Final Report:

Proposed New Large Network Asset –

Cairns and Far North Queensland Area

Powerlink Queensland
3 October 2003

CONTENTS

1 EXECUTIVE SUMMARY

Powerlink Queensland has identified emerging limitations in the electricity transmission network supplying the Cairns and Far North Queensland area. This area includes the city of Cairns and its immediate surrounds, as well as the area to the west and north of Cairns which is supplied from the Turkinje substation near Mareeba.

The majority of the electricity used in the Cairns and Far North Queensland region is transported from Central Queensland on Powerlink's 275kV system to Ross, near Townsville. From Ross it is transferred via a double circuit 275kV transmission line to Chalumbin, then via a single circuit 275kV transmission line between Chalumbin and the Woree substation on the outskirts of Cairns.

Powerlink's planning studies have identified that, from the summer of 2005/06, an outage of either the Chalumbin to Woree or a Ross to Chalumbin 275kV circuit during the peak summer period would require customer load shedding in order to prevent voltage collapse and to allow safe operation of the system. Action is required to overcome this limitation before late 2005 to allow Powerlink to meet its obligations under the National Electricity Code, the Electricity Act and its Transmission Authority.

Powerlink carried out consultation with interested parties to identify and determine feasible options to address the emerging network limitations. No non-network alternatives were proposed through this process. Investigations by Powerlink have identified two feasible network options for the proposed augmentation:

Option 1: Install a second 275/132kV 300MVA transformer and a 275kV bus bar at Woree substation and energise the second line between Chalumbin and Woree substations at 275kV.

Option 2: Install a 132kV (-80 ~ +150) 230MVAr static var compensator at Woree substation on the existing 132kV bus bar.

Subsequent anticipated projects have been identified for both proposed augmentation options.

Financial analysis was carried out to compare the Net Present Value (NPV) of the costs to market participants of the options identified, in accordance with the ACCC Regulatory Test. Sensitivity to three market development scenarios, and to assumptions about the capital cost, costs of network losses and the discount rate was assessed.

The ACCC Regulatory Test requires that, for reliability augmentations, the recommended proposed augmentation option represent the lowest NPV cost under the majority of market development scenarios considered. The economic analysis in this paper identified that proposed augmentation Option 2 is the least-cost solution over the 15 year period of analysis. Sensitivity analysis showed the results of the financial analysis to be robust under a range of assumptions.

Consequently, an 'Application Notice' was published in August 2003 containing a draft recommendation to implement proposed augmentation Option 2 to address the identified network limitations in the Cairns and Far North Queensland area. The proposed new large network asset is:

- A 132kV (-80 ~ +150) 230MVAr static var compensator at Woree substation on the existing 132kV bus bar at a cost of $16.9 million. Powerlink proposes to commit to construction of this asset in Quarter 1, 2004 and to commission the asset by September 2005.

One submission was received in response to the draft recommendation. This submission was made by Ergon Energy, the distribution authority for the Far North Queensland area. In its submission, Ergon Energy stated its support for the draft recommendation and the conclusion that any deferral of the proposed project would result in unacceptable system reliability. Powerlink has therefore adopted the draft recommendation without change as its final recommendation. Immediate steps will be taken to implement this recommendation.

2 INTRODUCTION

Powerlink Queensland has identified emerging limitations in the electricity network supplying Cairns and Far North Queensland. This area includes the city of Cairns and its immediate surrounds, as well as the area to the west and north of Cairns which is supplied from the Turkinje substation near Mareeba.

Where a transmission network service provider proposes to establish a new large network asset to address such limitations, it is required to issue an "Application Notice" under clause 5.6.6 of the National Electricity Code. The Code then requires consideration of submissions received in response to the Application Notice, and preparation of a Final Report in accordance with clauses 5.6.6 (e) and 5.6.6 (f).

This Final Report must contain information regarding:

- the reasons the augmentation is required, including, if relevant, why it is considered a 'reliability augmentation' as defined in the Code;
- feasible options available to address the emerging network limitations, including any proposed non-network alternatives that meet the requirements;
- a detailed description of the proposed new large network asset;
- the technical details of the recommended solution, including the timetable for implementation and commissioning date;
- why the proposed solution satisfies the Regulatory Test prescribed by the Australian Competition and Consumer Commission (ACCC); and
- a summary of submissions received from interested parties and the applicant's response to each submission.

This Final Recommendation is based on:

- The assessment that a reliable power supply will not be able to be maintained in the Cairns and Far North Queensland area during single network contingencies from late 2005 onwards;
- the consultation undertaken by Powerlink to identify potential solutions to address these emerging network limitations;
- an analysis of feasible options in accordance with the ACCC Regulatory Test; and
- the publication of an Application Notice containing a draft recommendation to address the identified network limitations, and the submissions from interested parties submitted in response to the Application Notice.

The recommended option maximises the net economic benefits to participants in the National Electricity Market. These economic benefits arise from maintaining a reliable power supply during single network contingencies, in accordance with Powerlink's obligations, and at the least cost to the market and therefore to end-use customers.

3 REASONS AUGMENTATION IS REQUIRED

3.1 Supply to the Cairns and Far North Queensland Area

Powerlink has identified emerging limitations in the electricity network supplying the Cairns and Far North Queensland area.

The Cairns area is at the northern extremity of the Queensland electricity transmission system and the majority of the energy supplied to the area is generated in Central Queensland, some 800 kilometres away. The relevant area is the city of Cairns and its immediate surrounds, which is supplied from the Woree substation, as well as the area to the west and north of Cairns which is supplied from the Turkinje substation near Mareeba.

The majority of the electricity used in the Cairns region is transported from Central Queensland on Powerlink's 275kV system to Ross, near Townsville. From Ross it is transferred via a double circuit 275kV transmission line to Chalumbin, then via a single circuit 275kV transmission line between Chalumbin and the Woree substation on the outskirts of Cairns. During typical conditions these 275kV circuits supply 65% of the electricity demand in the Cairns area.

The other 35% is supplied via the 132kV system. Parallel to the 275kV Chalumbin to Woree line is a 275kV circuit currently operating at 132kV. There are two other lower capacity 132kV lines, a double circuit line which runs from Garbutt in Townsville to Woree via a number of coastal centres and a single circuit line which runs from Chalumbin to Cairns via Turkinje, near Mareeba. The 132kV Turkinje to Cairns line will be removed in the future, as agreed with the Wet Tropics Management Authority. The coastal and inland transmission lines are connected by a 132kV line between Kareeya and Chalumbin.

The electricity supply system to Far North Queensland is shown in Figure 1 and an operational schematic of the transmission system is shown in Figure 2 below.

Woree substation is the primary supply point in the Cairns area. Power from Woree supplies the Powerlink bulk supply points at Cairns and Kamerunga where it is transferred into Ergon Energy's Cairns distribution network. At present, power from Woree also supplies approximately 35% of the energy to the Turkinje bulk supply point under normal conditions with the remainder being supplied directly from Chalumbin. This energy is transferred into the Ergon Energy network which distributes power in the area to the north of Cairns. Following decommissioning of the Turkinje to Cairns 132kV line, Turkinje will be supplied entirely from Chalumbin.

