FINAL REPORT

KURRI TO RUTHERFORD AUGMENT/SPLIT 33kV TEE FEEDER

NEW SMALL DISTRIBUTION NETWORK ASSET

2nd July 2009

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EXECUTIVE SUMMARY

This Final Report has been prepared to report on upgrade work that is proposed to develop the electricity supply network from Kurri subtransmission substation to Rutherford zone substation in accordance with Clause 5.6.2 (h) of the National Electricity Rules. The work proposed by this report is classified as a new small distribution network asset.

A Distribution Network Service Provider does not need to consult on an option which would be a new small distribution network asset. Accordingly EnergyAustralia has not previously consulted on this project.

Due to increased load growth, the 33kV network suppling Rutherford, Telarah and Maitland Central zone substations is heavily utilised and a number of loading constraints exist on the 33kV network within this area. To ensure a safe and reliable electricity supply for existing customers in Rutherford, Telarah and Maitland Central areas, EnergyAustralia will provide additional capacity to alleviate present loading and also to meet forecast load demands.

The provision of additional capacity is required to meet network performance requirements set by EnergyAustralia in accordance with Schedule 5.1 of the Rules.

This report covers the following issues:

Section 1 provides a background for the 33kV network that supplies Rutherford, Telarah and Maitland Central area and the need for augmentation.

Section 2 presents EnergyAustralia's service standards for the area, and describes in detail various asset condition and forecast capacity issues in the area that resulted in the need for augmentation of supply to the area.

Section 3 describes the proposed augmentation in relation to the National Electricity Rules (the Rules). The feeder from Kurri STS to Rutherford ZS is classified as a distribution system asset by the Rules, and the proposed development is classified as a small network asset as it involves expenditure less than $10 million.

Section 4 describes the options that were considered, including Demand Side Management as well as:

- Option 1 – Construct a 132/33kV dual circuit feeder and remove the tee
- Option 2 – Construct a 33kV single circuit feeder and remove the tee

Section 5 presents the results of the regulatory test and ranks the options.

Section 6 concludes that the most cost effective option within the regulatory test is Option 1.

EnergyAustralia's recommended action is Option 1 - Construct a 132/33kV dual circuit feeder and remove the tee at an estimated cost of $8.5M. This recommendation is made based on the least cost test to provide long term future capacity. The proposed work is scheduled for completion at the end of 2011.

1. BACKGROUND

1.1 Introduction

This Final Report has been prepared to meet the requirements of clause 5.6.2(h) of the National Electricity Rules (the Rules) and to advise on the development work that is proposed to develop the electricity supply network in Kurri – Rutherford area. The information provided includes:

- A discussion of emerging supply system limitations identified by EnergyAustralia that have lead to the necessity for augmentation of the 33kV sub-transmission network in the area;
- A discussion of the service standard that has been adopted for planning purposes;
- Descriptions of options for development of the electricity supply in the area; and
- Details of the outcomes of the cost-effectiveness analysis of the options considered.

1.2 Existing Supply Arrangement

The Maitland network area extends in the north from Luskintyre to Woodville, and south from Heddon Greta and Black Hill. The area is traversed from west to east by the Hunter River. The associated flood plains create the north and eastern boundary along with Hexham Wetlands to the South. A geographic network diagram is shown below:

