Proposed New Large Network Asset - Ardrossan West Substation Augmentation

Final Report

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Version 1.0

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This Final Report contains analysis based on estimates prepared by, and assumptions made by ElectraNet and ETSA Utilities. The document has also been prepared using information, including cost information, provided by a number of third parties. The cost estimates used to evaluate the options described are based on the best information available to ElectraNet and ETSA Utilities at the time of preparing the report and should not be taken as necessarily reflecting the actual costs of later implementing an option.

The Final Report contains the results of financial modelling and economic analysis undertaken by ElectraNet and ETSA Utilities. It contains assumptions regarding, among other things, economic growth and load forecasts that may or may not prove to be correct.

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Executive Summary

ElectraNet has identified emerging limitations within the transmission network which supplies the Ardrossan West connection point in the Yorke Peninsula region of South Australia.

Firstly, as a consequence of ongoing load growth in the region, the capacity of the two existing transformers at the Ardrossan West substation is forecast to be insufficient beyond the summer of 2009/10 to meet the upgraded supply reliability standard set out in the Electricity Transmission Code (ETC) issued by the Essential Services Commission of South Australia (ESCOSA) in July 2008. The revised standard requires that N-1 equivalent transformer capacity must be provided at this connection point, whereas the previous ETC only required N transformer capacity.

Secondly, when the Mid North region's 132 kV network is subjected to a single line contingency, the network will be unable to satisfy the National Electricity Rules (NER) requirement to maintain adequate voltages on the Yorke Peninsula.

To address these limitations, ElectraNet has investigated a number of potential solutions and applied the Regulatory Test for reliability augmentations to identify the least cost net present value solution.

From this assessment, the recommendation of this Final Report is to augment the Ardrossan West substation by replacing the two existing 10 MV.A transformers with two 25 MV.A transformers and installing a capacitor bank. The proposed solution includes reconfiguring the 132 kV switchyard to facilitate the N-1 requirement and replacement of existing telecommunications infrastructure to provide for adequate communications and control. As part of this solution, ETSA Utilities also proposes to rebuild the 33 kV switchyard at the Ardrossan West substation.

ElectraNet and ETSA Utilities have previously released an Application Notice calling for submissions, none were received.

The estimated total capital cost of the proposed solution is $30.2m, of which $22.8m will be attributable to ElectraNet's portion of the work, and $7.4m to ETSA Utilities. In accordance with the timing requirements of the ETC, the augmentation must be commissioned and commercially available before the 2012/13 summer at the latest.

1. Introduction

Changes to the ETC that took effect on 1 July 2008 have increased the level of supply reliability that ElectraNet must provide for the Ardrossan West connection point.

The ETC upgraded the level of supply reliability assigned to the Ardrossan West connection point from Category 1 to Category 2. This change in Category requires ElectraNet to continue to provide N equivalent line capacity, but to also now provide continuous equivalent N-1 transformer capacity for at least 100% of the Agreed Maximum Demand (AMD) for that connection point.

The previous Category 1 standard required the provision of N equivalent line and transformer capacity for at least 100% of the AMD.

Whilst two transformers are already installed at this location, according to the load forecast for the Ardrossan West connection point, under peak conditions the allowable maximum emergency cyclic loading of the installed N-1 transformers will be exceeded during the summer of 2009/10.

In addition to this, the voltage in the Yorke Peninsula is expected to fall below the voltage control requirements of the NER under peak load single contingency conditions in the Mid North sub-transmission system.

Ardrossan West 132/33 kV substation currently comprises two 10 MV.A 132/33 kV transformers with minimum associated 132 kV and 33 kV infrastructure. At present, the two transformers are configured in parallel and there is no provision for individual circuit breakers.

In order to address the increased transformer capacity requirement and the voltage control requirement, ElectraNet is proposing to replace the existing transformers at Ardrossan West substation with two larger units, install a capacitor bank and reconfigure the substation. ETSA Utilities also proposes to rebuild the 33 kV switchyard. The total combined capital cost for this proposed new large network asset is estimated at $30.2m.

In accordance with the requirements of the NER, this Final Report sets out information regarding:

- The reasons the augmentation is required, including, if relevant, why it is considered a ‘reliability augmentation’, as defined under the NER;
- Feasible options to address the future supply requirements, including non-network alternatives;
- The recommended solution, including the timetable for implementation; and
- Why the solution satisfies the Regulatory Test prescribed by the AER.

2. Background: Electricity Supply System

2.1 Geographic Area

The Ardrossan West substation is a 132/33 kV connection point that is located on the Yorke Peninsula. The substation is supplied radially from the Hummocks substation approximately 43 km to the north. Ardrossan West currently comprises two 10 MV.A 132/33 kV transformers and contains minimal 132 kV infrastructure. The simplified single line diagram of the transmission network in this area can be seen in Figure 1.

The limitations addressed by this Final Report affect the area of the Yorke Peninsula surrounding the Ardrossan West substation. The physical location of the Ardrossan West substation is shown in the geographic layout in Figure 2.

2.2 Existing supply arrangements

Presently, Ardrossan West is supplied radially from Hummocks substation to the north and in turn radially supplies Dalrymple substation to the south. The existing substation assets are shown in Figure .

2.3 Committed Network Developments

ElectraNet and ETSA Utilities have no committed transmission or sub-transmission network developments in the Mid-North region of South Australia that will address the emerging limitations in the supply to the area surrounding the Ardrossan West connection point.

2.4 Existing and Committed Generation Facilities

ElectraNet is not aware of any existing or committed generation facilities within the Mid-North region of South Australia that will address the emerging limitations in the supply to the area surrounding the Ardrossan West connection point.

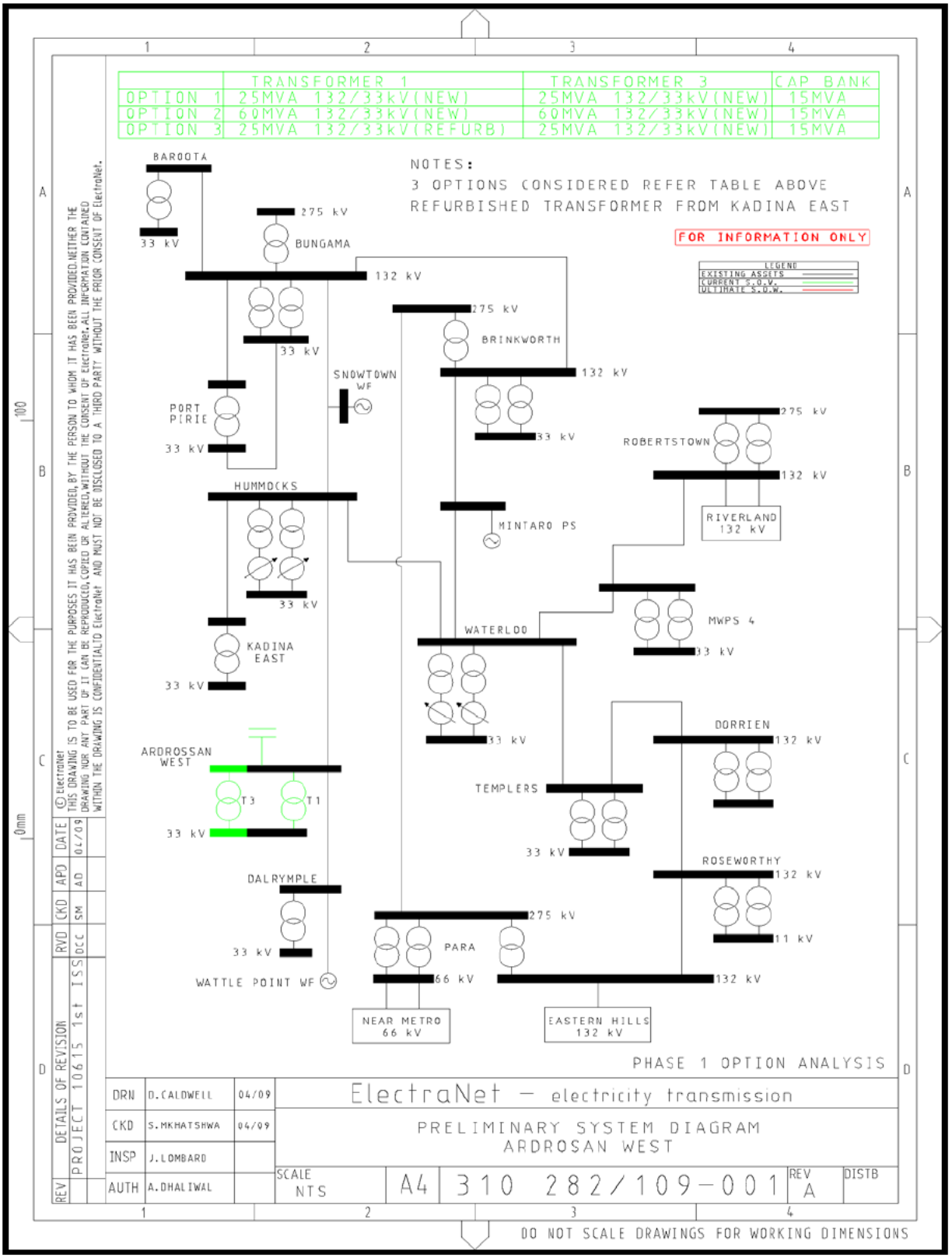

Figure 1: Existing transmission system-Mid North and the three options for Ardrossan West