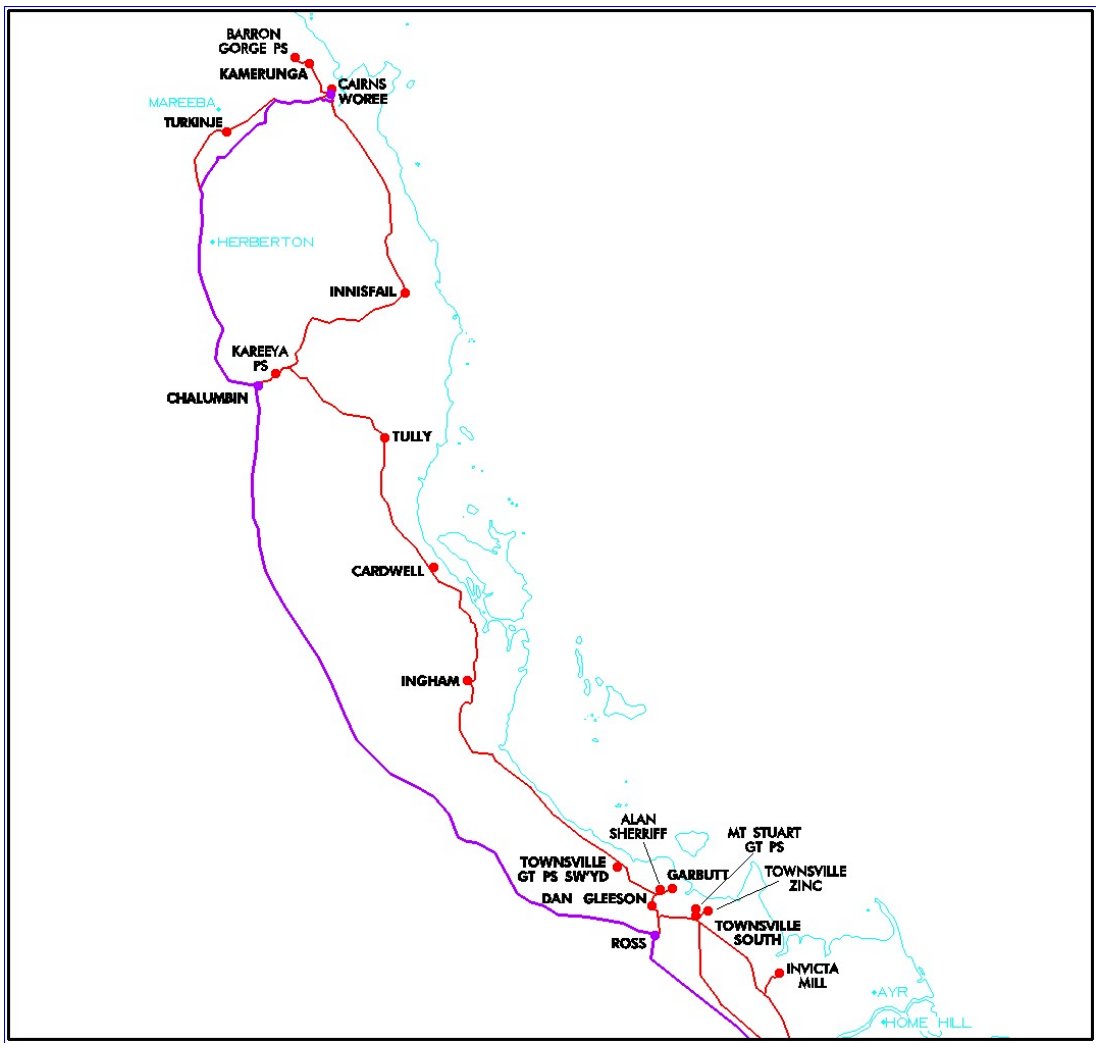


Figure 1: Electicity Supply System to Far North Queensland Geographical Area

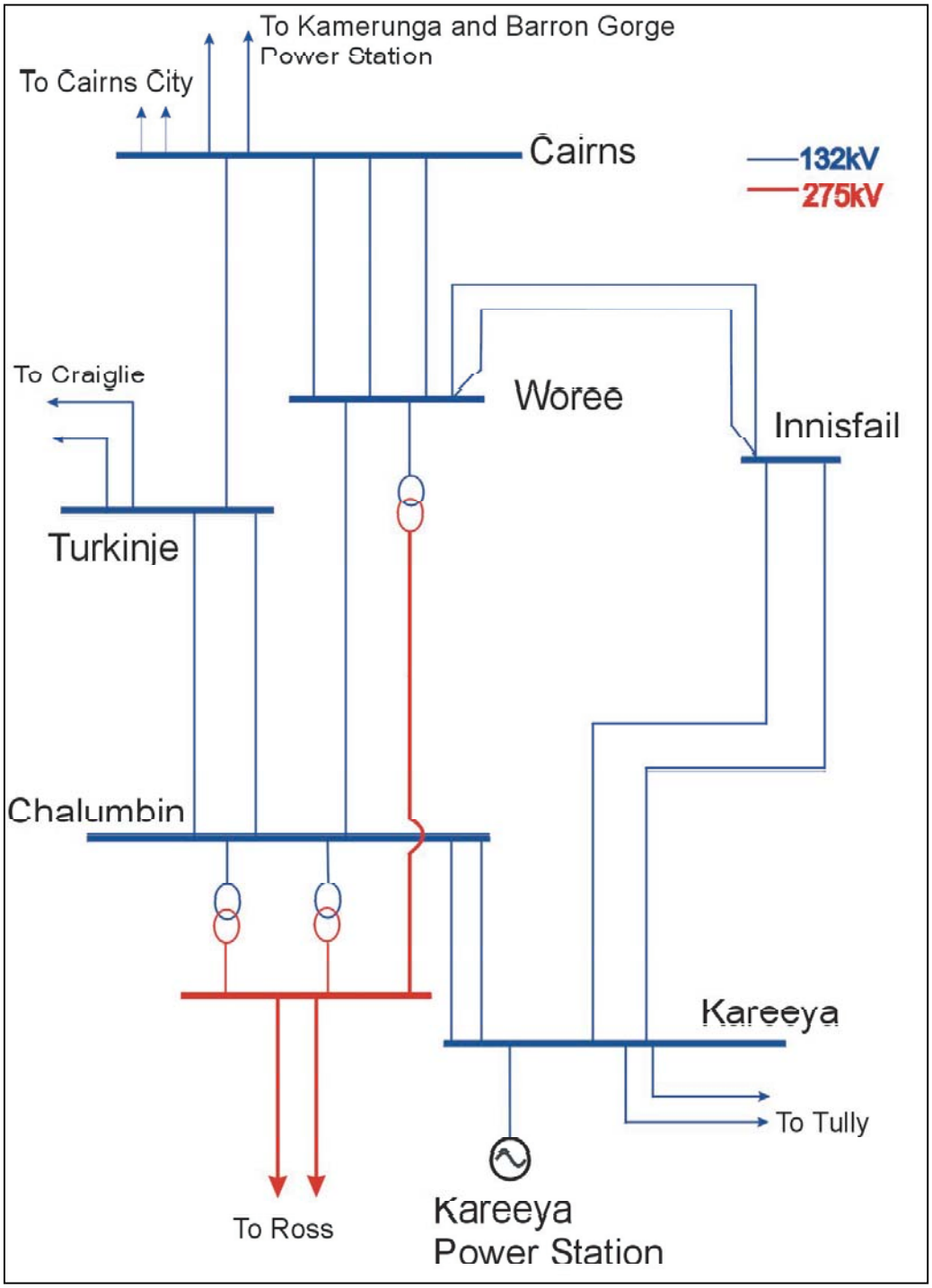


Figure 2: Far North Queensland Transmission System Schematic[1]

[1] The 132kV Turkinje-Cairns line will be removed in future as agreed with the Wet Tropics Management Authority.