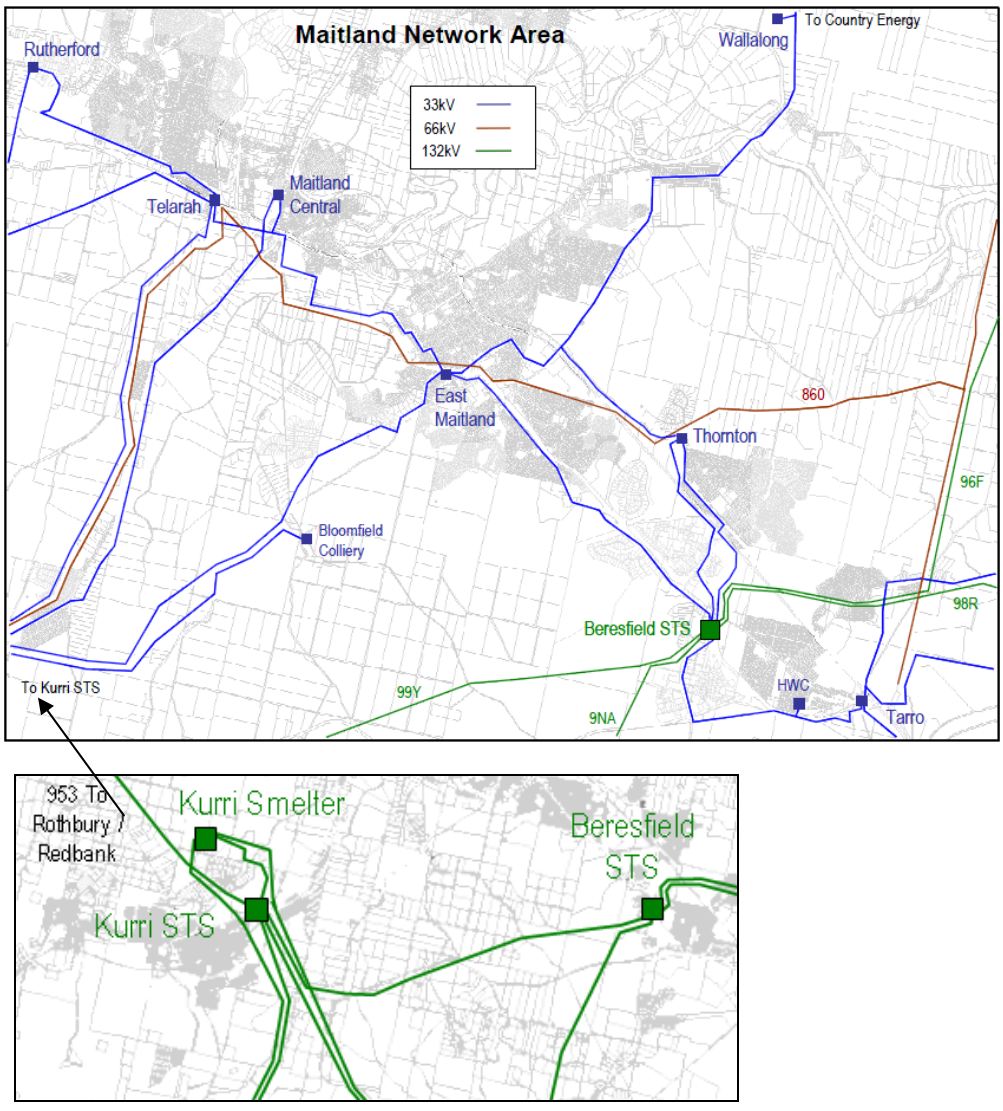

Figure 1: Geographical Overview of Maitland Network Area

The 33kV network in the Maitland area is predominately overhead and is supplied from Kurri and Beresfield subtransmission substation (STS). This document is concerned with the 33kV network normally supplied from Kurri STS, which supplies Rutherford, Telarah and Maitland Central zone substations (ZS). The preferred strategy under the Maitland Area plan is to maintain 33kV supply for areas in the vicinity of the existing 33kV infrastructure and develop at 132kV in the outlying areas that are remote from the existing assets.

Feeder 8 from Kurri STS to Rutherford zone is a tee feeder, which also supplies Telarah zone. The tee to Rutherford utilises part of the old 66kV feeder 11 that previously supplied Branxton zone. The remainder of out of service 66kV feeder 11 provides a route that generally runs in parallel with 33kV feeder 8 from the Tee back to Kurri STS.

