FINAL REPORT

PROPOSED NEW LARGE TRANSMISSION NETWORK ASSET

DEVELOPMENT OF ELECTRICITY SUPPLY TO THE NSW FAR NORTH COAST

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Executive Summary

This final report has been prepared to provide a basis for TransGrid and Country Energy to consult with registered participants and interested parties to identify options for the development of electricity supply to the far north coast area of New South Wales that will be included in an application of the Australian Energy Regulator's regulatory test.

Section 1 provides the context of this final report within the regulatory process and summarises the outcomes of that process.

Section 2 describes in detail the regulatory requirements relating to proposals for new large transmission network assets, the existing supply arrangements, the nature of the growing load in the far north coast area and the network limitations that give rise to a need to augment supply to the area. The agreed network performance requirements (planning criterion) against which the need and effectiveness of augmentation options are assessed are also described.

This section also covers submissions from proponents of non-network options. Discussions with those proponents are continuing.

In Section 3 two feasible network augmentation options are described. Option 1 involves the construction of a 330 kV transmission line between Dumaresq and Lismore. Option 2 involves the construction of a second 330 kV line between Armidale and Lismore. A number of other network developments that were considered but not put forward as reasonable options are also described.

In Section 4 the results of an application of the regulatory test considering Options 1 and 2 are presented.

The main conclusion is that Option 1 is the lowest cost option in all cases and satisfies the regulatory test. Consequently the proposed actions are for TransGrid to:

- Proceed with construction of Option 1 as described in Section 3.1. These works are estimated to cost $227 million; and
- Continue discussions with the proponents of non-network options to determine whether a cost effective network support arrangement, which would allow Option 1 to be deferred, can be developed.

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.

Country Energy owns the subtransmission and distribution networks on the NSW north coast and is responsible for planning and developing those networks.

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 emerging limitations in the transmission network supplying the far north coast area of New South Wales.

It includes:

- A summary of the load forecast for the area;
- A description of the network reliability criterion that has been adopted for planning purposes;
- A description of transmission network limitations identified by TransGrid and Country Energy that have led to the necessity for an augmentation of the transmission network in the far north coast area;
- 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;
- An assessment of the outcome of the regulatory test and proposed actions; and
- Information which may be relevant to persons who may wish to dispute any aspect of this final report.

1.2. Outline of Consultation Process

TransGrid has published a description of limitations affecting the transmission network supplying the far north coast area in its Annual Planning Statements for 1999 to 2001 and Annual Planning Reports (APRs) for 2002 to 2008. The APR 2008 includes a summary new large transmission network asset proposal for supply to the far north coast area.

In April 2008 TransGrid and Country Energy published an application notice covering a proposal for a new large transmission network asset that would address the network limitations described in Section 2.6. A summary of the application notice was published on NEMMCO's website on 28th April 2008. Interested parties were invited to make submissions in the period to 6th June 2008. Submissions were received from proponents of non-network options (refer to Section 2.10).

TransGrid and Country Energy have applied the regulatory test to all known reasonable options to meet the network limitations described in this final report and have determined the option that satisfies the test.

Accordingly TransGrid and Country Energy have completed their obligations under clause 5.6.6(b) of the Rules and will proceed in accordance with the proposed actions detailed in Section 5 of this final report.

Persons wishing to dispute any aspect of this final report are referred to Section 6.

A summary of this final report has been posted on NEMMCO's website.

2. Identification of a Necessity for Augmentation

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 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; and
- Provide an augmentation technical report or consents to proceed from affected Transmission Network Service Providers if the new large transmission network asset is likely to have a material internetwork impact.

These requirements are underpinned by Clauses 5.6.2 (a), (b) and (c) of the Rules, which require network service providers to:

- Analyse their networks and conduct joint annual planning reviews to identify necessities for augmentation or extension of those networks; and
- Undertake joint planning in order to determine plans that can be considered by registered participants, NEMMCO and interested parties.