3.2 Future Supply Issues

For the supply of the Cairns and Far North Queensland area, the critical contingency is either an outage of the Chalumbin to Woree 275kV transmission line or one of the Ross to Chalumbin 275kV transmission lines. Powerlink's planning studies have identified that, from the summer of 2005/06, an outage of either of these 275kV circuits during the peak summer period would result in unacceptably low voltage levels. Customer load shedding would be necessary to prevent voltage collapse and to allow safe operation of the system. Analysis to support this conclusion, including load forecasts and relevant assumptions, was published in the previous consultation document "Request for Information – Emerging Network Limitations in Cairns and Far North Queensland Area."[2]

Consistent with the National Electricity Code, its Transmission Authority requirements, and Connection Agreement with Ergon Energy, Powerlink plans future network augmentations so that the reliability and power quality standards of Schedule 5.1 of the Code can be met during the worst single credible fault or contingency (N-1 conditions) unless otherwise agreed with affected participants. This is based on satisfying the following obligations:

i "to ensure as far as technically and economically practicable that the transmission grid is operated with enough capacity (and if necessary, augmented or extended to provide enough capacity) to provide network services to persons authorised to connect to the grid or take electricity from the grid" (Electricity Act 1994, S34.2).

ii "The transmission entity must plan and develop its transmission grid in accordance with good electricity industry practice such that… the power transfer available through the power system will be adequate to supply the forecast peak demand during the most critical single network element outage" (Transmission Authority No T01/98, S6.2).

iii The Connection Agreement between Powerlink and Ergon Energy includes obligations regarding the reliability of supply as required under clause 5.1.2.2 of the Code. Capacity is required to be provided to the Cairns and Far North Queensland area such that forecast peak demand can be supplied with the most critical element out of service, ie N-1.

If no corrective action is taken, interruptions to customer supply will need to occur throughout the Cairns and Far North Queensland area during peak summer periods from October 2005, should an outage occur on either of the 275kV circuits supplying the Cairns and Far North Queensland area. This is not consistent with Powerlink's planning obligations. Powerlink therefore considers action to address the emerging network limitations in the Cairns and Far North Queensland area to be a 'reliability augmentation', as defined in the National Electricity Code[3].

The October 2005 timing conclusion is based on forecast demand growth of approximately 3.3% p.a. over the next 10 years, which averages 8MW increase per annum. Due to heavy use of airconditioning, the Cairns area also has a high reactive power demand with a consequent requirement for reactive power supply for voltage control[4].

[2] Published May 2003 - refer Powerlink's website www.powerlink.com.au

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

[4] Further discussion of network capability and voltage control is contained in Powerlink's Request for Information – Emerging Transmission Network Limitations: Cairns and Far North Queensland. Refer to Powerlink's website www.powerlink.com.au

4 RESPONSES TO THE CONSULTATION PROCESS

4.1 Responses to Draft Recommendation

Powerlink issued an Application Notice in accordance with Code requirements on 12 August 2003. This Application Notice contained a draft recommendation to address the emerging network limitations. It was recommended that the following "New Large Network Asset" be installed to address the emerging transmission network limitations in Cairns and Far North Queensland:

- A 132kV (-80 ~ +150) 230MVAr static var compensator at Woree substation on the existing 132kV bus bar at a cost of $16.9 million.

Ergon Energy provided a submission in response to this draft recommendation. No further submissions were received.

4.1.1 Ergon Energy Submission

Ergon Energy's submission states that as the distribution authority for the Far North Queensland region, Ergon Energy is supportive of the need to take appropriate action to ensure the reliability and quality of power supply from the transmission network is not compromised as a result of a single network contingency.

Ergon Energy further comments that it agrees with the conclusion that there is no 'do nothing' option. The Corporation advises it has no new information about possible alternatives to the solutions that have been identified and analysed in the Application Notice.

Ergon Energy states its support for the draft recommendation and the conclusion that any deferral of the proposed project would result in unacceptable system reliability.

5 OPTIONS CONSIDERED

5.1 Consultation Summary

Powerlink identified in its 2002 and 2003 Annual Planning Reports[5] an expectation that action would be required in the relatively short-term to address an anticipated major network limitation related to supply to the Cairns and Far North Queensland area.

In May 2003, Powerlink issued a Request for Information – a consultation document providing more detailed information on the emerging network limitations in the Cairns and Far North Queensland area. This paper was the first step in meeting regulatory requirements related to proposed network augmentations. It sought information from Code Participants and interested parties regarding potential solutions to address the anticipated network limitations. Powerlink held briefings with Ergon Energy and Stanwell Corporation prior to issuing the document to ensure their input was taken into account.

One submission was received in response to the Request for Information from Stanwell Corporation (refer 5.2.1).

An Application Notice in accordance with clause 5.6.6 of the National Electricity Code was issued on 12 August and a summary of the Application Notice was placed on the NEMMCO website on 13 August 2003.

5.2 Non-Transmission Options Identified

5.2.1 Existing Generation

Barron Gorge and Kareeya Power Stations have the capacity to increase the maximum supportable load in the Cairns and Far North Queensland area if they are operating at the time of a single 275kV contingency. However, because of market conditions and water availability, these hydro stations may not be operating at peak demand times.

In determining the maximum load which the transmission network can support, Powerlink has made assumptions about the maximum level of operation which can be relied on from these power stations[6]. Stanwell Corporation, owner of both power stations, made a submission to the 'Request for Information' document. In its submission, Stanwell confirmed that the assumptions made regarding the firm capability of Barron Gorge and Kareeya hydro plant, namely that one Barron Gorge Power Station unit would provide synchronous compensation, are reasonable. Stanwell also stated that it would not be able to offer any firm services in addition to those assumed. Further, Stanwell stated the Corporation had no plans to build new generating plant in the Cairns and Far North Queensland area.

Existing generators provided no additional information in response to the Application Notice.

5.2.2 Demand Side Management

Powerlink's demand and energy forecasts include all existing and foreseen demand side management initiatives incorporated in Ergon Energy's load forecast for the region. No information about other initiatives was provided during the consultation process.

[5] Published in June 2002 and June 2003 respectively.
[6] For the purpose of this analysis it is assumed that the hydro power stations are not generating but that one Barron Gorge generator is operating as a synchronous condenser.