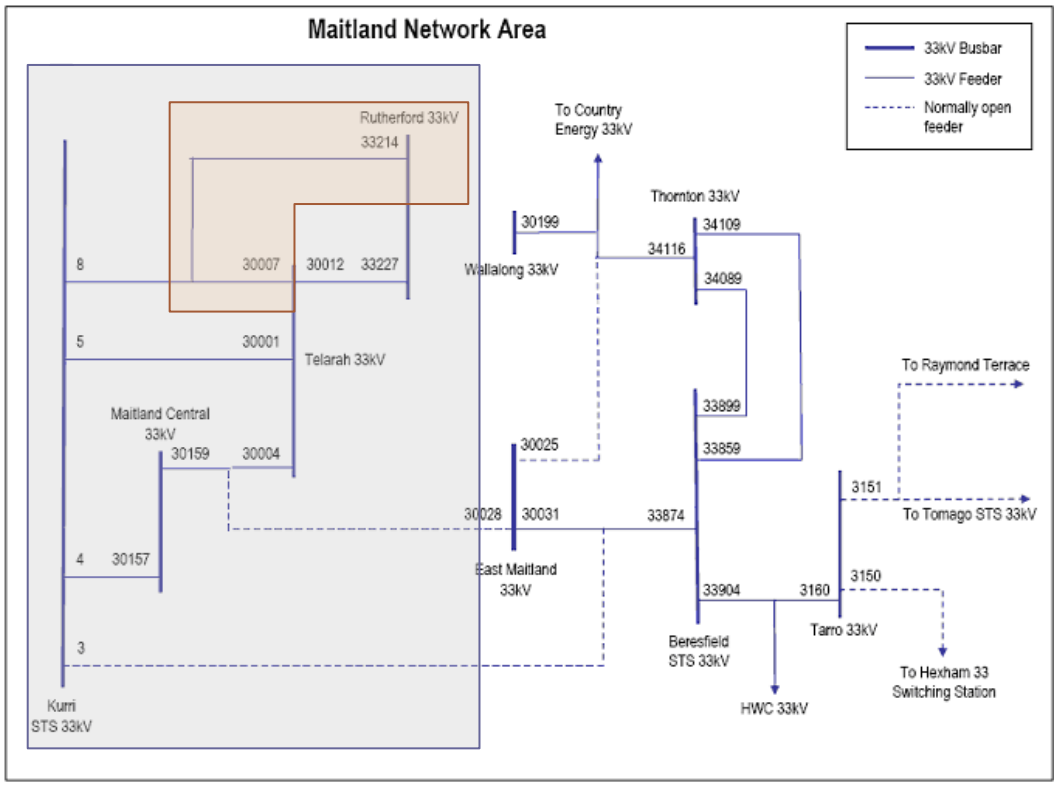

Figure 2: Schematic Diagram of Maitland Network Area

Notes: (a) The grey shade represents 33kV Rutherford/Telarah/Maitland Central network as presented in *Table 1*.
(b) Kurri to Rutherford 33kV tee feeder, the focus of this project, is shaded in orange.

2. ISSUES

2.1 Applied Service Standard

2.1.1 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.

2.1.2 Zone substations and subtransmission network (urban/non-urban)

Following a failure of a single critical element (i.e. N-1 conditions), the network must be designed to recover supply within one minute for systems supplying >10MVA, and otherwise, within best practice repair times. For systems that supply >10MVA, the forecast demand of a zone substation or overhead feeder network may exceed the N-1 capacity for up to 1% of the year i.e. a total aggregate time of 88 hours per annum, up to a maximum of 20% above the N-1 capacity; and the forecast demand of an underground feeder network may not exceed the N-1 capacity.

2.1.3 Voltage Regulation Requirements

The voltage regulation range of the subtransmission (132kV, 66kV and 33kV) system is determined by the requirement for zone transformers: to maintain voltage regulation under normal system conditions; and be less than 4% below their set voltage level (allowing for line drop compensation) during first contingency outages.

2.2 Description of Network Constraints

The following contingent loading conditions are forecast on the Rutherford/Telarah/Maitland Central 33kV feeders over the next five years. These are the loadings experienced for worst case contingent (N-1) loading conditions.

Feeder	Rating (A)	Feeder Type	Licence Limit (%)	Feeder Loading (%)				
				2008/09	2009/10	2010/11	2011/12	2012/13
8 (Kurri)	468	OH	120	141	147	157	160	172
8 Tee 33214	342	OH	120	167	184	202	216	224
8 Tee 30007	325	OH	120	71	71	76	76	83
5/30001	468	OH	120	138	154	165	183	189
30012/33227	630	OH	120	96	106	112	116	124
4/30157	727	OH	120	94	101	107	115	119
30159/30004	405	UG	100	113	121	130	139	147

Table 1: Contingent (N-1) Feeder Loading before augmentation

Notes: (a) Red indicates where the forecast load exceeds DNSP Licence Conditions during the first contingency loss of a feeder. (b) OH is the abbreviation for overhead. (c) UG is the abbreviation for underground

3. TYPE OF AUGMENTATION

The National Electricity Rules (the Rules) require 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. A Network Service Provider does not need to consult on a network option that would be a small network asset, or for options that do not augment the system.