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 principally by inability to meet the service standards linked to the technical requirements of schedule 5.1 of the Rules or in applicable regulatory instruments - the option minimises the costs of meeting those requirements, compared with alternative option/s in a majority of reasonable scenarios;

(b) in all other cases - the option maximises the expected net economic benefit to all those who produce, consume and transport electricity in the national electricity market compared to the likely alternative option/s in a majority of reasonable scenarios. Net economic benefit equals the market benefit less costs.

The Rules define a reliability augmentation as:

> A transmission network augmentation that is necessitated principally 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.

Thus for reliability augmentations clause (a) of the test should be used. That is for reliability augmentations the option that satisfies the regulatory test is the one that minimises the cost of meeting the minimum network performance requirements set out in schedule 5.1 of the Rules or via a jurisdictional or customer requirement.

2.2. Requirements of the Energy Services Corporations Act

TransGrid's enabling legislation is the Energy Services Corporation Act 1995. Section 6B of the Act sets out the five principal objectives which in summary are:

1. To be a successful business. This includes:

a. To operate at least as efficiently as any comparable business;

b. To maximise the net worth of the State's investment in it;

c. To exhibit a sense of social responsibility by having regard to the interest of the community in which it operates;

2. To protect the environment by conducting its operations in compliance with the principles of ecologically sustainable development;

3. To exhibit a sense of responsibility to regional development;

4. To operate efficient, safe and reliable facilities; and

5. To promote effective access.

It is important to note that the Act explicitly identifies that each of these objectives is of equal value, and thus a balanced approach must be taken in decision making to reflect this obligation. In particular it is worth noting that efficiency is not superior to the environment or the community.

When developing options to overcome actual or potential network constraints, TransGrid initially assesses possible options against the above requirements and then applies the regulatory test to those which satisfy them.

Possible options which were considered but not pursued are described in Section 3.3.

2.3. Jurisdictional Requirements – Reliability Criterion

As stated in its Annual Planning Report TransGrid is expected by the NSW jurisdiction to plan and develop its transmission network on an "N-1" basis. That is, unless specifically agreed otherwise by TransGrid and the affected distribution network owner or major directly connected end-use customer, there will be no inadvertent loss of load (other than load which is interruptible or dispatchable) following an outage of a single element (a line or a cable) or transformer, during periods of forecast high load.

These requirements are underpinned by mandatory licence conditions for New South Wales Distribution Network Service Providers. The licence conditions for Country Energy specify N-1, one minute reliability levels for subtransmission lines and zone substations supplying loads greater than or equal to 15 MVA in urban and non-urban areas. Consequently Country Energy has requested TransGrid to incorporate N-1 reliability levels into its planning standards and processes.

In accordance with these principles TransGrid and Country Energy have jointly agreed that the network performance requirements for reliability to be applied to this area are as follows:

1. With all network elements in service the loading on each element is not to exceed the continuous rating of that element and the voltage levels at end-user premises are to be within acceptable levels.
2. Following outage of one network element the loading on each remaining element is not to exceed the short time emergency rating of that element whilst operator actions, such as opening of other network elements and transferring of loads via lower voltage networks, are taking place.
3. With one network element out of service and following operator actions:
    - The loading on each remaining element is not to exceed the contingency rating of that element;
    - The voltage levels at end-user premises are to be within acceptable levels following switching of reactive plant and operation of transformer tap-changers. This requires that voltages at the low voltage busbars of TransGrid substations on the north coast do not fall below 1.05 per unit.

In terms of network reliability standards as described in the Rules this constitutes a nominal "N-1" reliability criterion (as described in S5.1.2.2 (b) (4)).

2.4. Local Supply Arrangements

The far north coast area of New South Wales (referred to in this document) includes the Ballina, Bellingen (part), Byron, Clarence Valley, Coffs Harbour, Kyogle, Lismore and Richmond Valley local government areas. It has a population of around 270,000. The area electrical load is characterised primarily by rural loads with urban residential loads and commercial/light industrial loads in the main population centres.

TransGrid's 330 and 132 kV system on the NSW north coast is shown in Figure 1 on the next page with the far north coast area indicated by the dotted ellipse.

As the load has grown the transmission network has expanded and progressively higher voltages have been introduced. 132 kV was introduced in the mid 1960s and 330 kV in the early 1990s. The major historical network developments are shown in Table 1.

