# FINAL REPORT

## PROPOSED NEW LARGE TRANSMISSION NETWORK ASSET

## ADDRESSING EMERGING CONSTRAINTS ON THE QUEENSLAND TO NEWSOUTH WALES INTERCONNECTOR (QNI)

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# Executive Summary

This final report covers a proposal for relieving a limitation on the southward flow of power on QNI due to the thermal rating of the Armidale – Kempsey 132 kV line 965.

Section 1 sets out the context of the final report within the consultation process required by the National Electricity Rules.

Section 2 describes the regulatory requirements for network augmentation proposals, the transmission network in the vicinity of 965 line, limitations on QNI import to NSW due to the limited thermal rating of 965 line and supply reliability issues.

Section 3 summarises four written submissions that were received in response to the application notice that was published in September 2006 and summarises TransGrid's responses.

In Section 4, one feasible network augmentation option is described. It involves the installation of a phase shifting transformer at Armidale to control power flows on 965 line. Non-network augmentation options are also discussed although none have come forward from the market at this point in time.

The capital cost of the network option is estimated to be $13 million (±25%).

In Section 5 it is concluded that, based on work previously carried out by TransGrid and Powerlink, the proposal still satisfies the market benefits limb of the regulatory test. Given the relatively low cost of the proposal and its potential to avoid future supply reliability issues, it is considered prudent to proceed with its construction, and it proposed to do so, with completion by summer 2008/9.

Section 6 provides information that may be relevant to persons wishing to dispute any aspect of this final report.

# 1. Introduction

## 1.1. Purpose and Scope

TransGrid owns the majority of the transmission network within NSW and is responsible, inter alia, for planning and developing its network to meet the requirements of customers within the state and to facilitate operation of the National Electricity Market (NEM). As part of its planning responsibilities and the requirements of the National Electricity Rules (the Rules) TransGrid consults with NEM registered participants, NEMMCO and interested parties on emerging limitations within its transmission network and options being considered to relieve them.

This final report has been prepared in accordance with Clause 5.6.6 (h) of the Rules. It relates to a proposal for a new large transmission network asset that will address a limitation on southward power flows on QNI.

It includes:

- A summary of the submissions received from interested parties who responded to the application notice for this proposal that was published in September 2006 and a summary of TransGrid's responses;
- A description of transmission network limitations identified by TransGrid that have led to an opportunity to provide a net market benefit via an augmentation of the transmission network;
- A description of all reasonable network and non-network options that have been identified to meet these limitations;
- An analysis of the ranking of these options in accordance with the Australian Energy Regulator's (AER's) regulatory test; and
- An assessment of the outcome of the regulatory test and proposed actions.

## 1.2. Summary of Consultation Process

This final report relates to what was previously a new small transmission network asset proposal that was originally published in TransGrid's 2005 Annual Planning Report (APR) (Refer to Appendix A). There were no submissions received in respect of that proposal and the consultation process required under clause 5.6.6A(a) of the Rules was regarded as complete.

Subsequently a material change occurred with respect of the proposal; it is now estimated that the cost of constructing the preferred option will exceed $10 million.

Therefore, in accordance with clause 5.6.6(c) of the Rules, TransGrid published an application notice relating to a proposed new large transmission network asset. A summary was posted on NEMMCO's website on 21st September 2006. The content of the application notice is similar to the content of this final report with material from the application notice having been updated and included in this final report where appropriate.

Four written submissions were received in response to the application notice. Section 3 of this final report contains a summary of this submission and a summary of TransGrid's responses. Appendix 2 contains information that was provided to one of the respondents.

TransGrid has now applied the regulatory test to all identified reasonable options to address the opportunity for network augmentation described in Section 2.3, has determined the option that satisfies the regulatory test and has proposed relevant actions.

TransGrid has therefore completed its obligations under clause 5.6.6(b) of the rules and will proceed in accordance with the actions proposed in Section 5 of this final report.

# 2. Identification of Augmentation Opportunity

## 2.1. Regulatory Requirements

### 2.1.1. Requirements of the National Electricity Rules

This final report covers a proposal for a new large transmission network asset.

The requirements of the National Electricity Rules for new large transmission network asset proposals are set out in Clause 5.6.6. This requires applicants (in this case TransGrid), inter-alia, to:

- Set out the reasons for proposing the new large transmission network asset, including the actual or potential constraint or inability to meet network performance requirements;
- Describe all reasonable network and non-network options to address the constraint;
- Rank the options in accordance with the principles of the AER's regulatory test including detailed analysis of why the applicant considers the new large transmission network asset satisfies the regulatory test;
- Where relevant, provide analysis of why the applicant considers the new large transmission network asset is a reliability augmentation.
- Provide an augmentation technical report or consents to proceed from affected TNSPs if the new large transmission network asset is likely to have a material internetwork impact.