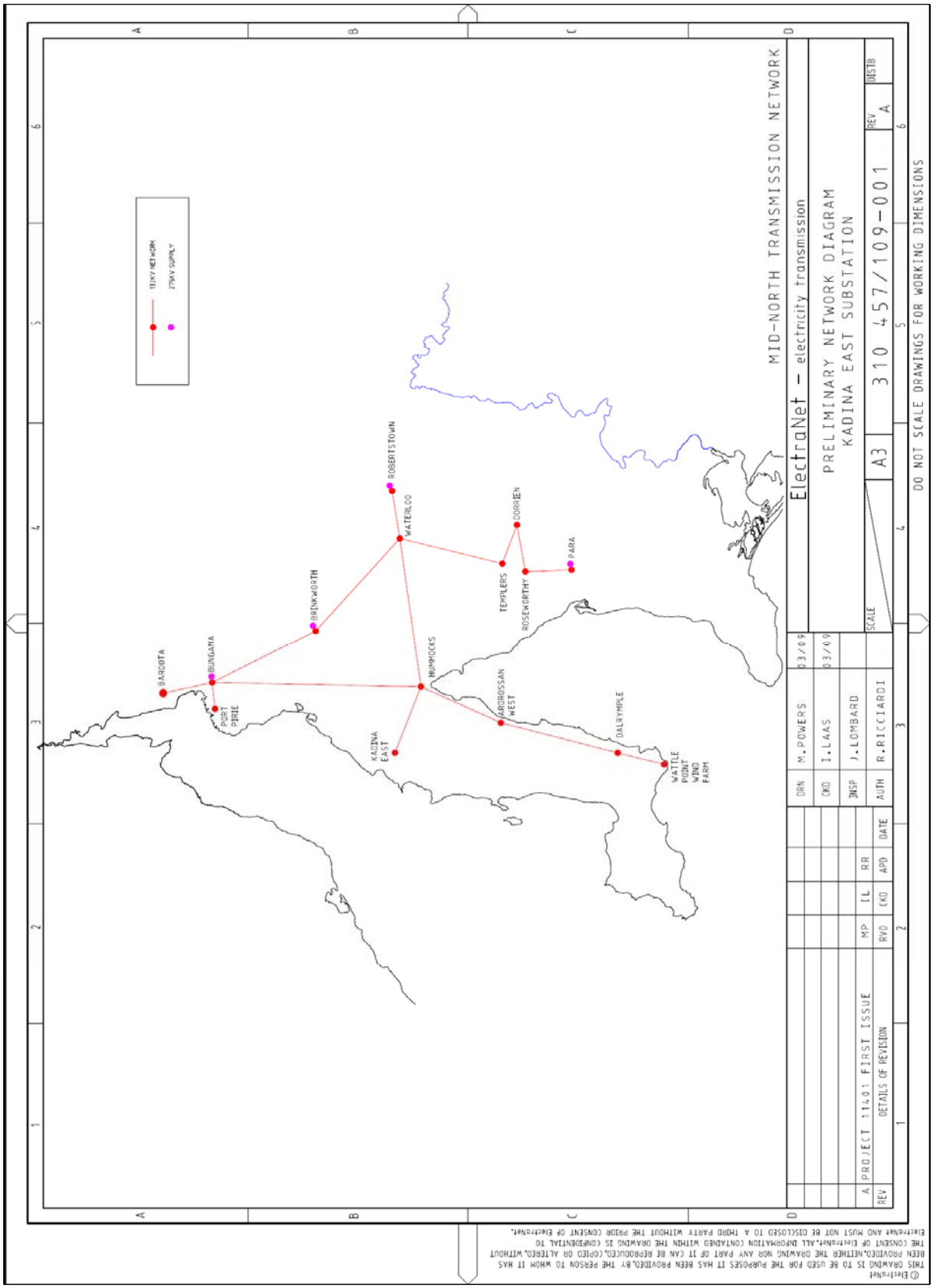

Figure **2**: Mid North Geographic Region showing Ardrossan West substation.

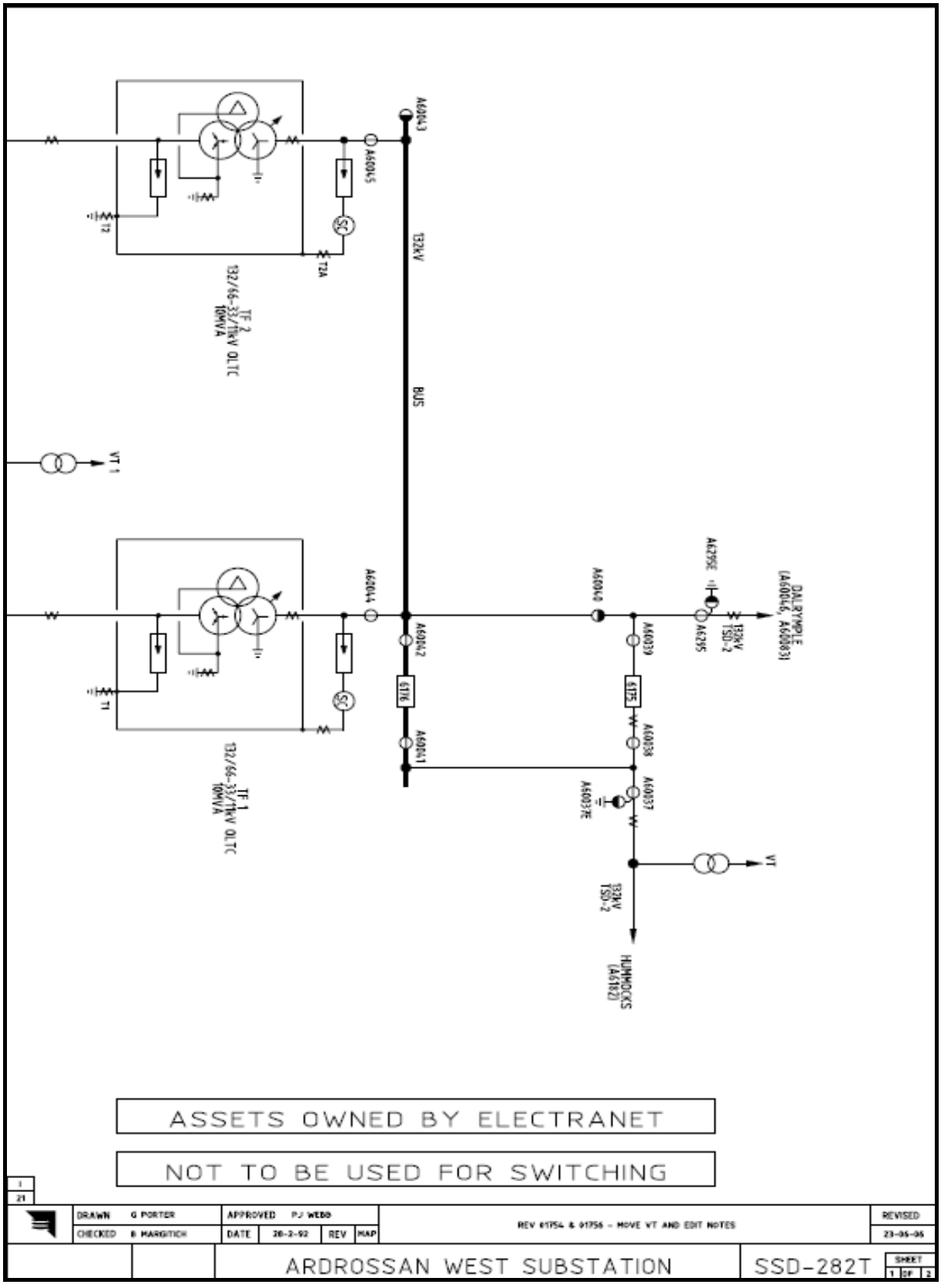

Figure 3: Existing Ardrossan West substation.

3. Background: Electricity Demand

3.1 Overview

The demand forecasts that underpin the recommendations of this Final Report are consistent with the twenty-year demand and energy forecasts as published in ElectraNet's 2010 Annual Planning Report.

Electricity demand forecasts over a ten-year period are obtained from ETSA Utilities at each connection point in ElectraNet's transmission system. Those forecasts take account of demand-side management programmes in-place and foreseen by ETSA Utilities, and embedded generation which may have the effect of reducing the forecast demand to be supplied via each transmission connection point.

3.2 Load Forecast

The growth in electrical load in a region is dependent on many variables, including; economic growth, housing and commercial development, industrial growth, spot-load increases that occur in response to local requirements, and environmental conditions (predominantly weather conditions). The forecasting of electrical load is based on econometric analysis coupled with knowledge of localised developments, historical information and trends. The load forecast provided in this section is based on a 10% probability of exceedence and medium economic growth.

ETSA Utilities has provided ElectraNet with three demand forecasts for Ardrossan West, reflecting high, medium and low load-growth scenarios. For this Final Report the medium load scenario ten-year forecast was used as the most likely case. ETSA Utilities also provides growth rates for each of the scenarios. ElectraNet applies these growth rates to the ten-year forecasts and extrapolates them to a period of twenty-years. The annual growth rates provided by ETSA Utilities to use are 4.08% (high), 3.4% (medium), and 2.72% (low).