Over the years TransGrid has installed a number of banks of capacitors at its substations in the area to manage voltage levels both with all network elements in service and during outage conditions. Country Energy has also installed a number of capacitors at its substations within the area. Table 2 shows capacitors installed at 330 kV and 132 kV substations on the far north coast.

In addition TransGrid installed a Static Var Compensator (SVC) at Lismore 330/132 kV substation in 1999 to provide dynamic voltage control.

A phase angle regulator has recently been installed at Armidale to manage flows on the 965 Armidale – Kempsey 132 kV line.

Figure 1 Transmission System Supplying the NSW North Coast

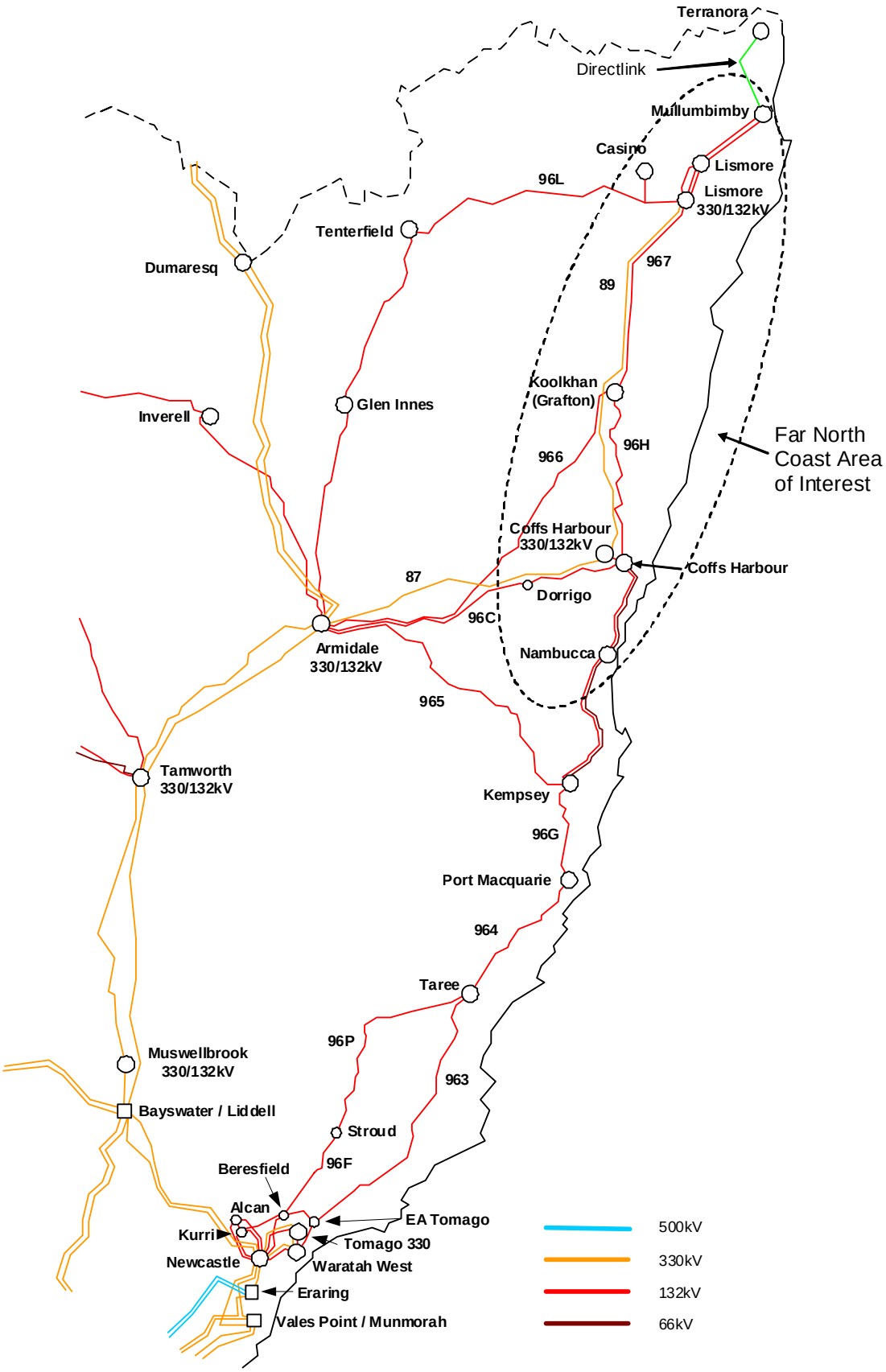


Table 1 Development of the TransGrid 330 kV and 132 kV Network Supplying the North Coast