### 2.1.2. Requirements of the Regulatory Test

The regulatory test may be applied in either one of two ways. The regulatory test states that an option satisfies the test if:

(a) in the event the option is necessitated solely by the inability to meet the minimum network performance requirements set out in schedule 5.1 of the Rules or in relevant legislation, regulations or any statutory instrument of a participating jurisdiction - the option minimises the present value of costs, compared with a number of alternative options in a majority of reasonable scenarios;

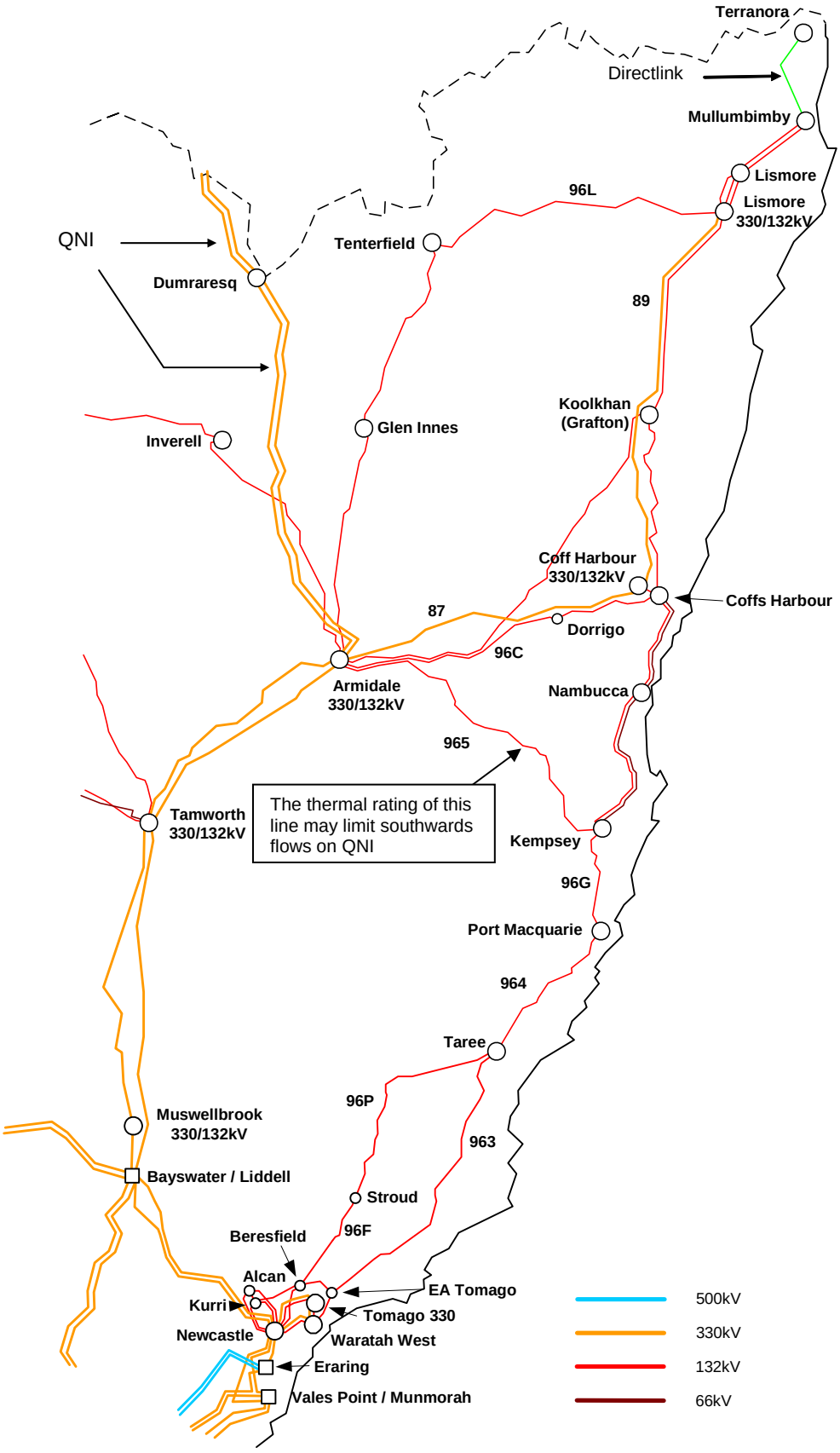
(b) in all other cases - the option maximises the expected net present value of the market benefit (or in other words the present value of the market benefit less the present value of costs) compared with a number of alternative options and timings, in a majority of reasonable scenarios.