5.3 Transmission Options Identified

In addition to the consultation process to identify possible non-transmission solutions, Powerlink carried out studies to determine the most appropriate transmission network solution to address the emerging limitations in the Cairns and Far North Queensland area[7].

Five possible augmentations were identified and investigated. An overview of those options is provided below. Details of the two lowest cost proposed augmentation options are contained in section 6.0, and in the spreadsheets in Appendix 2.

Possible Augmentations	
Option 1	Install a second 275/132kV 300MVA transformer and a 275kV bus bar at Woree substation and energise the second line between Chalumbin and Woree substations at 275kV (presently operating at 132kV). Further details are contained in section 6.0. This option has a capital cost of $12.0 million. If this option is selected it is anticipated that further reinforcement will be required in later years to meet future demand growth. Details of subsequent anticipated projects are listed in section 6.1.1.
Option 2	Install a 132kV (-80 ~ +150) 230MVAr static var compensator at Woree substation on the 132kV bus bar. Further details are contained in section 6.0. This option has a capital cost of $16.9 million. If this option is selected it is anticipated that further reinforcement will be required in later years to meet future demand growth. Subsequent anticipated projects are detailed in section 6.2.1.
Option 3	Install a mid-point switching station between Ross and Chalumbin. This option has a capital cost of $10.7 million. This potential solution was found to be non-optimal. Emerging voltage limitations in the Cairns and Far North Queensland area will arise at both Woree and Chalumbin. This option alone only increases supply capacity as far as Chalumbin, and has little impact on voltage limitations at Woree. For this option to be a feasible means of addressing all of the emerging voltage limitations, Option 1 or Option 2 works would need to be carried out in the same timeframe. Option 3 would therefore be significantly more expensive than Options 1 and 2.

[7] The 132kV Turkinje-Cairns line has not been included in Powerlink's analysis as it will be removed in the future as per an agreement with the Wet Tropics Management Authority.

Option 4	Install series capacitors mid-way between Ross and Chalumbin. This option has a capital cost of $28.8 million This potential solution was found to be non-optimal, as, like Option 3, it is unable to solve all of the emerging voltage limitations. Option 4 only increases supply capacity as far as Chalumbin. The cost of the series capacitors is also substantially higher than the works proposed in Options 1 and 2 listed above.
Option 5	Construct a third 275kV line between Ross and Chalumbin. This option has a capital cost of $57.9 million This option is not a feasible solution to the emerging voltage limitations, for the same reasons as Options 3 and 4. A third 275kV line would require a much larger capital investment than Options 1 and 2. However, it would only increase supply capacity as far as Chalumbin, creating no benefit at Woree.

6 LOWEST COST SOLUTIONS

This section provides an overview of the feasible proposed augmentation options identified, with full details of the financial analysis contained in the spreadsheets in Appendix 2.

The two lowest cost proposed augmentation options are detailed below.

In addition, anticipated/modelled projects that may be required to address future network limitations are also outlined. The ACCC Regulatory Test does not permit a network augmentation to be formally recommended for approval more than 12 months prior to the start of construction. However, Powerlink considers that the Regulatory Test explicitly requires that anticipated or modelled projects to address emerging Cairns and Far North Queensland area limitations be included in the economic evaluation[8].

6.1 Proposed Augmentation Option 1

Option 1 – Energise the second line between Chalumbin and Woree at 275kV.		
Date Reqd	Proposed Augmentation	Capital Cost
2005	Install 275/132kV 300MVA transformer and 275kV bus bar [9]at Woree substation and energise the second line between Chalumbin and Woree substations at 275kV.	$12.0 million

The works in Option 1 include upgrading the operation of the second circuit of the 73km double circuit 275kV transmission line between Chalumbin and Woree substations and associated substation works at Woree. Staged construction of this line was completed in 2002 and both circuits were operated at 132kV until October 2002 when one circuit was upgraded to 275kV operation. The second circuit presently operates at 132kV.

Substation works to enable operation of the second circuit at 275kV would include installation of a 300MVA 275/132kV transformer and a 275kV bus bar at Woree substation. Technical details of proposed augmentation Option 1 are published in Appendix 1.

In proposed augmentation Option 1, commitments to construct the network augmentation would be made in Quarter 1, 2004, for completion by late 2005.

The energised second 275kV line and associated substation works would overcome the identified emerging network limitations. The works would provide additional capability to supply the Cairns and Far North Queensland area and reduce the requirement for voltage support during the limiting contingencies identified in Section 3.0.

Proposed augmentation Option 1 is not expected to materially impact other transmission networks within the National Electricity Market.

[8] ACCC Regulatory Test S4.5.

[9] A bus bar is an item of substation plant that provides connectivity between different items of transmission equipment within the substation.

6.1.1 Anticipated/Modelled Projects

Powerlink's analysis indicates that if Option 1 were selected, further reinforcement of the transmission system between Ross and Chalumbin would be required in 2006 to meet future growth in electricity demand.

There are several possible options that could be developed to meet network limitations subsequent to Option 1. Analysis indicates that the installation of a static var compensator at Woree substation would be the lowest cost means of addressing future limitations.

It is also anticipated that further reactive support would be required in the Cairns and Far North Queensland area from 2010 onwards. The installation of low cost capacitor banks could address this requirement. However, such capacitor banks have not been included in the financial analysis in Appendix 2, as the timing of relevant works has been determined to be common to both Options 1 and 2.

Option 1 – Anticipated future projects		
Date Reqd	Anticipated/Modelled Project	Capital Cost
2006	Install a 132kV static var compensator at Woree substation	$16.9 million
2010	Install 50MVAr capacitor banks at Woree substation	$0.9 million
2012	Install 50MVAr capacitor banks at Woree substation	$0.9 million

6.2 Proposed Augmentation Option 2

Option 2 – SVC at Woree substation.		
Date Reqd	Proposed Augmentation	Capital Cost
2005	Install a 132kV (-80 ~ +150) 230MVAr static var compensator at Woree substation on the 132kV bus bar	$16.9 million

Proposed augmentation Option 2 works include installation of a 132kV static var compensator (SVC) at Woree substation. The capacitive range of this SVC is recommended to be -80 ~ +150MVAr to satisfactorily address voltage limitations in the area. Technical details of proposed augmentation Option 2 are published as Appendix 1.

In proposed augmentation Option 2, commitments to construction of the network augmentation would be made in Quarter 1, 2004, for completion by late 2005.

Any option involving reactive support will require installation of an SVC, because extensive reactive switching would be necessary to achieve capacitive support following a contingency. A dynamic reactive device (SVC) is required to ensure voltage collapse can be arrested following a contingency at high load levels. Subsequent to the installation of an SVC, future needs for additional reactive support can be met by installation of additional capacitor banks as outlined in 6.2.1.

The installation of an SVC would overcome the emerging network limitations. The works would increase the capability into Cairns and Far North Queensland for an outage of either the Ross to Chalumbin line or the Chalumbin to Woree line.

Proposed augmentation Option 2 is not expected to materially impact other transmission networks within the National Electricity Market.