The load forecasts for the Ardrossan West substation for the coming twenty-year period are shown in

ARDROSSAN WEST CONNECTION POINT		09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	2
HIGH DEMAND FORECAST	MW	14.1	14.7	15.3	15.9	16.5	17.2	17.9	18.6	19.4	20.2	21.0	21.9	
	PF	0.92	0.91	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90	0.89	0.89	
	MV.A	15.38	16.05	16.75	17.48	18.23	19.02	19.84	20.69	21.58	22.51	23.47	24.48	2
MEDIUM DEMAND FORECAST	MW	14.10	14.60	15.10	15.60	16.10	16.60	17.20	17.80	18.40	19.00	19.70	20.30	2
	PF	0.92	0.91	0.91	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90	0.90	
	MV.A	15.33	16.04	16.59	17.12	17.71	18.29	19.11	19.69	20.39	21.10	21.91	22.62	2
LOW DEMAND FORECAST	MW	14.1	14.5	14.9	15.3	15.7	16.1	16.5	17.0	17.5	17.9	18.4	18.9	
	PF	0.93	0.93	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	
	MV.A	15.17	15.62	16.07	16.54	17.02	17.52	18.03	18.55	19.09	19.64	20.21	20.80	2

Table 1. The forecast summer peak demand is based on a medium load growth rate and hot weather, and excludes transmission losses. The forecast power factor

(pf) that ETSA Utilities anticipates will be maintained at each Ardrossan West is also provided.

ARDROSSAN WEST CONNECTION POINT		09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30
HIGH DEMAND FORECAST	MW	14.1	14.7	15.3	15.9	16.5	17.2	17.9	18.6	19.4	20.2	21.0	21.9	22.8	23.7	24.6	25.7	26.7	27.8	28.9	30.1	31.3
	PF	0.92	0.91	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90	0.89	0.89	0.89	0.90	0.90	0.90	0.90	0.90	0.90	0.89	0.89
	MV.A	15.38	16.05	16.75	17.48	18.23	19.02	19.84	20.69	21.58	22.51	23.47	24.48	25.52	26.17	27.30	28.48	29.70	30.98	32.30	33.69	35.13
MEDIUM DEMAND FORECAST	MW	14.10	14.60	15.10	15.60	16.10	16.60	17.20	17.80	18.40	19.00	19.70	20.30	21.00	21.70	22.50	23.20	24.00	24.90	25.70	26.60	27.50
	PF	0.92	0.91	0.91	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90	0.90	0.89	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90
	MV.A	15.33	16.04	16.59	17.12	17.71	18.29	19.11	19.69	20.39	21.10	21.91	22.62	23.60	23.82	24.75	25.57	26.67	27.55	28.49	29.54	30.54
LOW DEMAND FORECAST	MW	14.1	14.5	14.9	15.3	15.7	16.1	16.5	17.0	17.5	17.9	18.4	18.9	19.4	20.0	20.5	21.1	21.6	22.2	22.8	23.4	24.1
	PF	0.93	0.93	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91
	MV.A	15.17	15.62	16.07	16.54	17.02	17.52	18.03	18.55	19.09	19.64	20.21	20.80	21.40	21.61	22.24	22.89	23.56	24.24	24.95	25.67	26.41

Table 1: Forecast summer peak demand for Ardrossan West (high, medium, low economic growth)

3.3 Pattern of Use

Peak demand at the Ardrossan West connection point occurs during summer. Figure 4, shows the day profile for Ardrossan West on the peak summer day in the year 2009 and Figure 5 shows the load duration curve for Ardrossan West during 2008/09.

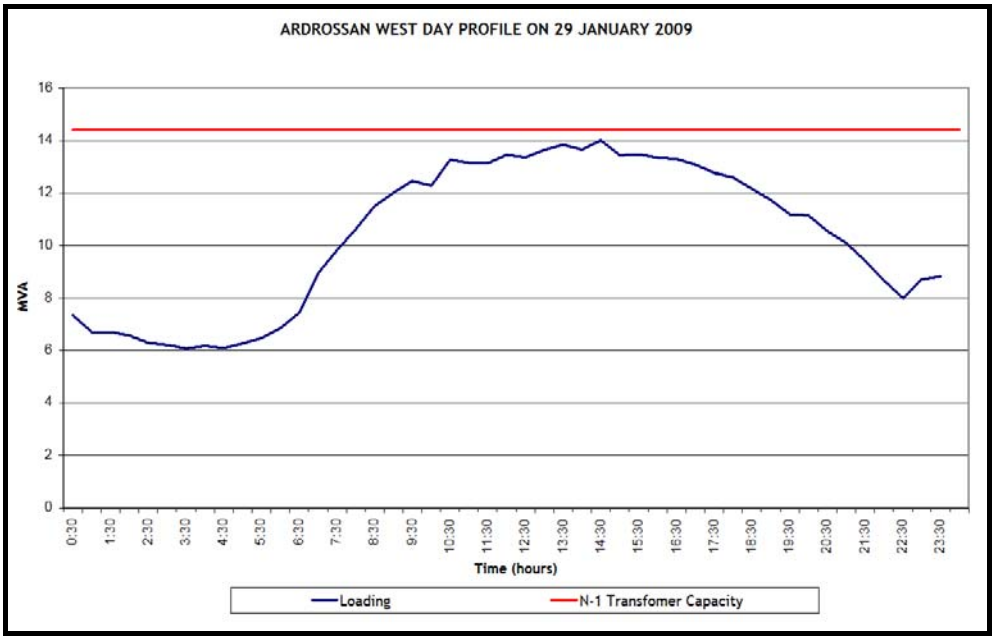

Figure 4: Day Profile for Ardrossan West – peak summer day 29th January 2009

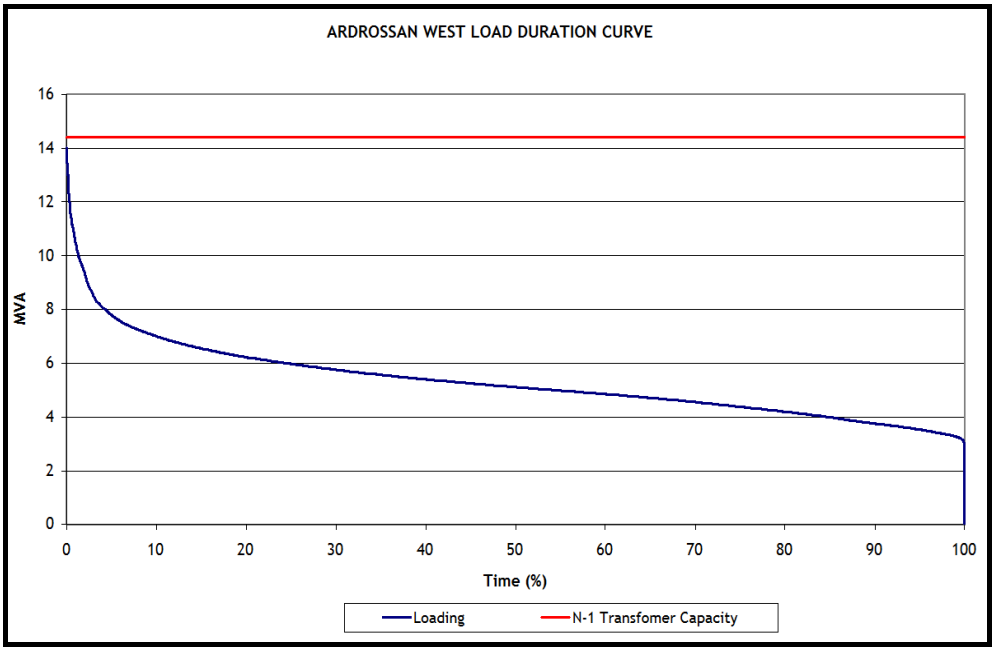

Figure 5: Load Duration Curve for Ardrossan West – year 2008/09

4. Service Obligations

ElectraNet is required to meet the supply reliability standards of the ETC and power system security and quality of supply requirements of the NER. Similarly, ETSA Utilities is bound by the service obligations of the NER and the Electricity Distribution Code (EDC).

4.1 National Electricity Rules

Schedule 5.1.2.1 of the NER requires that ElectraNet must plan, design, maintain, and operate its transmission network to allow the transfer of power from generating units to customers with all facilities or equipment associated with the power system in service. Additionally ElectraNet may be required by a Registered Participant, under a connection agreement, or in this case, ESCoSA through the ETC, to provide N-1 reliability.

The NER also requires that ElectraNet maintain strict control of transmission network voltages. The NER requires, in Schedule 5.1.4, that "at all times the supply voltage remains between 90 percent and 110 percent of the normal voltage determined in accordance with clause S5.1a.4 except as a consequence of a contingency event". In addition to this, ETSA Utilities requires that the 33 kV bus voltage returns to at least 100 % of nominal following tap changer operation in order to deliver satisfactory customer voltages throughout its distribution network.

During a contingency, it is accepted that the transmission system voltages may be several percent lower than those obtained under normal operating conditions. For planning purposes, a target value of 90% of nominal voltage is typically applied. Voltages below this limit would prevent nominal voltages from being restored at the customer level after transformer tap changing.

4.2 South Australian Electricity Transmission Code

The ETC focuses primarily on supply reliability requirements at individual connection points. The following relevant service standards are contained in the ETC.

4.2.1 Quality of supply

> *"A transmission entity must use its best endeavours to plan, develop and operate the transmission network to meet the standards imposed by the National Electricity Rules in relation to the quality of transmission services such that there will be no requirements to shed load to achieve these standards under normal and reasonably foreseeable operating conditions." (Clause 2.1.1)*

4.2.2 System reliability

> *"A transmission entity must use its best endeavours to plan, develop and operate the transmission system so as to meet the standards imposed by the National Electricity Rules in relation to transmission network reliability such that there will be minimal requirements to shed load under normal and reasonably foreseeable operating conditions." (Clause 2.1.2)*

The ETC also assigns reliability standards for each connection (exit) point or group of connection points within the transmission network and thereby imposes specific requirements on ElectraNet for planning and developing its transmission network.

