/ 2010	2010/ 2011	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021	2021/ 2022	2022/ 2023
	O&M	11		-	-	-	-	-	-	-	-	-	-	-	5	5	5	5	5
Stage 4	Eraring STS Tx uprating	2,772	6,523	-	-	-	-	-	-	-	-	-	-	3,257	3,266	-	-	-	-
	O&M	136		-	-	-	-	-	-	-	-	-	-	-	-	81	85	85	85
	Myuna 1x6MVar capacitors	168	418	-	-	-	-	-	-	-	-	-	-	-	351	67	-	-	-
	O&M	7		-	-	-	-	-	-	-	-	-	-	-	-	-	5	5	5
	Myuna 33/11kV feeder upgrade	1,252	3,948	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,647	300
	O&M	0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Eraring STS 33kV CB uprating	188	597	-	-	-	-	-	-	-	-	-	-	-	-	-	-	502	95
	O&M	2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Stage 4 Total	***4,525***	***11,486***																
	TOTAL	**47,567**	**61,782**																

All values are in 2007/2008 real dollars [$K].