6.2.1 Anticipated/Modelled Projects

Powerlink's analysis indicates that an SVC as proposed in Option 2 would offset the need for further transmission reinforcement until late 2008[10]. Subsequent to Option 2, Powerlink has identified and investigated possible anticipated projects to meet electricity demand beyond this time. The lowest cost option was found to be the proposed augmentation outlined in Option 1 (that is, the proposed augmentations and anticipated/modelled projects for Option 1 and 2 are the reverse of each other, implemented at different timings).

As with Option 1, it is also anticipated that the installation of capacitor banks would be required in the Cairns and Far North Queensland area from 2010 onwards. As the anticipated timing of these works is common to both Options 1 and 2, they have not been included in the financial analysis in Appendix 2.

Option 2 – Anticipated future projects

Date Reqd	Anticipated/Modelled Project	Capital Cost
2008	Install 275/132kV 300MVA transformer and 275kV bus at Woree substation and energise the second 275kV line between Chalumbin and Woree substations	$12.0 million
2010	Install 50MVAr capacitor banks at Woree substation	$0.9 million
2012	Install 50MVAr capacitor banks at Woree substation	$0.9 million

[10] Assuming no hydro generation from Barron Gorge or Kareeya Power Stations.

7 MARKET DEVELOPMENT SCENARIOS

7.1 Context for Evaluation of Options

All feasible solutions to the identified network constraints must be viewed in the context of wider developments in the National Electricity Market:

- NEMMCO's Statement of Opportunities issued in July 2003 contained information on existing and committed generation developments in Queensland. There is currently a considerable margin between supply capacity and demand, with several large new generating units commissioned in Queensland in the past two years. However high rates of demand growth are now forecast to absorb this capacity margin by the 2005/6 summer and additional investment in generation may be needed at that time.

- The Queensland Government is proceeding with the implementation of its policy requirement for Queensland energy retailers to source 13% of their energy from gas-fired generation from 1 January 2005. The 13% Gas Scheme is designed to deliver on the government policy objectives of diversifying the State's energy mix towards a greater use of gas and encouraging new gas infrastructure in Queensland, while reducing the growth in greenhouse gas emissions.

- Commonwealth legislation has been in effect since 1 January 2001 to encourage increased generation from renewable energy sources. Powerlink has incorporated independent forecasts of additional renewable energy generation into the forecasts of demand and energy used in assessing the expected incidence of future network limitations.

7.2 Assumed Market Development Scenarios

The ACCC Regulatory Test requires that options to address a network limitation be assessed against a number of plausible market development scenarios. These scenarios need to take account of:

- the existing system
- future network developments
- variations in load growth
- committed generation and demand side developments
- potential generation and demand side developments

The purpose of utilising this approach is to test the Net Present Value costs of the options being evaluated under a range of plausible scenarios.

7.2.1 Existing Network and Future Transmission Developments

No market development scenarios have been developed related to new transmission works proposed by Powerlink outside the Cairns and Far North Queensland area. These are independent of the identified network limitations that are the subject of this report, and are considered to be common to all options analysed.

7.2.2 Variations in Load Growth

Market development scenarios have been developed to consider sensitivity to variations in load growth. The scenarios used in the analysis in this report are outlined in 7.2.5.

These scenarios are based on typical weather (50% probability of exceedance) forecast for electricity usage, with varying levels of economic growth[11]. The forecasts include all known information about existing and planned demand side initiatives, and also include independent forecasts of local embedded generation developments. The forecasts do not consider extreme temperature conditions.

7.2.3 Existing and Committed Generators

For the purpose of this analysis, it is assumed that the hydro power stations are not generating but that one Barron Gorge generator is operating as a synchronous condenser.

It has been assumed that no additional generation capacity will be available in the region to meet peak demand loads. Some increase in cogeneration capacity is expected at sugar mills in the region but this is typically available only during the cane crushing season from June to November, not during the period from December to March when peak summer demand occurs. Therefore scenarios in which the output of generators is increased have not been developed.

7.2.4 Potential Generation Developments

NEMMCO's 2003 Statement of Opportunity indicates that additional investment in generation in Queensland may be required by 2005/06 but any such investment is more likely to occur in Southern or Central Queensland than in the Far North.

No market development scenarios have been developed to consider the establishment of new stand-alone generators in the Cairns area. No new generation was proposed in response to the Request for Information document, or Application Notice, and construction of new generation in the area is considered unlikely because of a lack of economic fuel sources.

7.2.5 Market Development Scenarios

Market development scenarios have been developed to simulate the impact of variations in load growth and assumptions as outlined above:

Scenario A	Medium load growth
Scenario B	High load growth
Scenario C	Low load growth

[11] Refer 2003 Annual Planning Report.

8 FORMAT AND INPUTS TO ANALYSIS

8.1 Regulatory Test Requirements

The requirements for the comparison of options to address an identified network limitation are contained in the Regulatory Test prescribed by the Australian Competition and Consumer Commission (ACCC).

The Regulatory Test requires that the recommended option be the option that "maximises the net present value of the market benefit having regard to a number of alternative projects, timings and market development scenarios". To satisfy the Test, a proposed augmentation must achieve a greater market benefit in most, *but not necessarily all*, credible scenarios.

The Regulatory Test contains guidelines for the methodology to be used to calculate the net present value (NPV) of the market benefit. For example, where an augmentation is required to satisfy minimum network performance requirements (ie, a reliability augmentation), the methodology published by the ACCC defines "market benefit" as the total net cost to all those who produce, distribute and consume electricity in the National Electricity Market. That is, the option with the lowest NPV cost maximises the market benefit.

Information to be considered includes the "efficient operating costs of competitively supplying energy to meet forecast demand" and the cost of complying with existing and anticipated laws. 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.

8.2 Inputs to Analysis

A solution to address emerging network limitations in the Cairns and Far North Queensland area as outlined in this document is required to satisfy reliability requirements linked to Schedule 5.1 of the National Electricity Code, the requirements of the Queensland Electricity Act[12] and Powerlink's Transmission Authority.

According to the ACCC Regulatory Test, this means that the costs of all options must be compared, and the least cost solution is considered to satisfy the Regulatory Test. The results of this evaluation, carried out using a cash flow model to determine the NPV of the various options, are shown in section 9.0.

Cost inputs to the NPV analysis are described below.

8.2.1 Cost of Transmission Augmentations

The costs of the transmission augmentations outlined in the options in section 6.0 have been estimated by Powerlink. Sensitivity studies have been carried out using variations in the capital cost estimates of plus or minus 15% (see section 9.3).

[12] Refer section 3.0.

The financial analysis considers all cost impacts of the proposed network augmentations to market participants as defined by regulatory processes. The estimated saving in the cost of network losses for each option has been included based on the assumption of typical load factor and an average cost of losses of $25/MWh[13]. Sensitivity studies have also been carried out on the assumed cost of losses (see section 9.3).

While a solution must be adopted by late 2005 to overcome the identified network limitations, the NPV analysis contains anticipated projects required to address longer-term supply reliability requirements, excepting future developments common to all options which have been excluded. The sensitivity of the timing of these anticipated projects to load growth (and therefore the incidence of the capital expenditure) has been taken into account in the financial analysis.