The ETC includes additional obligations with regard to response times, spares holdings, and reporting requirements. The following provides a summary of ElectraNet's service obligations for the Ardrossan West connection point based on the ETC requirements (refer to Clause 2.6 of the ETC).

For Category 2 loads ElectraNet must:

- not contract for an amount of agreed maximum demand greater than 100% of installed transmission line or transformer capacity and;
- provide N-1 equivalent transformer capacity for at least 100% of agreed maximum demand;
- In the event of an interruption, use best endeavours to restore the required equivalent line capacity within two days; and
- In the event of a transformer failure, use best endeavours to repair or install a replacement equivalent transformer as soon as possible so as to minimise the likelihood of an interruption as a result of the failure of any other transformer installed at the relevant connection point.

The ETC can be viewed in its entirety at the following website: http://www.escosa.sa.gov.au/webdata/resources/files/060906-R-ElecTransCodeET05.pdf

5. Identified Network Limitations

Forecast future load growth indicates that the demand at Ardrossan West substation will exceed the allowable maximum emergency cyclic loading of 14.4 MV.A in the summer peak of 2009/10. Transformer capacity will therefore be inadequate from this date to satisfy the ETC requirement for N-1 equivalent transformer capacity for at least 100% of AMD based on current peak demand projections.

Also identified is the unacceptably low voltages that are experienced on the Yorke Peninsula as a result of a single line contingency in the Mid North meshed 132 kV sub-transmission system. Loadflow studies have shown that the optimal electrical location for reactive support is at the point where the voltage is depressed to the greatest extent. A need for additional voltage support in the area therefore exists.

Since the identified limitations addressed in this Final Report are driven by service standards contained in Schedule 5.1 of the NER and jurisdictional reliability standards applying to electricity supply to the Ardrossan West connection point, the augmentation recommended in this report has been assessed as a “reliability augmentation” in accordance with the requirements of the Regulatory Test version 3 promulgated by the AER.

6. Future Network Developments – Mid North Region

In addition to the network limitations identified in Section 5 of this Final Report, other limitations within this region are emerging that are not the subject of this report. The nature of these limitations and potential solutions to them are summarised in Table 2, which is an extract from ElectraNet's 2010 Annual Planning Report. These projects were incorporated into the analysis for each option presented in this Final Report.

Year	Limitation	Mitigation Option
2010	Inadequate voltage on the distribution network between Waterloo, Clare and Brinkworth under N-1 conditions	Construct a new Category 4 substation at Clare with 2 x 25 MV.A 132/33 kV transformers
2011	ETC change requiring N-1 transformer redundancy at Kadina East	Install 2 x 60 MV.A 132/33 kV transformers at Kadina East
2011	Inadequate voltage in the Barossa area for the loss of the Para to Roseworthy 132 kV transmission line	Establish Templers West 275/132 kV substation
2013	Thermal overload of the remaining transformer at Hummocks under N-1 conditions	Replace aged assets and entire secondary systems at Hummocks Substation; Install 2 x 25 MV.A 132/33 kV transformers
2013	Thermal overload of the remaining transformer at Dorrien under N-1 conditions	Install a third 60 MV.A 132/33 kV transformer at Dorrien Substation

Year	Limitation	Mitigation Option
2015	Inadequate voltage on the Yorke Peninsula for the loss of the 275/132 kV transformer at Bungama or the Hummocks to Waterloo 132 kV transmission line	Install 1 x 15 Mvar 132 kV PoW switched capacitor bank at Kadina East Substation Install 1 x 8 Mvar 132 kV PoW switched capacitor bank at Dalrymple Substation (Capacitor bank sizes subject to detailed studies)
2015	Inadequate voltage in the vicinity of Port Pirie for the loss of the Bungama 200 MV.A 275/132 kV transformer	Install a second 200 MV.A 275/132 kV transformer at Bungama Substation
2016	Inadequate voltage on the York Peninsula for the loss of the 275/132 kV transformer at Bungama or the Hummocks to Waterloo 132 kV line; ETC change requires Dalrymple to be raised to a category 2 reliability level.	Install 1 x 8 Mvar PoW switched capacitor bank at Dalrymple substation; install a second 26 MV.A 132/33 kV transformer and complete the mesh bus.
2018	Thermal overload of the Waterloo to Hummocks 132 kV transmission line for the loss of the Bungama to Hummocks 132 kV line	275/132 kV injection in the vicinity of the Hummocks substation.

Table 2: Projects proposed for the Mid-North region independent of the Ardrossan West augmentation

7. Options Considered

7.1 Non-Network Options

Due to the radial nature of the 132 kV supply to Ardrossan West substation, the only non-network option that could meet the ETC reliability redundancy requirement for Ardrossan West substation would be to contract the entire connected load to a demand-side or generator proponent.

In the case of local generation, specific ETSA Utilities and NER requirements apply to generators operating in 'islanded mode' for loss of either the Ardrossan West transmission line or transformers. Generation proponents will need to assess the viability of their proposal in relation to those requirements.

ElectraNet has not been advised, and is not aware, of any committed or planned demand-side management arrangements or generation connections to the Ardrossan West substation 33 kV networks that will achieve the N-1 equivalent transformer capacity requirement or address the identified voltage limitations in the region.

7.2 Transmission Network options

7.2.1 Permanent or Rapid Load Transfer

Load transfer to another source of supply by reconfiguring the distribution network open-points following transformer failure is not possible. This is due to the lack of adequate alternative distribution networks in the area, as well as the limited 132 kV primary plant infrastructure to allow operation of one transformer during a fault on the other transformer.

In addition, this option does not address the 132 kV busbar arrangements or the requirements for reactive power support.

7.2.2 Option 1: Install two 25 MV.A 132/33 kV (new) transformers and a 15 Mvar switched capacitor bank at Ardrossan West

This option involves replacing the two existing 10 MV.A transformers at Ardrossan West with two new 25 MV.A units, together with the installation of 132 kV switchgear suitably configured to support the N-1 transformer requirement.

ElectraNet has determined that the proposed works for this option could be located within the existing substation boundary, thereby providing the additional advantage that minimal interruption to supply will be required both during construction and when connecting the new assets to the existing 132 kV and 33 kV networks.

The two existing 10 MV.A transformers could then be redeployed for use elsewhere on the network (condition permitting).

Installing two 25 MV.A transformers at Ardrossan West would provide sufficient N-1 transformer capacity at the substation well beyond the 2028/29 horizon of the financial analysis period.

In order to address the low voltage issues under contingency conditions in the Yorke Peninsula, this option also involves the installation of a 15 Mvar capacitor bank at Ardrossan West connection point.

Figure 6 below shows the substation layout for this option and the required capital works, and their associated costs for ElectraNet and ETSA Utilities are shown in Table 3 and Table 4 respectively.

Option 1 – Install 2x25 MV.A 132/33 kV (new) transformers and 15 Mvar switched capacitor bank at Ardrossan West		
Date required	**Proposed Augmentation**	**Total capital costs**
2011-12	• Remove the two 10 MV.A 132/33 kV transformers at Ardrossan West substation (condition will be assessed and relocated elsewhere on the network) • Install two 25 MV.A 132/33 kV (new) transformers at Ardrossan West substation • Reconfigure 132 kV busbar to Mesh busbar arrangement • Install 15 Mvar capacitor bank on the 132 kV busbar at Ardrossan West	$23.7m

Table 3: Proposed ElectraNet capital works required for Option 1

ETSA Utilities integration portion for this option		
Date required	**Proposed Augmentation**	**Total capital costs**
2011-12	• Install two 33 kV ElectraNet supply points via disconnectors • Install two 33 kV busbar sections (operated as one busbar, two busbar disconnectors only) • Install one 33000/110 V VT with disconnectors • Install three 33kV line bays • Do protection and control works • Install two station transformers • Establish a new control building • Do civil and infrastructure works (site levelling, fencing, earth grid) • Install telecommunications for SCADA • Demolish and remove redundant 33kV substation infrastructure • Associated 33kV line works	$7.4m