The proposed development option on Kurri – Rutherford 33kV network involves expenditure less than $10 million and is regarded by the Rules as a new small distribution network asset and therefore a Consultation Paper was not required.

The new capacity provided by the proposed augmentation has been necessitated by the need to provide increased system capacity to meet EnergyAustralia's licence conditions described in Section 2 and would thus be regarded as a reliability driven augmentation for the purposes of the Regulatory Test. Consequently, EnergyAustralia has used a least cost test to examine the options identified to address projected system limitations.

4. OPTIONS CONSIDERED

The development option for the Kurri – Rutherford 33kV network is driven by the need to address capacity issues. The following section describes Demand Management and supply side options considered to address these issues.

4.1 Demand Management

A Demand Management Screening Test on Rutherford/Maitland Central/Telarah 33kV feeders was carried out in August 2008. To defer the proposed supply side solution for one year, demand at Rutherford Zone needs to be reduced by 8MVA for summer 2009/10. An 8MVA reduction in load represents 28% of the total load forecast on Rutherford Zone, which is high. The value of one year deferral is $786,000 or $98/kVA, which is low. Longer deferrals would require even large reductions.

Therefore, based on this analysis it is not considered reasonable to expect that it would be cost-effective to postpone the proposed supply-side solutions by implementing demand management strategies.

4.2 Supply Side Options

4.2.1 Option 1 – Construct a 132/33kV dual circuit feeder and remove the tee

It is proposed that a 9.5km dual circuit feeder be constructed and the existing tee between feeder 8 and 33214 subsequently be removed. The circuits of the new feeder would be operated at 33kV and 132kV. The 33kV circuit will supply Rutherford zone, while the other will supply 132kV for the propose 132/11kV Lochinvar zone substation in 2016. The new dual circuit feeder will utilize part of the out of service 66kV circuit that runs parallel to the existing tee between feeder 8 and 33214. The result of this augmentation will provide two dedicated feeders from Kurri STS, one to Rutherford zone and the other to Telarah zone.

The project consists of the following main sub-projects in chronological order:

- Ensure 33kV feeder bay 13 at Kurri STS is complete and ready for service.
- At Kurri STS, rearrange existing 33kV feeder 5 to become 33kV feeder 13.
- Connect bay 13 at Kurri STS, to bay 30001 at Telarah zone.
- Construct a dual 132/33kV circuit feeder by utilizing the route/easement of the old 66 kV feeder 11. The dual circuit feeder is about 9.5km in length. (With minimal interruptions to existing Tee feeder 8).
- Remove the tee from feeder 8. This is done by (a) disconnecting Rutherford section from feeder 8, and then (b) at Kurri STS, connect feeder 5 to the proposed dual circuit feeder (operating at 33kV). As the result, there would be a new direct 33kV feeder from bay 5 at Kurri STS, to bay 33214 at Rutherford zone.
- Retain existing 33kV feeder from bay 8 at Kurri STS, to bay 30007 at Rutherford zone.

To achieve compliance with Design Planning Criteria on the Rutherford / Telarah / Maitland Central 33kV network, the following projects would also be required:

- 33kV re-arrangement for Auto-Load transfer.
- Installation of capacitors at Rutherford zone.

Figure 3 is a schematic diagram of the proposed feeder arrangement.