[13] Network losses are a function of the length and capacity of individual network elements, and the power being transferred through them. Additional network elements reduce the amount of power that must be forced through the existing network, and therefore reduce total losses.

9 FINANCIAL ANALYSIS

9.1 Description of Financial Analysis Approach

The economic analysis undertaken considered the net present value (NPV) of net market benefits of alternative options over the 15 year period from 2004 to 2018. Full details of this analysis are contained in Appendix 2.

9.2 Net Present Value Analysis

Financial analysis was carried out to calculate and compare the NPV of the costs to market participants of each option under the range of assumed market development scenarios.

Fifteen years was selected, as an appropriate period for financial analysis. A discount rate of 10% was selected as a relevant commercial discount rate, and sensitivity analysis was conducted to test this assumption.

Capital and operating costs for items which are common to all options were not included in the analysis. These common costs include the capital and operating costs of other future transmission works, where these costs are independent of the identified network limitations or where they are independent of the proposed augmentation. As such, they have no impact on the relative ranking of options resulting from the analysis. Where the timing of common works is affected by the proposed options, the cost of the other works proposed has been included in the NPV analysis.

Under the Regulatory Test, it is the ranking of the options which is important, rather than the actual NPV results. This is because the Regulatory Test requires the recommended option to have the lowest NPV cost under most but not necessarily all plausible scenarios.

The following table is a summary of the economic analysis contained in Appendix 2. It shows the NPV of each alternative, and identifies the best ranked option, for the range of scenarios considered.

Discount rate 10%		**Scenario A** *Medium Load Growth*		**Scenario B** *High Load Growth*		**Scenario C** *Low Load Growth*	
		NPV ($M)	**Rank**	**NPV ($M)**	**Rank**	**NPV ($M)**	**Rank**
Option 1	Energize the second Chalumbin - Woree line at 275kV	$16.26	2	$16.26	2	$16.26	2
Option 2	SVC at Woree	$15.05	1	$15.80	1	$13.73	1

9.3 Sensitivity Analysis

In addition to examining the impact of market development scenarios, the sensitivity of the option ranking to other critical parameters was also examined.

The effect of varying these parameters over their credible range was investigated using standard Monte Carlo techniques[14]. The following table shows the parameters that were investigated in the sensitivity analysis, the distribution that was assumed for each parameter and the range of values.

Parameter	Distribution
Capital Cost of Transmission Option	The capital cost of the two options and anticipated projects was tested for sensitivity to variations of plus or minus 15% from the expected value. The variation in each cost was modelled as a triangular distribution with the assumption that the costs are statistically independent. This means that the cost of each network component is allowed to vary within plus and minus 15% independently of the over or underspend of the other components.
Cost of losses	The sensitivity to the average cost of losses was tested by allowing this parameter to vary randomly between $20/MWh and $30/MWh using a triangular distribution with a mode of $25/MWh.

The Monte Carlo analysis assigns a value to each of the above parameters according to its distribution and then ranks the options. This simulation is done many times (in this case, 1,000 times) to cover a large number of combinations of parameters. The analysis identifies which option is the best ranked option (the option that has the lowest cost on an NPV basis for the largest number of samples) and gives the frequency for which this option 'wins'.

In addition to the above sensitivities, the sensitivity of the ranking of options to the discount rate assumption was also investigated by repeating the above analysis with a discount rate of 8%, 10% and 12%. The following table shows the 'winning option' and the frequency for which it 'wins' for each scenario and discount rate across the range of parameters assessed.

	Discount Rate		
	8%	10%	12%
Scenario A - Medium Load Growth	2(100%)	2(100%)	2(100%)
Scenario B - High Load Growth	2(100%)	2(100%)	2(100%)
Scenario C - Low Load Growth	2(100%)	2(100%)	2(100%)

As can be seen in this table, Option 2 is the best ranked option under the majority of scenarios. These sensitivity analysis results are consistent with the base case economic analysis, and the outcome is robust in terms of the variations in parameters assessed.

[14] Using the @Risk add-in for Microsoft Excel.

10 DISCUSSION OF RESULTS

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

- There is no acceptable 'do nothing' option. If the emerging network limitations are not addressed by late 2005, customer loadshedding in Cairns and Far North Queensland area will be required during a single contingency on either the Chalumbin to Woree 275kV transmission line or one of the Ross to Chalumbin 275kV transmission lines during summer peak periods from late 2005 onwards. This situation is not consistent with reliability standards which Powerlink is required to meet under the terms of its Transmission Authority and the National Electricity Code.

- Powerlink issued a Request for Information in May 2003 and carried out a consultation process through the issue of an Application Notice in August 2003. In response to the Request for Information, one submission was received, from Stanwell Corporation, stating its inability to offer any firm services in addition to the provision of one Barron Gorge Power Station unit for synchronous compensation. In response to the Application Notice, one party, Ergon Energy, provided a submission. In it submission, Ergon Energy supported the draft recommendation.

- Economic analysis has identified that Option 2 is the least-cost solution over a 15 year period of analysis under the majority of scenarios considered. On this basis, the installation of a 132kV (-80 ~ +150) 230MVAr static var compensator at Woree substation on the 132kV bus bar would satisfy the Regulatory Test.

- Sensitivity analysis showed that this conclusion was robust to variation in capital cost and other assumptions. Option 2 is also the highest ranked option under the majority of applicable market development scenarios.

- In addition to maximisation of benefit, the Regulatory Test requires that a transmission network service provider optimise the timing of any proposed network augmentation that is justified under the Regulatory Test. It is evident from the analysis that action is required prior to October 2005 in order to maintain a reliable power supply to customers. Any deferral of timing beyond late 2005 will result in unacceptable system reliability.

- The construction time for a network solution will require works to commence in the first quarter of 2004 to ensure completion by September 2005. Consequently, deferral of a decision to proceed with implementation of the proposed solution is not recommended.

11 FINAL RECOMMENDATION

Based on the conclusions drawn from the analysis, and from the submission to the draft recommendation contained in the Application Notice, it is recommended that the draft recommendation be adopted without change. That is, it is recommended that the following "New Large Network Asset" be installed to address the emerging transmission network limitations in Cairns and Far North Queensland:

- A 132kV (-80 ~ +150) 230MVAr static var compensator at Woree substation on the existing 132kV bus bar at a cost of $16.9 million.

Technical details relevant to this proposed new large network asset are contained in Appendix 1. The proposed construction timetable provides for award of construction and equipment contracts in Quarter 1, 2004, commencement of on-site construction in Quarter 1, 2005 and commissioning by September 2005. Following publication of this report, Powerlink intends to take immediate steps to implement this recommendation.