Table 4: Proposed ETSA Utilities capital works required for Option 1

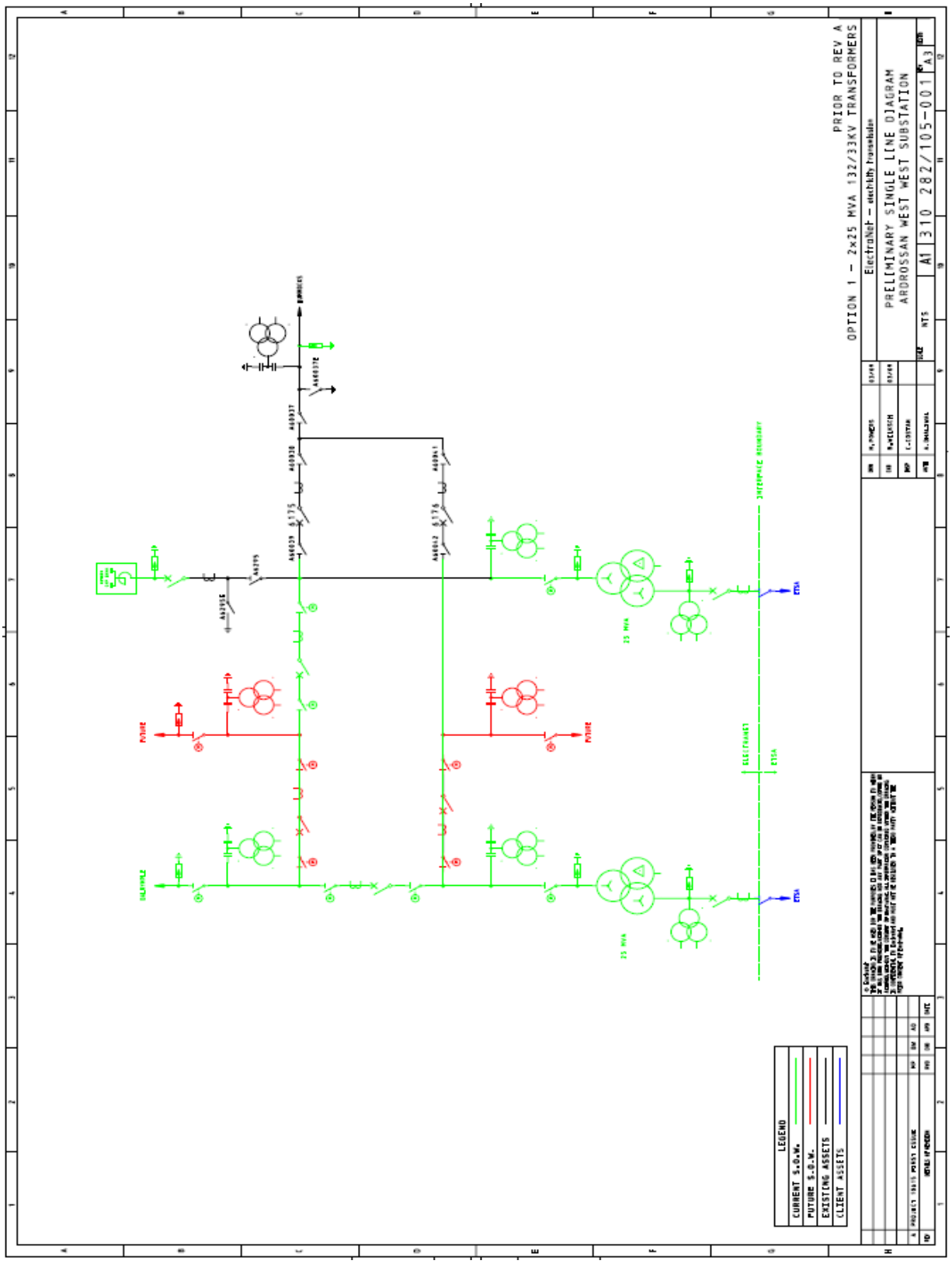

Figure 6: Substation layout for Option 1

7.2.3 Option 2: Install two 60 MV.A 132/33 kV (new) transformers and a 15 Mvar switched capacitor bank at Ardrossan West

This option involves replacing the two existing 10 MV.A transformers at Ardrossan West with two 60 MV.A units (ElectraNet's next standard transformer size after 25 MV.A) together with the installation of 132 kV switchgear suitably configured to support the N-1 transformer requirement.

ElectraNet has determined that the proposed works for this option could an be located within the existing substation boundary, thereby providing the additional advantage that minimal interruption to supply will be required both during construction and when connecting the new assets to the existing 132 kV and 33 kV networks.

The two existing 10 MV.A transformers could then be redeployed for use elsewhere on the network (condition permitting).

Installing two 60 MV.A transformers at Ardrossan West would provide sufficient N-1 transformer capacity at the substation well beyond the 2028/29 horizon of the financial analysis period.

In order to address the low voltage issues under contingency conditions in the Yorke Peninsula, this option also involves the installation of a 15 Mvar capacitor bank at Ardrossan West connection point.

Figure 7 below shows the substation layout for this option, and the required capital works and their costs for ElectraNet and ETSA Utilities are shown in Table 5 and Table 6 respectively.

Option 2 – Install 2x60 MV.A 132/33 kV (new) transformers and 15 Mvar switched capacitor bank at Ardrossan West		
Date required	**Proposed Augmentation**	**Total capital costs**
2011-12	• Remove the two 10 MV.A 132/33 kV transformers at Ardrossan West substation (condition will be assessed and relocated elsewhere on the network) • Install two 60 MV.A 132/33 kV (new) transformers at Ardrossan West substation • Reconfigure 132 kV busbar to Mesh busbar arrangement • Install 15 Mvar capacitor bank on the 132 kV busbar at Ardrossan West	$25.0m

Table 5: Proposed ElectraNet capital works required for Option 2

ETSA Utilities integration portion for this option		
Date required	**Proposed Augmentation**	**Total capital costs**
2011-12	• Install two 33 kV ElectraNet supply points via disconnectors • Install two 33 kV busbar sections (operated as two sections, including section breaker two busbar disconnectors) • Install two 33000/110 V VT with disconnectors • Install three 33 kV line bays • Do protection and control works • Install two station transformers • Establish a new control building • Do some civil and infrastructure works (site levelling, fencing, earth grid) • Install telecommunications for SCADA • Demolish and remove redundant 33 kV substation infrastructure • Associated 33kV line works	$9.1m

Table 6: Proposed ETSA Utilities capital works required for Option 2

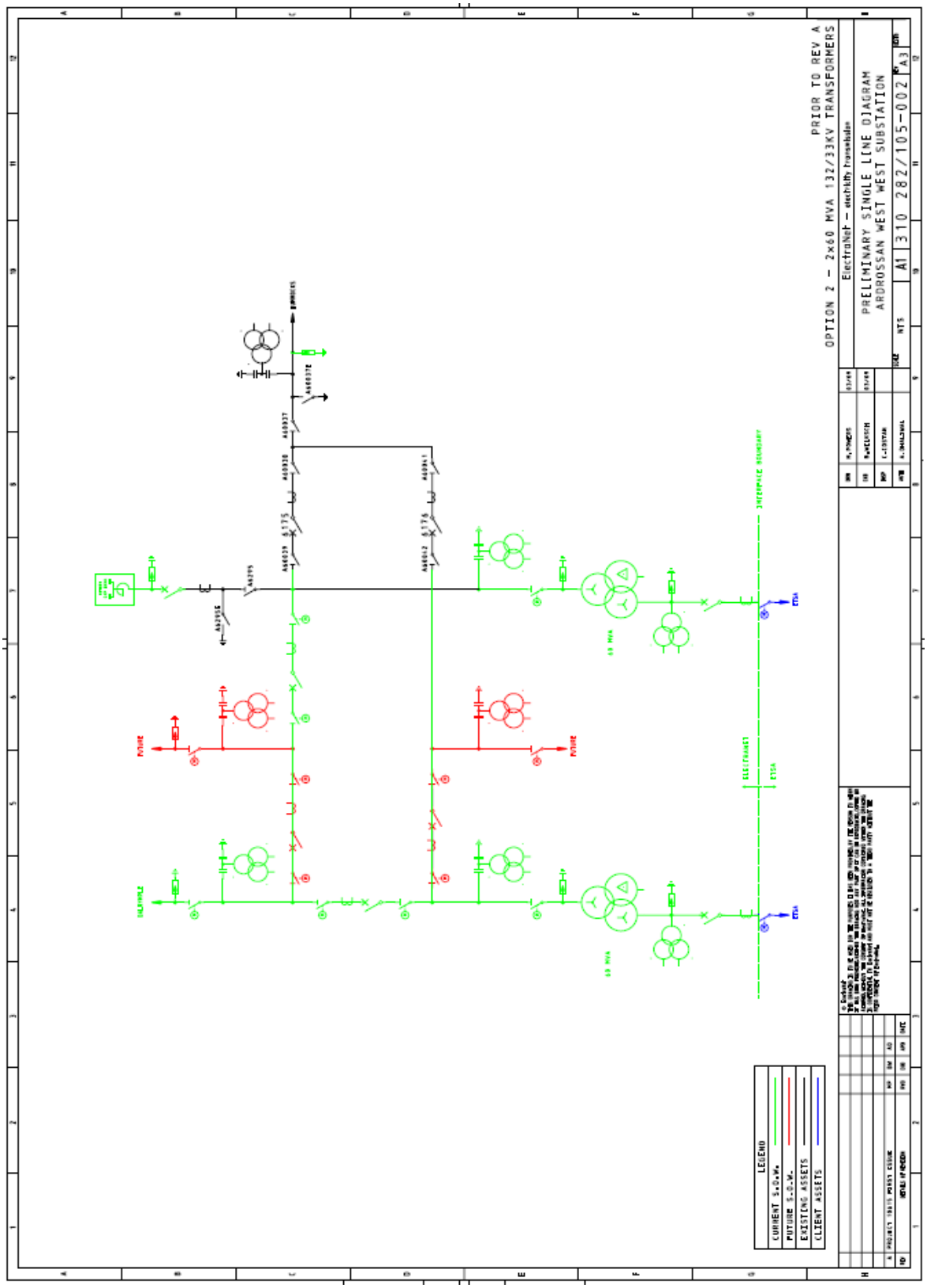

Figure 7: Substation layout for Option 2

7.2.4 Option 3: Install two 25 MV.A 132/33 kV transformers (one new and one refurbished) and a 15 Mvar switched capacitor bank at Ardrossan West

This option involves replacing the two existing 10 MV.A transformers at Ardrossan West with two 25 MV.A (one new and one refurbished) units, together with the installation of 132 kV switchgear suitably configured to support the N-1 transformer requirement.