Development	Date
First Newcastle – Taree line and Taree substation	Mid/late 1950s
Armidale – Koolkhan line and Koolkhan substation	Early 1960s
Armidale – Kempsey line and Kempsey substation	Mid 1960s
Koolkhan – Lismore line and Lismore substation, Armidale – Glen Innes – Tenterfield line and Glen Innes and Tenterfield substations	Late 1960s
Tenterfield – Lismore line	Early 1970s
Second Newcastle – Taree line	Mid 1970s
Armidale – Coffs Harbour line and Coffs Harbour substation, Coffs Harbour – Koolkhan line	Late 1970s
Taree – Port Macquarie line and Port Macquarie substation	Late 1970s
Armidale Coffs Harbour (330 kV construction), Koolkhan – Lismore (330 kV construction)	Early 1980s
Port Macquarie – Kempsey line	Mid 1980s
Coffs Harbour – Koolkhan line (330 kV construction), Operation of 330 kV construction lines at 330 kV, Lismore 330/132 kV substation	Early 1990s
Lismore SVC	Late 1990s
Coffs Harbour – Kempsey line and Nambucca substation	2002
Coffs Harbour 330/132 kV substation	2006

Country Energy commissioned a 132 kV supply to Casino from TransGrid's Tenterfield – Lismore 132 kV line in 2007.

Table 2 Capacitor Installations at 330 kV and 132 kV Substations on the Far North Coast

Substation	Capacitors Installed
Lismore 132/66 kV (Country Energy)	2 x 10 MVAr at 66 kV 1 x 12 MVAr at 132 kV
Lismore 330/132 kV	2 x 30 MVAr at 132 kV
Koolkhan (Grafton)	2 x 8 MVAR at 66 kV
Coffs Harbour	2 x 7 MVAr at 66 kV 1 x 20 MVAr at 132 kV
Nambucca	2 x 8 MVAr at 66 kV

2.5. Local Load Forecast

Demand on the far north coast has grown strongly over recent years and is expected to continue to do so. Forecast winter and summer maximum demands[1] are shown in Table 3 and Table 4.

Table 3 Winter Peak Demand Forecasts (MW)

Supply Point	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Coffs Harbour	90	80	82	85	87	90	92	95	98	100
Dorrigo	4	4	4	4	4	4	5	5	5	5
Koolkhan	57	59	60	61	63	64	66	67	69	70
Lismore	180	186	192	197	203	208	216	222	228	235
Macksville	0	11	11	12	12	12	12	13	13	13
Nambucca	31	12	12	13	13	13	14	14	14	15
Raleigh	0	13	13	14	14	15	15	15	16	16
Tenterfield	6	6	6	7	7	7	7	7	7	7
West Sawtell [1]	0	10	10	11	11	11	12	12	12	13
Total	368	381	390	404	414	424	439	450	462	474
Diversified Total	353	366	374	388	397	407	421	432	444	455

Note 1: West Sawtell is a generic name for Boambee South substation which was used prior to the exact location of that substation being determined.

Table 4 Summer Peak Demand Forecasts (MW)

Supply Point	2007/ 08	2008/ 09	2009/ 10	2010/ 11	2011/ 12	2012/ 13	2013/ 14	2014/ 15	2015/ 16	2016/ 17
Coffs Harbour	88	91	85	88	91	95	98	102	106	110
Dorrigo	4	4	4	4	4	4	4	4	4	5
Koolkhan	60	62	64	66	68	70	72	74	76	79
Lismore	180	189	199	208	217	226	235	243	251	259
Macksville	0	0	11	11	12	12	13	13	14	14
Nambucca	30	18	10	10	11	11	11	12	12	13
Raleigh	0	13	13	14	14	15	15	16	17	17
Tenterfield	5	5	5	5	6	6	6	6	6	6
West Sawtell	0	0	9	9	10	10	11	11	11	12
Total	367	382	400	415	433	449	465	481	497	515
Diversified Total	356	371	388	403	420	435	451	466	482	500

Figure 2 below shows actual and forecast winter maximum demands (in MW) for the far north coast.