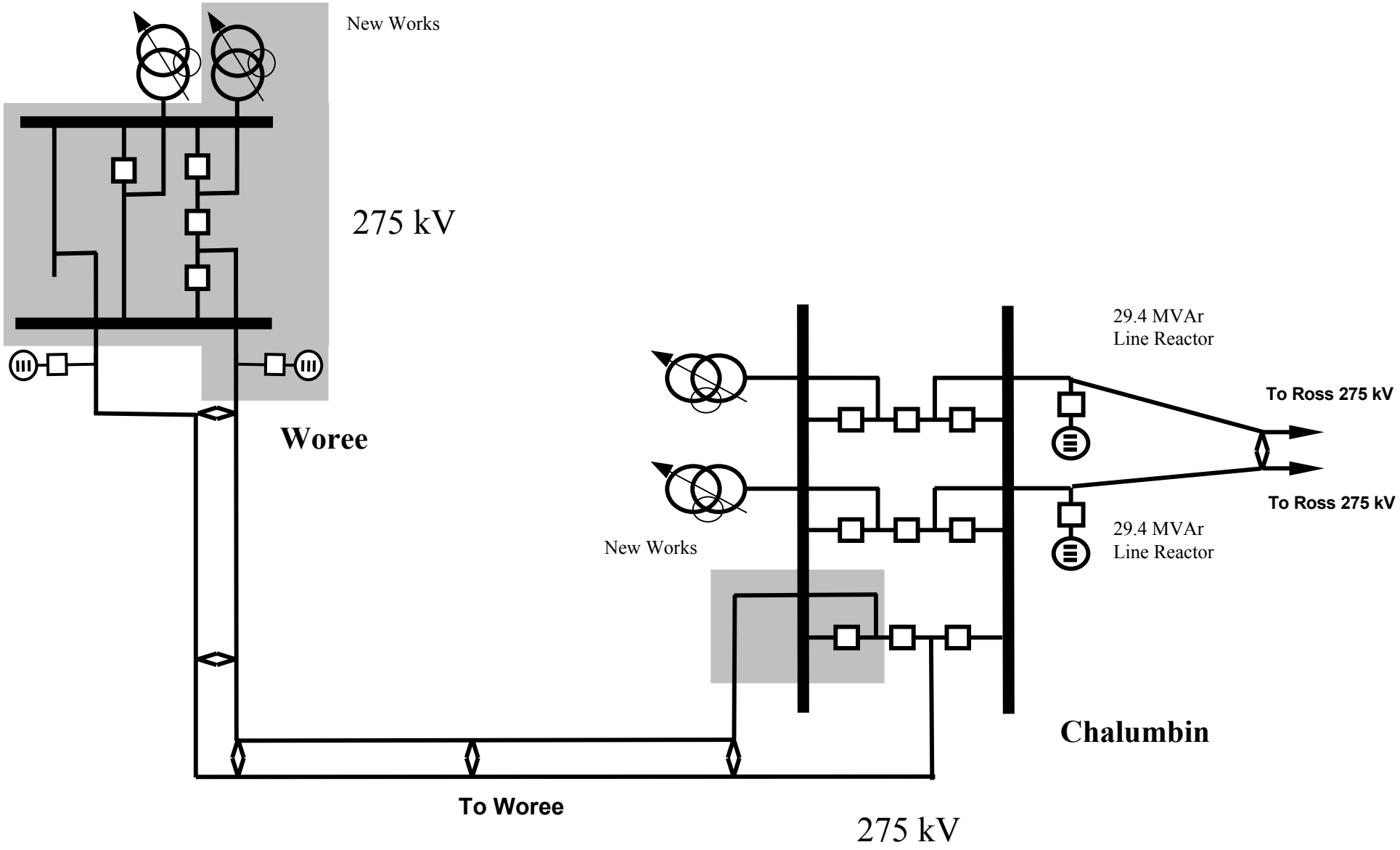
APPENDIX 1

TECHNICAL DETAILS OF PROPOSED NEW LARGE NETWORK ASSET

Option 1

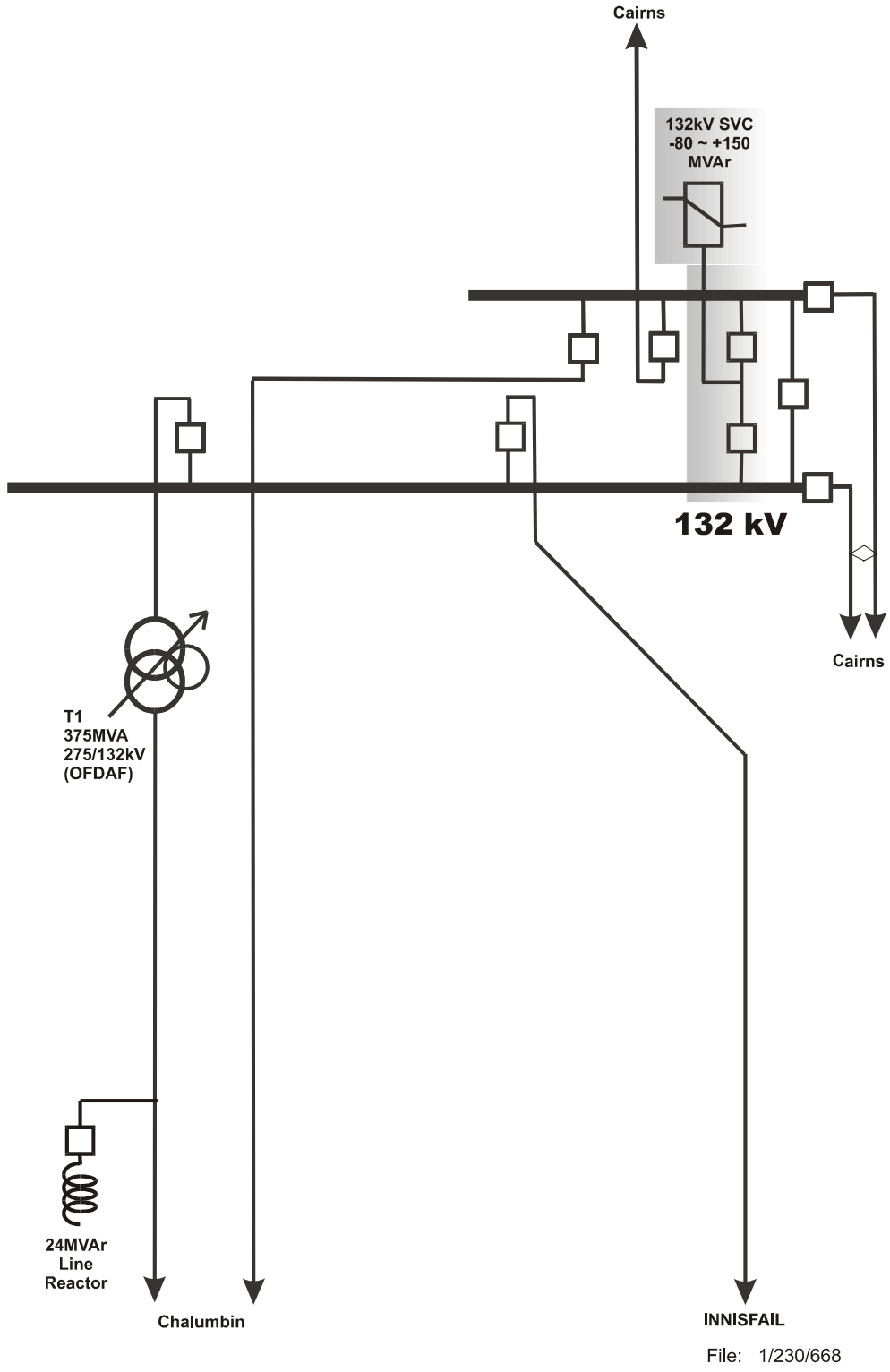
Option 1 includes the following works:
- Installation of a second 275/132kV 375MVA transformer at Woree;
- Installation of a four circuit breaker 275kV switching mesh at Woree;
- Installation of a 275kV circuit breaker at Chalumbin;
- Upgrade the second feeder between Chalumbin and Woree substations from 132kV to 275kV including installation of a 24 MVAr line reactor at Woree.