ElectraNet has a 25 MV.A 132/33 kV transformer in the system that will be replaced with larger units, and under this option that transformer would be assessed and refurbished for use at Ardrossan West connection point. This could reduce cost and still improve the reliability at Ardrossan west as required by the ETC.

ElectraNet has determined that the proposed works for this option could be located within the existing substation boundary, thereby providing the additional advantage that minimal interruption to supply will be required both during construction and when connecting the new assets to the existing 132 kV and 33 kV networks.

The two existing 10 MV.A transformers could then be redeployed for use elsewhere on the network (condition permitting).

Installing two 25 MV.A transformers at Ardrossan West would provide sufficient N-1 transformer capacity at the substation well beyond the 2028/29 horizon of the financial analysis period.

In order to address the low voltage issues under contingency conditions in the Yorke Peninsula, this option also involves the installation of a 15 Mvar capacitor bank at Ardrossan West connection point.

Figure 8 below shows the substation layout for this option, and the required capital works and their costs for ElectraNet and ETSA Utilities are shown in Table 7 and Table 8 respectively.

Option 3 – Install 2x25 MV.A 132/33 kV transformers (1xnew and 1xrefurbished) and 15 Mvar switched capacitor bank at Ardrossan West		
Date required	**Proposed Augmentation**	**Total capital costs**
2011-12	• Remove the two 10 MV.A 132/33 kV transformers at Ardrossan West substation (condition will be assessed and relocated elsewhere on the network) • Install two 25 MV.A 132/33 kV transformers (one new and one refurbished) at Ardrossan West substation • Reconfigure 132 kV busbar to Mesh busbar arrangement • Install 15 Mvar capacitor bank on the 132 kV busbar at Ardrossan West	$22.8m

Table 7: Proposed ElectraNet capital works required for Option 3

ETSA Utilities integration portion for this option		
Date required	**Proposed Augmentation**	**Total capital costs**
2011-12	• Install two 33 kV ElectraNet supply points via disconnectors • Install two 33 kV busbar sections (operated as one busbar, two busbar disconnectors only) • Install one 3300/110 V VT with disconnectors • Install three 33 kV line bays • Do protection and control works • Install two station transformers • Establish a new control building • Do some civil and infrastructure works (site levelling, fencing, earth grid) • Install telecommunications for SCADA • Demolish and remove redundant 33kV substation infrastructure • Associated 33kV line works	$7.4m

Table 8: Proposed ETSA Utilities capital works required for Option 3

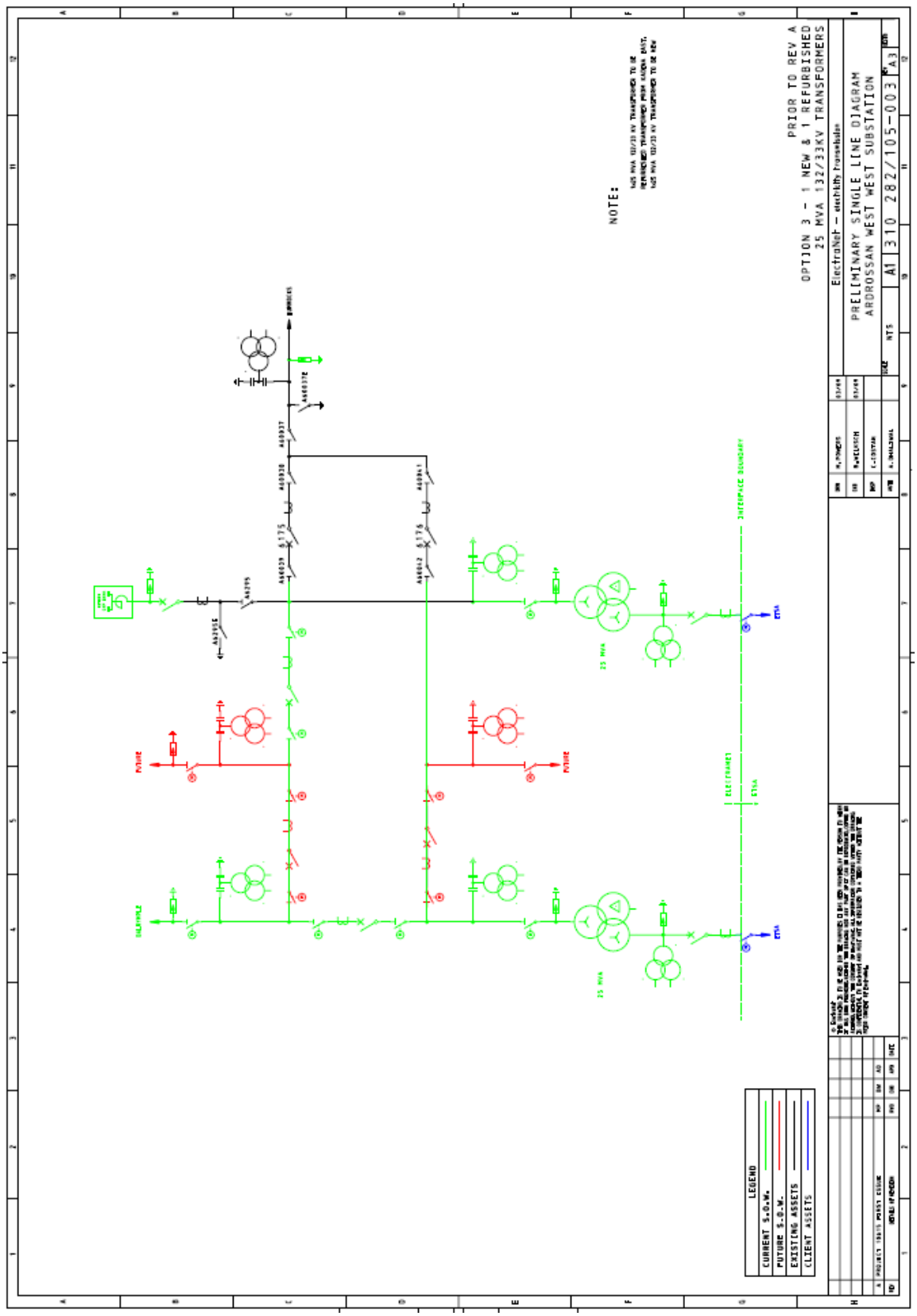

Figure 8: Substation layout for Option 3

ETSA Utilities layout for Ardrossan West Substation

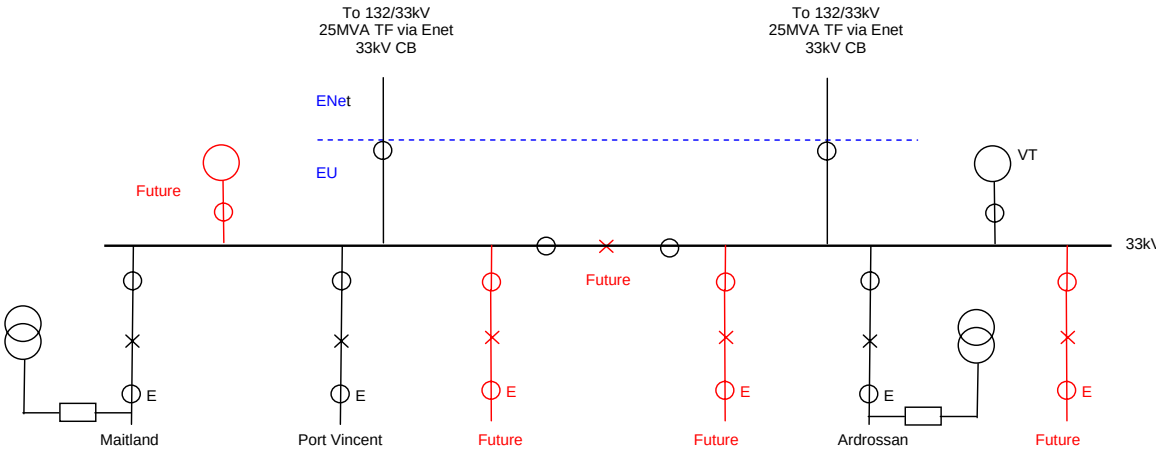

Figure 9: ETSA Utilities layout for Option 3

8. Scenarios Considered

8.1 Context for Evaluation of Options

All feasible options to the identified supply requirements must be viewed in the context of wider developments in the NEM. ElectraNet is not aware of any inter-state or intra-state transmission network augmentations that would impact the decision by the ESCoSA to increase supply reliability to the Ardrossan West connection point.

8.2 Assumed Market Development Scenarios

The Regulatory Test for reliability augmentations requires that options to address network requirements be assessed against a number of reasonable scenarios. Those scenarios need to consider:

- The existing network;
- Future network developments;
- Variations in load growth;
- Committed generation and demand side developments; and
- Potential generation and demand side developments.

The purpose of this approach is to test the PV costs of the options being evaluated under a range of plausible scenarios.

8.3 Existing Network and Future Transmission Development

As discussed in Section 6 of this report, all existing and future network developments that have the potential to impact supply arrangements to the Ardrossan West supply point have been included as anticipated projects in the underlying analysis.

8.4 Variations in Demand Growth

The forecast demand growth used in this assessment was based on 10% Probability of Exceedence (PoE) medium economic conditions. Use of 10% PoE demand forecasts is standard ElectraNet practice when planning the transmission system.