[1] These are the forecast demands published in TransGrid's 2008 APR. They are slightly lower than the forecast published in the 2007 APR, which were included in the application notice.

Figure 2 Actual and Forecast Winter Max Demands

New South Wales Far North Coast (Nambucca to Lismore) Winter Maximum Demands

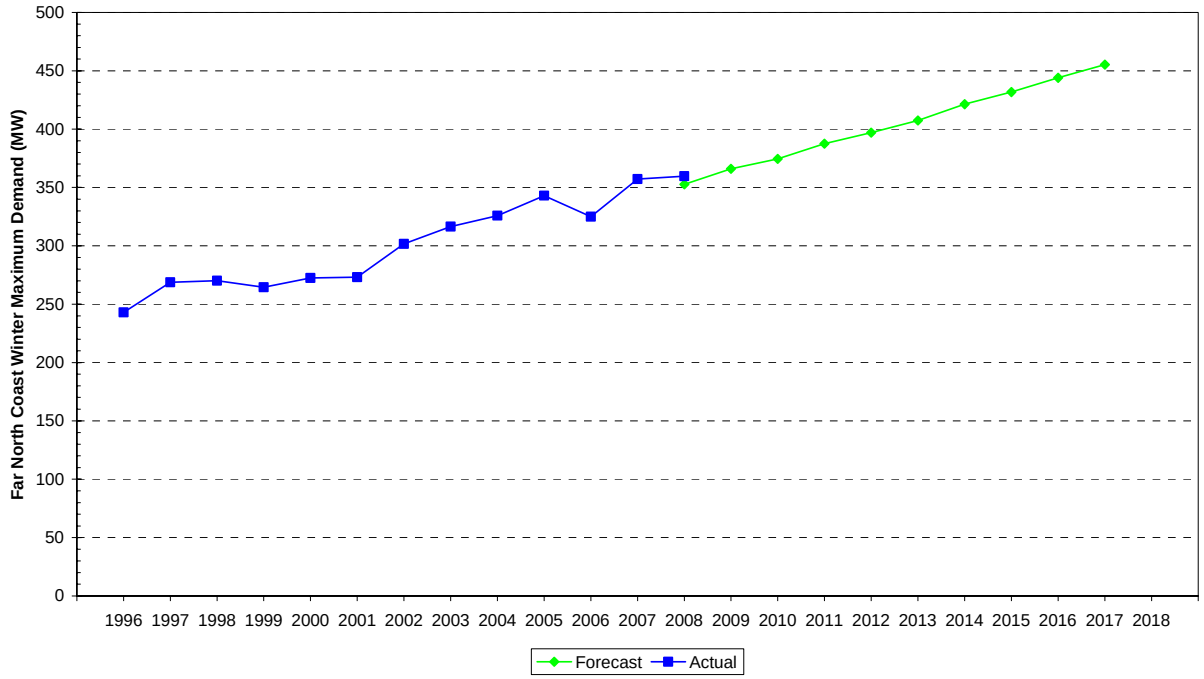
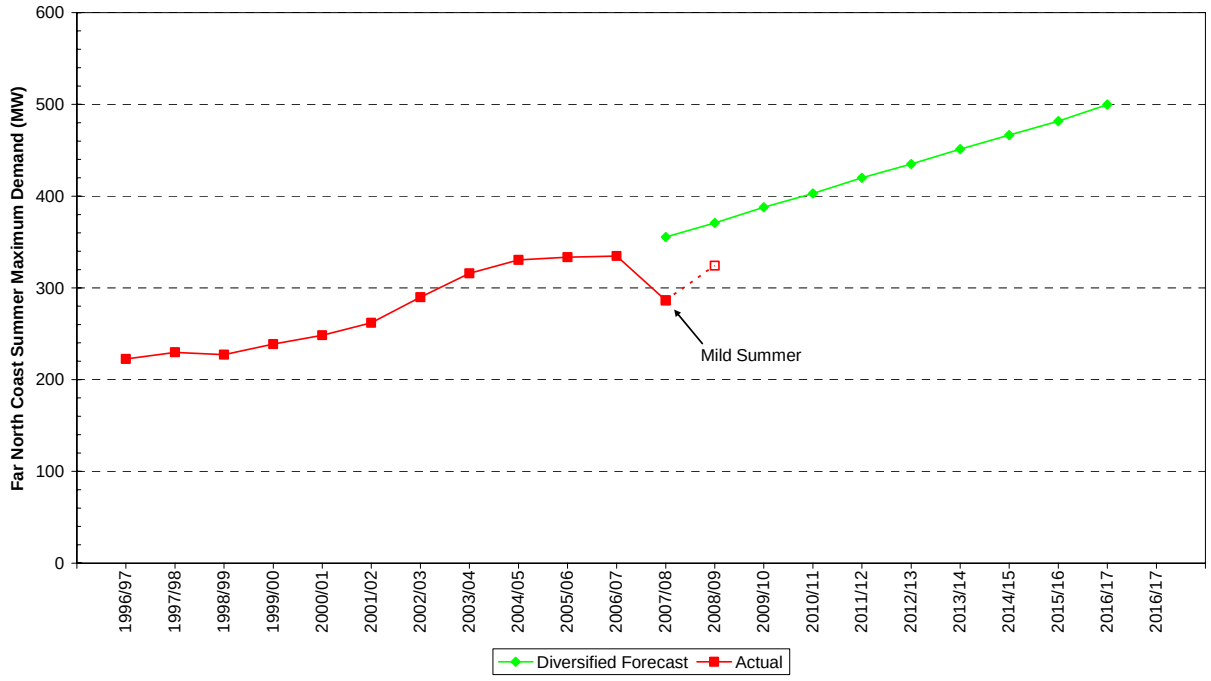