Whilst this proposal has reliability benefits for the network supplying the NSW mid North Coast it is being assessed under the market benefits limb of the regulatory test (paragraph (b) above).

## 2.2. Transmission Network in the Vicinity of 965 Line

The transmission network in the vicinity of the Armidale – Kempsey 132 kV line 965 is shown in Figure 1. The 132 kV network supplying the NSW Mid North Coast parallels the 330 kV network between Armidale and the Newcastle area. Consequently flows on this network depend, in part, on the magnitude of flows on the 330 kV network, particularly flows on the NSW – Queensland interconnector (QNI).

**Figure 1 Transmission Network in the Vicinity of 965 Line**



## 2.3. Network Constraints and Opportunity for Network Augmentation

At times of high summer demand on the NSW Mid North Coast, the thermal rating of the Armidale – Kempsey 132 kV line 965 can constrain southward flows on QNI. This is because of the co-incidence of high loads and the lower thermal capacity of transmission circuits at times of higher ambient temperature.

Remedial works were undertaken in 2003 to increase the thermal rating of this line. As a consequence of these works, the summer day contingency rating of 965 transmission line was increased from 90 MVA to 129 MVA. Since that time, loads on the Mid North Coast of NSW have grown and the limitations on QNI flows imposed by the rating of the line are now re-emerging.

These limitations give rise to an opportunity to provide market benefits by augmenting the transmission network as described in Section 3.

## 2.4. Supply Reliability Issues

In addition to providing market benefits, the transmission network augmentation described in Section 3 would also improve reliability of supply to New South Wales.

It is anticipated that by summer 2008/09, New South Wales will be highly reliant on imports from both Queensland and Snowy/Victoria at times of high demand. Should this proposal not proceed, constraints on QNI import due to limitations in the thermal rating of 965 line may lead to supply reliability issues in NSW from this time onwards.

As indicated in Section 2.1.2 the network augmentation will also provide reliability benefits to the NSW Mid North Coast.

## 2.5. Material Inter-network Impact

The Rules require TransGrid to assess whether a proposed new large transmission network asset is reasonably likely to have a material inter-network impact.

In its APR 2005, TransGrid concluded that:

> "The proposal is likely to have a material inter-network impact with Powerlink the other affected TNSP. Powerlink has given consent to proceed for the works as proposed".

That conclusion is unchanged.

# 3. Summary of Responses to the Application Notice

There were four written responses to the application notice that was published in September 2006, from Macquarie Generation, Origin Energy and TRUenergy and a fourth respondent who requested that its response be treated as confidential.

A number of meetings and discussions have been held with representatives from these organisations.

In accordance with clause 5.6.6(h) of the Rules the table on the following pages summarises these submissions (by the issues raised in them) and TransGrid's responses.

## Summary of Written Submissions to the Application Notice and TransGrid's Responses

| ID | Raised by | Description of Issue | Response |
|---|---|---|---|
| 1 | Origin Energy | Strongly supportive of maximising the level of transmission capacity between all regions of the NEM;<br><br>Suggested that a sufficient level of transmission capacity ultimately benefits consumers through lower delivered energy prices; and<br><br>Referred to ongoing work by TransGrid and Powerlink on options to increase the capacity of QNI and suggested that a significant upgrade of QNI may be justifiable under the regulatory test. | These comments are noted. |
| 2 | TRUenergy | Believed that the regulatory test had not been applied with the usual rigour but considered that this was a reasonable approach for this proposal. Would not support a similar approach for other proposals. | Noted. |
| 3 | TRUenergy | Were concerned that all potential alternative projects may not have been fully explored. | Additional information relating to the consideration of possible alternatives was made available to TRUenergy and has been included as Appendix 2 to this final report. |
| 4 | Macquarie Generation | Macquarie Generation was not convinced that the proposed augmentation satisfies either the market benefits or reliability limbs of the regulatory test.<br><br>They would have no objection to the proposal if TransGrid could demonstrate its reliability benefits. | TransGrid had a number of meetings and discussions with Macquarie Generation. A range of issues, was discussed including:<br><br>• Reliability benefits for the whole of NSW;<br>• Reliability benefits for the Mid North Coast; and<br>• Load growth on the Mid North Coast.<br><br>Additional information was also made available to Macquarie Generation to clarify these issues.<br><br>Following these meetings and discussions Macquarie Generation stated that it does not oppose the proposal. |
| 5 | Fourth Respondent | The fourth respondent requested that its submission be treated as confidential.<br><br>The submission concerned a proposal which is at a very early stage of development. Consequently, at this stage, TransGrid has concerns about the time by which it may be completed. | This concern, together with the fact that the proposed development would be likely to cost more than the network proposal, leads TransGrid to conclude that it is unlikely to make a material difference to this proposal. |