The forecasts include all known information about existing and planned demand-side management initiatives, and include independent forecasts of existing and planned local embedded generation.

For the purposes of the Ardrossan West augmentation studies, scenarios assuming both high (4.08%) and low (2.72%) demand growth were also considered to ensure the robustness of the findings of this report.

8.5 Existing and Committed Generators and Demand Side Developments

Neither ElectraNet nor ETSA Utilities are aware of any generation or demand-side proposals that would provide the increased reliability level required for the Ardrossan West connection point. However, as with the discussion of the impact of transmission developments in the previous section, should any such proposal be offered, it would affect either option equally, and therefore not affect their relative present-worth ranking.

8.6 Potential New Generation

Neither ElectraNet nor ETSA Utilities are aware of any potential new generation proposals that will impact on supply to the Ardrossan West substation.

As electricity demand continues to grow, it is forecast that additional generation will be required within the South Australian region. It has been assumed for the purposes of planning studies examining future supply requirements to the Ardrossan West supply area that, although entry of new generation will occur in the foreseeable future to meet the increasing electricity demand, that new generation plant will be located such that its direct impact on the Ardrossan supply area will be indiscernible.

9. Economic Analysis

9.1 Regulatory Test Requirements

The Regulatory Test requires that, for reliability augmentations, the recommended option be the option that "minimises the present value of costs, compared with a number of alternative options in a majority of reasonable scenarios". It is therefore the ranking of assessed options, rather than their actual present value, that is important.

The Regulatory Test contains guidelines for the methodology to be used to identify the lowest cost option. Information to be considered includes construction, operating and maintenance costs, and the cost of complying with existing and anticipated laws and regulations. However, the Regulatory Test specifically excludes indirect costs and costs that cannot be measured as a cost in terms of financial transactions in the electricity market.

A solution to address future supply requirements in the Ardrossan West supply area as outlined in this document is required to satisfy reliability requirements linked to Schedule 5.1 of the NER and the requirements of the South Australian ETC, and hence the reliability limb of the Test has been applied to this assessment.

According to the Regulatory Test, this means that the PV costs of all options must be compared, and the least cost solution identified in order to satisfy the Regulatory Test. The results of that evaluation, carried out using a discounted cash flow model to determine the PV cost of the three options, are discussed below.

9.2 Format to Analysis

ElectraNet has elected to use a twenty-year period over which to undertake the economic analysis. That analysis takes into account the total capital cost of implementing each of the three alternative options as well as the costs of any progressive augmentations that would be required during the twenty-year period from the 2009/10 financial analysis date to 2028/29, for all options. All cost estimates that have been used are current as at 2010.

In addition to examining the impact of a range of reasonable scenarios, as required by the Rules, the sensitivity of the option-ranking to other critical parameters was also examined. Table 9 shows the parameters that were investigated in the sensitivity analysis, the range over which they were varied, and the resulting ranking of the three options when subjected to those variations.

9.3 Discount Rate

The Regulatory Test and Application Guidelines require that the present value calculations must use a commercial discount rate appropriate for the analysis of a private enterprise investment in the electricity sector. The discount rate used should be consistent with the cash flows being discounted. ElectraNet has assumed a rate of 10.00% as the discount rate.

Sensitivity analysis was carried out in the range 8.50% (reflecting the regulated rate of return currently applied to ElectraNet) and 12.00%.

9.4 Capital costs

The economic analysis considers all foreseeable cost impacts of the proposed network augmentations to market participants.

The capital cost[1] to implement each of the feasible options outlined in section 7 has been estimated by ElectraNet based on a conceptual scope of works. Sensitivity studies have been carried out using variations in the capital cost estimates of plus and minus 20%.

9.5 Future Projects, Timings and Sensitivity Analysis

The economic analysis of the three options includes the costs of anticipated future projects that will be needed to maintain the required reliability standards for the Ardrossan West supply area.

Timing for anticipated projects is based on meeting future electricity supply requirements over a twenty year planning horizon. ElectraNet has used load forecasts prepared by ETSA Utilities in April 2009 and published in ElectraNet's 2009 Annual Planning Report. Actual timings of the anticipated projects may change as a result of the ongoing review of load forecasts for the Mid North including Ardrossan West, and other market developments.

The sensitivity of the timing of those anticipated projects to a range of market development scenarios, and therefore the incidence of the capital expenditure, has been also been assessed as part of the economic analysis to ensure that the findings are robust.

9.6 Results of Analysis

As can be seen from the results of the economic analysis provided in Table 9, Option 3 has the lowest present value cost under all of the scenarios considered based on the analysis incorporating capital expenditure and operating and maintenance costs, with sensitivity studies on key variables that ElectraNet and ETSA have no control over demonstrating the robustness of that finding.

[1] In 2010 dollars

Parameter	Range over which the parameter was varied	Option 1 2x25 MV.A 132/33 kV (new) transformers and 15 Mvar capacitor bank		Option 2 2x60 MV.A 132/33 kV (new) transformers and 15 Mvar capacitor bank		Option 3 2x25 MV.A 132/33 kV (1 new & 1 refurbished) transformers and 15 Mvar capacitor bank	
		Present Value Cost	Rank	Present Value Cost	Rank	Present Value Cost	Rank
Growth rate	Low (2.72%pa)	$24.15M	2	$26.48M	3	$23.45M	1
	Medium (3.4%pa)	$24.15M	2	$26.48M	3	$23.45M	1
	High (4.08%pa)	$24.15M	2	$26.48M	3	$23.45M	1
Capital cost (Both ElectraNet's and ETSA Utilities' costs varying)	80%	$19.32M	2	$21.18M	3	$18.76M	1
	100%	$24.15M	2	$26.48M	3	$23.45M	1
	120%	$28.98M	2	$31.77M	3	$28.14M	1
Discount rate	8.5%	$26.73M	2	$29.31M	3	$25.95M	1
	10.0%	$24.15M	2	$26.48M	3	$23.45M	1
	12.0%	$21.23M	2	$23.28M	3	$20.62M	1

Table 9: Sensitivity Analysis

On the basis of the economic analysis and subsequent sensitivity testing, Option 3 is the identified option that satisfies the Regulatory Test.

9.7 Inter-network Impact

ElectraNet is required under the NER to assess whether a new large network asset is reasonably likely to have a material inter-network impact. ElectraNet has determined that the proposed new large network asset will have minimal impact on inter-regional transfer capability, and in particular will not impose power transfer constraints nor adversely impact the quality of supply within adjacent networks.

10. Summary and Conclusions

The following summary and conclusions have been drawn from the analysis presented in this report:

- The augmentation proposed in this document is defined as a 'reliability augmentation' under the NER as it will prevent interruptions to supply during peak load periods under critical single transformer contingency events in the transmission network and supply to the distribution network supplied from Ardrossan West connection point.

- There is no acceptable 'do-nothing' option as ElectraNet is required to meet the ETC reliability standard for the Ardrossan West and maintain NER compliant transmission system voltages within the area. This is not possible given recent load growth and existing network configuration.

- Planning studies were undertaken to evaluate potential network options that would address emerging network limitations in the electricity supply to the Ardrossan West supply area, from which three viable options were identified.

- The economic analysis has identified that Option 3 (installation of 2 x 25 MV.A 132/33 kV transformers (1 new and 1 refurbished) and 15 Mvar switched capacitor bank at Ardrossan West) is the least-cost solution of all the credible scenarios considered and therefore satisfies the requirements of the Regulatory Test.

- Sensitivity studies demonstrated that the results of that analysis are robust to variations in capital cost and other factors beyond the control of ElectraNet and ETSA Utilities. Option 3 is therefore considered to satisfy the Regulatory Test.

11. Draft Recommendation

Based on the conclusions drawn from the preceding analysis, the NER requirements relating to New Large Network Assets, and the supply reliability standards that ElectraNet is required to meet at Ardrossan West connection point, as prescribed by ESCoSA in the ETC, it is recommended that the following be progressed:

- Remove the two existing 10 MV.A 132/33 kV transformers at Ardrossan West substation (condition will be assessed and be relocated elsewhere on the network)
- Replace the above transformers with two 25 MV.A 132/33 kV transformers (1 new and 1 refurbished)
- Reconfigure the 132 kV busbar to mesh busbar arrangement
- Install a 15 Mvar switched capacitor bank at Ardrossan West 132 kV busbar
- Complete integration works on the 33 kV ETSA Utilities switchyard to ensure that the complete connection point is upgraded to the reliability levels required by the ETC

The total estimated cost of the project is $30.2m, of which $22.8m will be attributable to ElectraNet's portion of the required works, and $7.4m to ETSA Utilities.

The proposed timetable for implementation of the recommended solution is as follows:

- Civil works to commence by March 2011
- Delivery of plant by May 2011
- Delivery of transformers by October 2011
- Asset commissioning by February 2012
- Assets in service by April 2012

12. Consultation

ElectraNet and ETSA Utilities previously released an Application Notice with submissions closing 1 June 2010; no submissions were received.

This joint Final Report entitled "Proposed New Large Network Asset – Ardrossan West Substation Augmentation" is issued in accordance with the requirements of the NER and ESCOSA Guideline 12.

The options that have been considered in this report have been subjected to the Regulatory Test for reliability augmentations promulgated by the AER under the NER

In accordance with NER requirements, ElectraNet therefore invites submissions from Registered Participants and interested parties on this Final Report.

Submissions are due by the close of business on xxx 2010.