New works are highlighted in the following network configuration diagram.


New Works
275 kV
Woree
29.4 MVAr
Line Reactor
To Ross 275 kV
To Ross 275 kV
29.4 MVAr
Line Reactor
New Works
Chalumbin
To Woree
275 kV

Option 2

Install a 132kV (-80 ~ +150 MVAr) static var compensator at Woree substation switchable to either 132kV bus bar.
New works are highlighted in the following network configuration diagram.



APPENDIX 2

FINANCIAL ANALYSIS

Summary

Discount rate 10%		Scenario A *Medium Load* NPV ($M)	Rank	Scenario B *High Load Growth* NPV ($M)	Rank	Scenario C *Low Load Growth* NPV ($M)	Rank
Option 1	Energize the second Chalumbin - Woree line at 275kV	$16.26	2	$16.26	2	$16.26	2
Option 2	SVC at Woree	$15.05	1	$15.80	1	$13.73	1

Development Options	FY	Capex $M	FY	Capex $M	FY	Capex $M
	Scenario A		Scenario B		Scenario C	
Option 1 - Energise second line at 275kV						
275/132kV transformer and bus bar	05/06	12.0	05/06	12.0	05/06	12.0
Static var compensator	06/07	16.9	06/07	16.9	06/07	16.9
Option 2 - Static var compensator						
Static var compensator	05/06	16.9	05/06	16.9	05/06	16.9
275/132kV transformer and bus bar	08/09	12.0	07/08	12.0	10/11	12.0

Scenario A	*Medium Load Growth*														
		1 04/05	2 05/06	3 06/07	4 07/08	5 08/09	6 09/10	7 10/11	8 11/12	9 12/13	10 13/14	11 14/15	12 15/16	13 16/17	14 17/18	15 18/19
Option 1		**Energize the second Chalumbin - Woree line at 275kV**														
Energize the second Chalumbin - Woree line at 275kV																
=> TUOS		0.000	0.000	1.323	1.305	1.288	1.270	1.252	1.235	1.217	1.200	1.182	1.164	1.147	1.129	1.111
===> NPV of TUOS	$7.28															
SVC at Woree																
=> TUOS		0.000	0.000	0.000	1.883	1.838	1.814	1.789	1.764	1.739	1.714	1.689	1.664	1.640	1.615	1.590
===> NPV of TUOS	$8.98															
Relative Losses																
* Losses $		0.000	0.000	-0.001	-0.001	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	-$0.00															
Total for Option 1	**$16.26**															
Option 2		**SVC at Woree**														
SVC at Woree																
=> TUOS		0.000	0.000	1.883	1.838	1.814	1.789	1.764	1.739	1.714	1.689	1.664	1.640	1.615	1.590	1.565
===> NPV of TUOS	$10.25															
Energize the second Chalumbin - Woree line at 275kV																
=> TUOS		0.000	0.000	0.000	0.000	0.000	1.323	1.305	1.288	1.270	1.252	1.235	1.217	1.200	1.182	1.164
===> NPV of TUOS	$4.80															
Relative Losses																
* Losses $		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.00															
Total for Option 2	**$15.05**															

Scenario B	*High Load Growth*														
		1 04/05	*2* 05/06	*3* 06/07	*4* 07/08	*5* 08/09	*6* 09/10	*7* 10/11	*8* 11/12	*9* 12/13	*10* 13/14	*11* 14/15	*12* 15/16	*13* 16/17	*14* 17/18	*15* 18/19
Option 1		**Energize the second Chalumbin - Woree line at 275kV**														
Energize the second Chalumbin - Woree line at 275kV																
=> TUOS		0.000	0.000	1.923	1.905	1.888	1.870	1.852	1.835	1.817	1.800	1.782	1.764	1.747	1.729	1.711
==> NPV of TUOS	$7.28															
SVC at Woree																
=> TUOS		0.000	0.000	0.000	1.883	1.838	1.814	1.789	1.764	1.739	1.714	1.689	1.664	1.640	1.615	1.590
==> NPV of TUOS	$8.98															
Relative Losses																
* Losses $		0.000	0.000	-0.001	-0.001	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	-$0.00															
Total for Option 1	**$16.26**															
Option 2		**SVC at Woree**														
SVC at Woree																
=> TUOS		0.000	0.000	1.883	1.838	1.814	1.789	1.764	1.739	1.714	1.689	1.664	1.640	1.615	1.590	1.565
==> NPV of TUOS	$10.25															
Energize the second Chalumbin - Woree line at 275kV																
=> TUOS		0.000	0.000	0.000	0.000	1.923	1.905	1.888	1.870	1.852	1.835	1.817	1.800	1.782	1.764	1.747
==> NPV of TUOS	$5.55															
Relative Losses																
* Losses $		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.00															
Total for Option 2	**$15.80**															

Scenario C	*Low Load Growth*														
		1 04/05	*2* 05/06	*3* 06/07	*4* 07/08	*5* 08/09	*6* 09/10	*7* 10/11	*8* 11/12	*9* 12/13	*10* 13/14	*11* 14/15	*12* 15/16	*13* 16/17	*14* 17/18	*15* 18/19
Option 1		**Energize the second Chalumbin - Woree line at 275kV**														
Energize the second Chalumbin - Woree line at 275kV																
=> TUOS		0.000	0.000	1.323	1.305	1.288	1.270	1.252	1.235	1.217	1.200	1.182	1.164	1.147	1.129	1.111
==> NPV of TUOS	$7.28															
SVC at Woree																
=> TUOS		0.000	0.000	0.000	1.883	1.838	1.814	1.789	1.764	1.739	1.714	1.689	1.664	1.640	1.615	1.590
==> NPV of TUOS	$8.98															
Relative Losses																
* Losses $		0.000	0.000	-0.001	-0.001	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	-$0.00															
Total for Option 1	**$16.26**															
Option 2		**SVC at Woree**														
SVC at Woree																
=> TUOS		0.000	0.000	1.883	1.838	1.814	1.789	1.764	1.739	1.714	1.689	1.664	1.640	1.615	1.590	1.565
==> NPV of TUOS	$10.25															
Energize the second Chalumbin - Woree line at 275kV																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.323	1.305	1.288	1.270	1.252	1.235	1.217	1.200
==> NPV of TUOS	$3.48															
Relative Losses																
* Losses $		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.00															
Total for Option 2	**$13.73**															