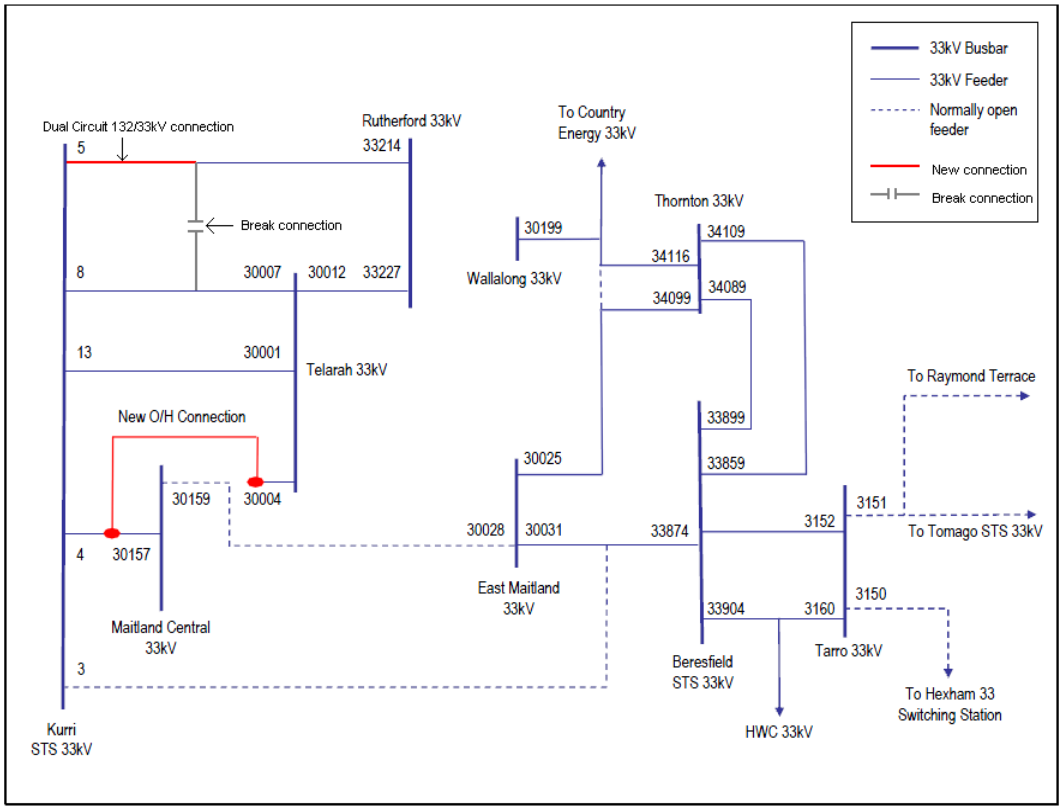

Figure 3: Schematic Diagram of the proposed feeder arrangement

Proposed Feeder No.	Existing Feeder No.	Rating (A)	Feeder Type	Licence Limit (%)	Feeder Loading (%)				
					2008/09	2009/10	2010/11	2011/12	2012/13
5/33214	5/30001	630	OH	120	71	78	83	87	90
8/30007	8 tee 30007 & 8 (Kurri)	325	OH	120	71	76	81	85	90
13/30001	New bay 13	468	OH	120	103	101	114	110	118
30012/33227	30012/33227	630	OH	120	73	82	85	90	93
4/30157	4/30157	727	OH	120	71	76	81	85	90
4 Tee 30004	30159/30004	545	OH	120	35	31	37	33	36

Table 2: Contingent (N-1) Feeder Loading after augmentation

Note: (a) OH is the abbreviation for overhead

4.2.2 Option 2 – Construct a 33kV single circuit feeder and remove the tee

This option is a staged development. Stage 1 proposes the construction of a 9.5km long single circuit feeder. The new feeder would utilize part of the out of service feeder 11's route/easement. The feeder would be operated at 33kV to supply Rutherford zone. Stage 2 would then requires a need to redevelop feeder 8 (Kurri STS to Telarah ZS) as a 132/33kV dual circuit, which would provide future 132kV supply to the proposed 132/11kV Lochinvar zone substation in year 2016. The economic analysis for this option includes the initial construction of a single circuit feeder and later redevelopment of a dual circuit feeder.

The project consists of three main sub-projects:

- At Kurri STS, rearrange 33kV feeder 5 to feeder 13.
- Construct a single 33kV feeder by utilizing section of the old 66kV feeder 11.
- Create a new direct feeder from Kurri STS to Rutherford ZS, and disconnect the tee to Rutherford ZS.

To achieve compliance with Design Planning Criteria on the Rutherford and Telarah 33kV feeders, the following projects would also be required, and they include: 33kV Re-arrangement for Auto-Load transfer and Installation of capacitors at Rutherford zone.

5. APPLICATION OF REGULATORY TEST

Economic analysis has been carried out in accordance with the regulatory test promulgated by the ACCC under clause 5.6.5A of the Rules. As indicated in section 1.2 the "reliability limb" of the test was applied. It involves the comparison of options by carrying out a Net Present Cost (NPC) analysis. In this case the option that satisfies the regulatory test is considered to be the one that minimises the NPC of the relevant overall area supply strategy.