Please address submissions to:

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Senior Manager NEM Development and Regulation,
ElectraNet,
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Hutt Street Post Office,
Adelaide, South Australia, 5000
Tel: (08) 8404 7324
Fax: (08) 8297 0162

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13. Glossary

Adelaide Central	That area of Adelaide which is located east of West Terrace, north of South Terrace, west of East Terrace, and south of the River Torrens.
Act	Electricity Act 1996
AER	Australian Energy Regulator
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AMD	Agreed Maximum Demand – for a connection point or a group of connection points, it is the demand specified as such in the connection agreement between ElectraNet and the relevant transmission customers or ETSA Utilities.
Application Notice	A notice made available to Registered Participants and Interested Parties pursuant to clause 5.6.6 of the Rules
Distribution Code – EDC	South Australian Electricity Distribution Code – as issued by ESCOSA
DNSP	Distribution Network Service Provider
DM, DMS	Demand Management or Demand Side Management
ElectraNet	ElectraNet is the principal transmission network service provider in South Australia. It is a privately owned company that has a long term lease for the operation, maintenance, and development of the South Australian transmission system which comprises plant and equipment mainly operating at voltages of 132 kV and above. ElectraNet is registered with AEMO as a Transmission Network Service Provider (TNSP)
Equivalent Transformer Capacity	Capacity to transform energy to meet demand using means including, but not limited to: transmission system capability; network support arrangements. As defined in the ESCOSA Electricity Transmission Code

ESCOSA	Essential Services Commission of South Australia established under the Essential Services Commission Act 2002
ESDP	Electricity System Development Plan (ESDP) developed annually by ETSA Utilities and published by 30 June. The ESDP includes details of projected limitations on the ETSA Utilities Distribution system for at least the next three year period and provides the information needed for a party to register as an Interested Party as defined within ESCOSA Guideline 12
ETC	South Australian Electricity Transmission Code issued by ESCOSA
ETSA Utilities	ETSA Utilities is South Australia's principal Distribution Network Service Provider (DNSP), and is responsible for the distribution of electricity to all distribution grid connected customers within the State under a regulatory framework. ETSA Utilities is a partnership of Cheung Kong Infrastructure Holdings Ltd (CKI), Hong Kong Electric International Ltd (HEI), and Spark Infrastructure
Guideline 12 (GL 12)	ESCOSA Electricity Industry Guideline 12 – Demand Management for Electricity Distribution Networks
Market Participant	A person who has registered with AEMO as a Market Generator, Market Customer or Market Network Service Provider under Chapter 2
NEM	National Electricity Market
NPV	Net Present Value
O&M	Operating and Maintenance
OLTC	On Load Tap Changer – a device used to control the output voltage of a transformer
QOS	Quality of Supply
RDP	Regional Development Plan
Registered Participant	A person who is registered with AEMO as a Network Service Provider, a System Operator, a Network Operator, a Special Participant, a Generator, a Customer or a Market Participant

Regulatory Test	The test promulgated by the AER, which all major regulated network augmentation investments must comply with
RFI	Request for Information
RFP	Request for Proposals
ROA	Return on Asset
Rules	National Electricity Rules (Rules) formerly the National Electricity Code (NEC)
TNSP	Transmission Network Service Provider
TUOS	Transmission Use of System charges applicable to Registered Participants in the NEM
WACC	Weighted Average Cost of Capital
VoLL	Value of Lost Load as measured in the NEM

ElectraNet
electricity transmission

ETSA Utilities

Ardrossan West Final Report

Appendices – Financial Analysis

August 2010

Version 1.0

Appendix A Option 1 Financial Analysis

Scenario B			Medium load Growth																	
			0 **9/10**	*1* **10/11**	*2* **11/12**	*3* **12/13**	*4* **13/14**	*5* **14/15**	*6* **15/16**	*7* **16/17**	*8* **17/18**	*9* **18/19**	*10* **19/20**	*11* **20/21**	*12* **21/22**	*13* **22/23**	*14* **23/24**	*15* **24/25**	*16* **25/26**	*17* **26/27**	18 **27/28**	19 **28/29**
Option 1				2 x New 132/33kV 25MVA Transformers																		
2 x New 132/33kV 25MVA Transformers		31.10																				
			9/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29
* WDV		31.1	0	0.0	32.7	32.2	31.5	30 8	30.1	29.3	28 6	27.9	27.2	26.4	25.7	25.0	24 2	23.5	22.8	22.1	21.3	20.6
* Depreciation over		45		0.0	0.4	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
* Opex		0.015		0.0	0.3	0 5	0.5	0.5	0 5	0.5	0.5	0 5	0.5	0.5	0 5	0.5	0.5	0 5	0 5	0.5	0.5	0 5
* WACC		0 0851		0.0	1.6	2.7	2.7	2.6	2 6	2.5	2.4	2.4	2.3	2.2	2 2	2.1	2.1	2 0	1 9	1.9	1.8	1 8
=> TUOS			0	0.0	2.3	4 0	3.9	3.8	3 8	3.7	3.6	3 6	3.5	3.5	3.4	3.3	3.3	3 2	3 2	3.1	3.0	3 0
==> NPV of TUOS	$24.15																					
Total TUOS per year				0.0	2.3	4 0	3.9	3.8	3 8	3.7	3.6	3 6	3.5	3.5	3.4	3.3	3.3	3 2	3 2	3.1	3.0	3 0
NPV of total TUOS	$24.15																					
Total for Option 1	**$24.15**																					

Option 1 – Medium growth scenario

Appendix B Option 2 Financial Analysis

Scenario B			Medium load Growth																	
			0 **9/10**	*1* **10/11**	*2* **11/12**	*3* **12/13**	*4* **13/14**	*5* **14/15**	*6* **15/16**	*7* **16/17**	*8* **17/18**	*9* **18/19**	*10* **19/20**	*11* **20/21**	*12* **21/22**	*13* **22/23**	*14* **23/24**	*15* **24/25**	*16* **25/26**	*17* **26/27**	18 **27/28**	19 **28/29**
Option 2				2 x New 132/33kV 60MVA Transformers																		
2 x New 132/33kV 60MVA Transformers		34.10																				
			9/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29
* WDV		34.1	0	0.0	35 8	35.3	34.5	33.7	33.0	32.2	31.4	30.6	29.8	29 0	28.2	27.4	26 6	25.8	25.0	24.2	23.4	22.6
* Depreciation over		45		0.0	0.5	0 8	0.8	0.8	0 8	0.8	0.8	0 8	0.8	0.8	0 8	0.8	0.8	0 8	0 8	0.8	0.8	0 8
* Opex		0.015		0.0	0.3	0 5	0.5	0.5	0 5	0.5	0.5	0 5	0.5	0.5	0 5	0.5	0.5	0 5	0 5	0.5	0.5	0 5
* WACC		0 0851		0.0	1.8	3 0	2.9	2.9	2 8	2.7	2.7	2 6	2.5	2.5	2.4	2.3	2.3	2 2	2.1	2.1	2.0	1 9
=> TUOS			0	0.0	2.6	4 3	4.3	4.2	4.1	4.1	4.0	3 9	3.9	3.8	3.7	3.7	3.6	3 5	3 5	3.4	3.3	3 3
==> NPV of TUOS		$26.48																				
Total TUOS per year				0.0	2.6	4 3	4.3	4.2	4.1	4.1	4.0	3 9	3.9	3.8	3.7	3.7	3.6	3 5	3 5	3.4	3.3	3 3
NPV of total TUOS		$26.48																				
Total for Option 2		**$26.48**																				

Option 2 – Medium growth scenario

Appendix C Option 3 Financial analysis

Scenario B		Medium load Growth																			
		0 **9/10**	*1* **10/11**	*2* **11/12**	*3* **12/13**	*4* **13/14**	*5* **14/15**	*6* **15/16**	*7* **16/17**	*8* **17/18**	*9* **18/19**	*10* **19/20**	*11* **20/21**	*12* **21/22**	*13* **22/23**	*14* **23/24**	*15* **24/25**	*16* **25/26**	*17* **26/27**	18 **27/28**	19 **28/29**
Option 3			1x New 1x Refurb 132/33kV 25MVA Transformer																		
1x New 1x Refurb 132/33kV 25MVA Transformer	30 20																				
		9/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29
* WDV	30.2	0	0.0	31.7	31.3	30.6	29.9	29.2	28.5	27.8	27.1	26.4	25.7	25 0	24.3	23.5	22.8	22.1	21.4	20.7	20 0
* Depreciation over	45		0.0	0.4	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
* Opex	0.015		0.0	0.3	0 5	0.5	0.5	0 5	0.5	0.5	0 5	0.5	0.5	0.5	0.5	0.5	0 5	0.5	0 5	0.5	0.5
* WACC	0 0851		0.0	1.6	2.7	2.6	2.5	2 5	2.4	2.4	2 3	2.2	2.2	2.1	2.1	2.0	1 9	1.9	1 8	1.8	1.7
=> TUOS		0	0.0	2.3	3 8	3.8	3.7	3.7	3.6	3.5	3 5	3.4	3.4	3.3	3.2	3.2	3.1	3.1	3 0	2.9	2.9
==> NPV of TUOS	$20.62																				
Total TUOS per year			0.0	2.3	3 8	3.8	3.7	3.7	3.6	3.5	3 5	3.4	3.4	3.3	3.2	3.2	3.1	3.1	3 0	2.9	2.9
NPV of total TUOS	$20.62																				
Total for Option 3	**$20.62**																				

Option 3 – Medium growth scenario