# 4. Options

## 4.1. Network Options

TransGrid has developed a single reasonable cost network option to meet the constraint described in Section 2. This option involves installation of a 132 kV phase shifting transformer (quadrature regulator) at Armidale to control the power flow on the single circuit 132 kV line 965.

It should be noted that further increases in the thermal capacity of this 132kV line beyond the present ratings are not considered to be practicable.

## 4.2. Consideration of Non Network Options

TransGrid received no comments in response to this proposal when published in the APR 2005.

Reductions in demands on the NSW Mid North Coast have the potential to reduce the loading on 965 line as well as other lines supplying the Mid North Coast. A number of limitations affecting supply to the Mid North Coast have been described in TransGrid's Annual Planning Statements and Annual Planning Reports from 1999 to 2005. They have also been described in a document titled "Transmission Network Limitations on the New South Wales Mid North Coast". The original version of this document was jointly published by TransGrid and Country Energy in July 2002 and a revised version in early May 2006.

Following publication of the revised version TransGrid received three submissions/enquiries:

- Preliminary enquiries from a party considering the Mid North Coast as one of a number of possible locations for additional generation in NSW;
- A general proposal to establish generation in the area should natural gas become available; and
- A preliminary enquiry from a party contemplating coordinating and aggregating end-use customer demand reductions.

These proposals are at a preliminary stage of development.

# 5. Conclusions and Proposed Actions

In 2004 TransGrid and Powerlink published the results of a major joint review of options to upgrade QNI. The review concluded, inter-alia, that a low capacity upgrade (which would alleviate constraints on the southward flow of QNI caused by limitations in the 132 kV transmission network in northern NSW) may satisfy the regulatory test. It was estimated that such an upgrade would cost $15 - $20 million.

In its APR 2005, TransGrid proposed the installation of power flow control on 965 line as a new small transmission network asset (the relevant section from the APR 2005 is included as Appendix A). This was effectively an implementation of the low capacity QNI upgrade described above with the cost of the works being estimated to be less than $10 million. No comments were received on this proposal.

Since the APR 2005 was published, more detailed investigations have been completed, including obtaining more detailed information from manufacturers of phase shifting transformers. These investigations indicate that the cost of the works would be $13 million (±25%).

As the estimated cost exceeds $10 million, TransGrid proposes the works as a new large transmission network asset.

Due to the complexity and uncertainty of the required calculations and the relatively low cost of the proposal the analysis previously carried out by TransGrid and Powerlink has not been updated. Instead, the general conclusions of that work are accepted. Accordingly, as the cost of the proposal is less than $15 million, it is considered that the proposal still satisfies the market benefits limb of the regulatory test.

The proposal will also avoid the possibility that supply reliability issues in NSW may arise, as described in Section 2.4 and will also provide reliability benefits for the network supplying the NSW mid North Coast (these reliability issues were not considered in TransGrid and Powerlink's 2004 review).

In these circumstances relieving a potential limitation on imports over QNI via a relatively low cost network augmentation is considered to be prudent.

These conclusions are the same as the preliminary conclusions detailed in the application notice. The issues raised in the responses to the application notice (refer to Section 3) do not materially affect these conclusions.

Consequently, TransGrid proposes to install a 132 kV phase shifting transformer at Armidale to control flows on 965 line by summer 2008/09.

# 6. Notice of Disputes

Persons wishing to dispute the contents, assumptions, findings or recommendations of this final report are referred to clause 5.6.6 (j) of the Rules.