A range of parameters has been included in the comparison of options such as change in discount rate and variations in material costs. In summary the two options presented are technically and economically comparable given due consideration to all capital and operating costs that are able to be defined and quantified.

5.1 Base Case Analysis

The options considered are ranked by the NPC of the relevant area supply strategy considering an 8.5% p.a. discount rate for the base case as shown in the following table. The total capital costs of each strategy are also shown in *Table 3* below.

Options	NPC* ($M)	Cost ($M)	Ranking
Option 1: Construct a 132/33kV dual circuit feeder and remove the tee	**7.82**	**8.25**	**1**
Option 2: Construct a 33kV single circuit feeder and remove the tee	10.34	13.95	2

Table 3: Summary of base case analysis of options

*The net present cost (NPC) includes operational and maintenance cost

The analysis above indicates that under base case conditions, the NPC of Option 1 is the least cost solution.

Refer to APPENDIX A – ECONOMIC ANALYSIS OF BASE CASE for the detailed analysis.

5.2 Sensitivity Analysis

Sensitivity Analysis was carried out to consider the impact of different discount rates and price variations. The base case and the range over which sensitivity checks were conducted are shown in *Table 4*.

Sensitivity Factor	NPC ($M)	
	Option 1	Option 2
7% Discount Rate	**7.88**	10.91
8.5% Discount Rate (base case)	**7.82**	10.34
10% Discount Rate	**7.60**	9.82
25% decrease in capital cost	**5.86**	7.76
25% increase in capital cost	**9.77**	12.93

Table 4: Summary of the results of the sensitivity analysis

The result of the sensitivity analysis indicates that Option 1 - Construct a 132/33kV dual circuit and remove the tee is the least net present cost option under all of the sensitivity scenarios.

5.2.1 Variation in Load Growth Rates

Variation in load growth rates will not affect the cost of supply options as the 33kV network is presently constrained. Variations in load growth have no effect on the timing of the projects.

6. CONCLUSION AND RECOMMENDED ACTION

Option 1 is the least cost option under all scenarios, and is thus recommended as the course of action to be taken by EnergyAustralia.

EnergyAustralia intends to upgrade Kurri / Rutherford / Telarah network by remove 33kV tee feeder and construct a dual circuit 132/33kV between Kurri STS and Rutherford zone substation at an estimated cost of $8.5M.

This work is forecast to be completed in year 2011. This service availability date may change if the project is affected by circumstances beyond EnergyAustralia's control, such as changes in the timing of customer load increases or other issues such as: delays in the approval process; equipment supply difficulties; unforeseen technical constraints; acts of God; and industrial action.

7. APPENDIX A – ECONOMIC ANALYSIS OF BASE CASE

WACC = 8.5%

Option 1 – Construct a 132/33kV dual circuit feeder and remove the tee

Action	NPC ($M)	CAPEX ($M)	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Dual circuit construction and remove the tee	**7.51**	**8.25**	0.35	6.19	1.71	-	-	-	-	-	-	-
Operation & maintenance	**0.31**		-	-	-	0.03	0.08	0.08	0.08	0.08	0.08	0.08
Totals	**7.82**	**8.25**	**0.35**	**6.19**	**1.71**	**0.03**	**0.08**	**0.08**	**0.08**	**0.08**	**0.08**	**0.08**

Option 2 – Construct a 33kV single circuit feeder and remove the tee

Action	NPC ($M)	CAPEX ($M)	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Stage 1:												
Single circuit construction and remove the tee	**4.84**	**5.33**	-	4.38	0.95	-	-	-	-	-	-	-
Stage 2:												
Feeder 8 dual circuit construction for Lochinvar 132/11kV zone	**5.24**	**8.62**	-	-	-	-	-	-	7.78	0.84	-	-
Operation & maintenance	**0.26**		-	-	-	0.02	0.05	0.05	0.05	0.05	0.08	0.14
Totals	**10.34**	**13.95**	**-**	**4.38**	**0.95**	**0.02**	**0.05**	**0.05**	**7.83**	**0.89**	**0.08**	**0.14**

Notes: All figures in the above table are quoted in 2008/09 real dollars ($M).