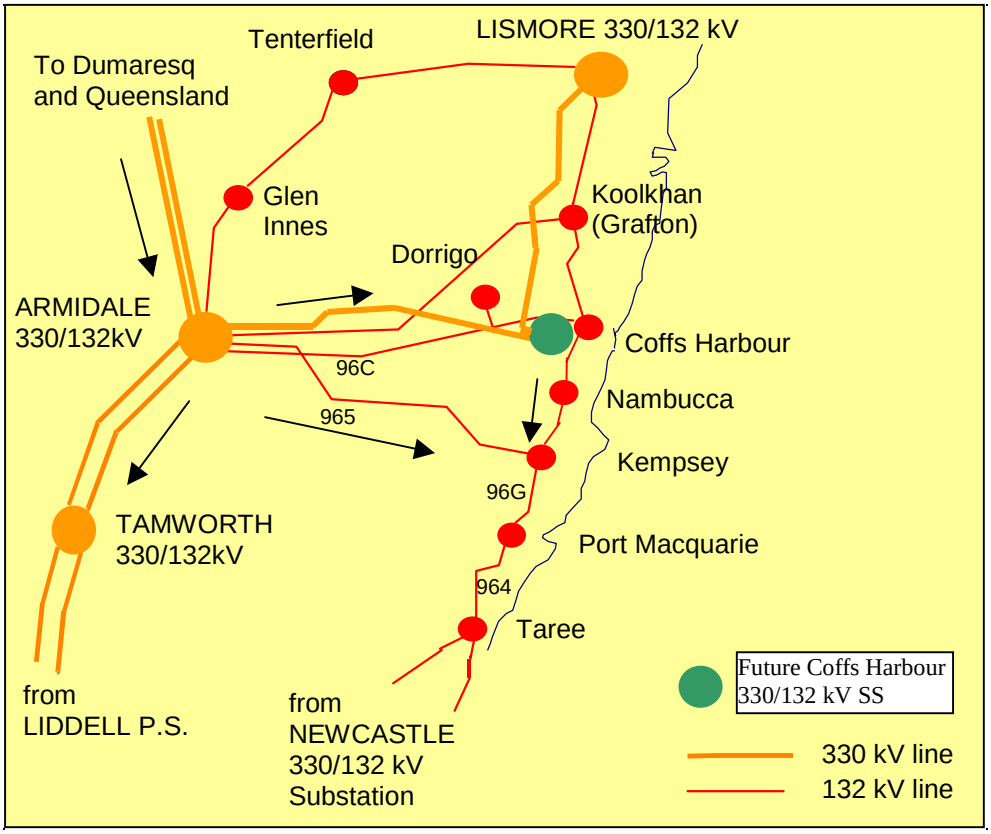
Disputing parties must lodge a notice of the dispute in writing to the AER and provide a copy of the dispute notice to TransGrid within 30 business days of the publication of the summary of this final report on NEMMCO's website.

TransGrid copies of dispute notices regarding this final report should be forwarded to:

Garrie Chubb
Tel: 02 9284 3553
fax: 02 9284 3456
email: garrie.chubb@transgrid.com.au

# Appendix 1 Extract from TransGrid's Annual Planning Report 2005

### 6.3.13 Power Flow Control – Armidale – Kempsey 132 kV Line 965




QNI was first closed to connect the Queensland system to the NSW system in late 2000. Since that time the interconnector has undergone testing and its capability has been progressively released to the NEM.

QNI has been observed to operate at its maximum power transfer capability in both the northerly and southerly directions. In the future it is expected that the capability will be fully utilised with the patterns of power flow governed by the ongoing bidding behaviour of generators and development of new generators in Queensland or NSW.

Over the next decade or so the power transfer capability over QNI is expected to be determined by the following factors:

Power transfer in a northerly direction

- Line thermal rating limitations in the supporting 330 kV network in NSW;
- Voltage control limitations, particularly in the northern NSW network; and
- Transient stability limitations following a trip of the largest Queensland generating unit or a fault on a line in the northern NSW network or in the Queensland network associated with QNI.

Power transfer in a southerly direction

- Transient stability limitations following interruption to the operation of a potline at the Boyne Island Aluminium Smelter in Queensland or fault on a line in the northern NSW network;
- Oscillatory stability considerations which relate to the capability of generator control systems to withstand frequent small disturbances to the system; and
- The thermal ratings of lines in northern NSW, between Armidale and the Hunter Valley area.

One line rating limitation in NSW that significantly affects the capability for Queensland export is due to the thermal rating of the Armidale – Kempsey 132 kV transmission line (No. 965). TransGrid undertook uprating of the 132 kV line during 2003 to the point where the limitations were almost completely alleviated during the high load periods of late 2003 and early 2004. The uprated line rating again imposed brief

limitations during the summer of 2004/5. The line is now uprated to what is considered to be its physical limit.

The power flow as a result of Queensland export distributes along the paths as shown in the figure on the previous page. A small portion of this power flow is transmitted from Armidale along the 132 kV network that lies along the NSW Mid North Coast, supplying loads in that area. For every MW of NSW import, a fraction of the order of 1/20 flows through the 132 kV network.

As a result of the growing Mid North Coast loads, particularly at Port Macquarie and Kempsey, the loading on the No. 965 line will increase and it is expected that thermal limits on this line will again be reached from summer 2005/6. Hence it is expected that binding constraints on QNI will reappear at times of high NSW load. The growth of the coastal loads is well above the state average and due to the sensitivity of the NSW import capability to the rating of the Armidale – Kempsey line it is expected that the limitation on NSW import will become relatively large.

Following the establishment of Coffs Harbour 330/132 kV Substation (Refer to Section 5.2.4) the system normal power flow from Coffs Harbour to Kempsey will increase. The loading on the No. 965 line however remains vulnerable to the forced outage of the Coffs Harbour – Nambucca 132 kV line. Hence the capability of QNI due to the thermal rating limitations of No. 965 line will change as a result of the establishment of Coffs Harbour 330/132 kV Substation and this impact is presently being assessed in detail.

TransGrid and Powerlink carried out a major review of possible upgrade options for QNI that was published for information to the market early in 2004. No viable high capacity upgrade was identified that was judged likely to pass the current ACCC Regulatory Test. However it was possible that a low capacity upgrade costing $15-20 million may pass the test.

TransGrid has been considering the options available to relieve the impact of the No. 965 line. These include installation of power flow control on the line and potential line development works on the Mid North Coast.

The cost of the 132 kV line power flow control is less than $10M and it is expected to afford several hundred MW of import capability at times of high summer temperatures. TransGrid included these works in its November 2004 application to the ACCC with respect to the future transmission capital investment program.

TransGrid and Powerlink have jointly considered the proposal to install power flow control on 965 line in the light of these costs and have come to the following conclusions:

- The proposal is similar to the low capacity upgrade considered in the 2004 work and is expected to deliver similar market benefits under similar market development scenarios;
- As the cost of the proposal is $10-15 million less than the assumed costs of the low capacity upgrade, the net market benefits are expected to be $10-15 million greater than those determined in the 2004 work, being positive for the majority of the scenarios considered.
- The proposal is technically feasible and will not preclude the consideration of other higher capacity upgrades of QNI (Refer to Section 6.4.2). In fact it will most likely be a component of such upgrades.
- TransGrid and Powerlink thus consider that the proposal satisfies the market benefits limb of regulatory test.
- The proposal is likely to have a material inter-network impact with Powerlink the other affected TNSP. Powerlink has given consent to proceed for the works as proposed.

It is thus proposed to proceed with the installation of power flow control on the Armidale – Kempsey 132 kV line 965 with completion expected during 2007/8.

# Appendix 2 Information Provided to TRUenergy

Nature of the Limitation

The transmission network supplying the Mid North Coast is shown in Figure 1. At times of high import to NSW over QNI in summer, a constraint can arise in the network south and east of Armidale (shown as a heavy dashed line in Figure 1). For an outage of one of the 330 kV lines between Armidale and Tamworth or between Armidale and Coffs Harbour, the 965 Armidale – Kempsey line can be overloaded.

965 line was uprated a few years ago and further uprating is not considered to be practical.

Potential Network Options

Potential network options would need to either:

- "rebalance" flows to allow better utilisation of the existing transmission capacity; or
- increase transmission capacity across the constrained part of the network.

The proposed phase shifting transformer (quadrature regulator) in 965 line "rebalances" flows. Other potential "rebalancing" projects include installing series capacitors or phase angle regulators in the Tamworth – Armidale 330 kV lines, which would be considerably more expensive than the phase angle regulator in 965.

Increased transmission capacity could be provided by building additional transmission lines. This is expected to be required in the medium term to maintain reliable supply to the North Coast. However, as it would be a number of years before such a line could be completed, it is not a feasible option in the short term.

It is expected that, due to the magnitude of load on the north coast, the rate of load growth and the difficulty in obtaining line routes, a new line to the area (from the existing northern NSW 330 kV network) would be of 330 kV construction. Such a line would be considerably more expensive than the 965 phase angle regulator.

## Figure 1 Network Supplying the Mid North Coast