Figure 3 below shows historical and forecast summer maximum demands (in MW) for the far north coast.

Figure 3 Actual and Forecast Summer Maximum Demands

New South Wales Far North Coast (Nambucca to Lismore) Summer Maximum Demands



2.6. Description of Network Limitations

If all elements of the 330 kV and 132 kV network are in service it is presently capable of adequately supplying the far north coast at all times within a ten year planning horizon. However it is presently, or is expected to be, limited by the single contingency events described in the following sections.

2.6.1. Outage of the 87 Armidale – Coffs Harbour 330 kV Line

If the 87 Armidale – Coffs Harbour 330 kV line is out of service at times of high demand then:

- Unacceptably low voltages could occur at Lismore or on the mid north coast; and
- The 96C Armidale – Coffs Harbour 132 kV line may be overloaded.

The limitation relating to the loading of the 965 Armidale – Kempsey 132 kV line, which was mentioned in the application notice, has been overcome by the installation of a phase angle regulator in the line at Armidale.

The extent of these limitations depends inter alia on the magnitude and direction of power flows on QNI. The limitations may be managed via southward power flows on Directlink to the extent that the transmission system in Queensland and Directlink can accommodate them.

Table 5 and Table 6 below show the level of support (via Directlink or from other sources on the far north coast) required to manage all of the above limitations over a range of QNI flows. Changes in the level of support required reflect load growth and developments within the 132 kV networks supplying the north coast.

Additional information on the individual limitations is provided in Appendix A.

Table 5 Approximate Level of Support Required During Summer (87 Line Outage)

Summer	500 MW Export to QLD on QNI	No Flow on QNI	800 MW Import to NSW on QNI	1,000 MW Import to NSW on QNI
2008/09	65	85	120	130
2009/10	58	80	125	138
2010/11	75	100	145	160
2011/12	87	110	155	170
2012/13	105	130	175	185

Table 6 Approximate Level of Support Required During Winter (87 Line Outage)

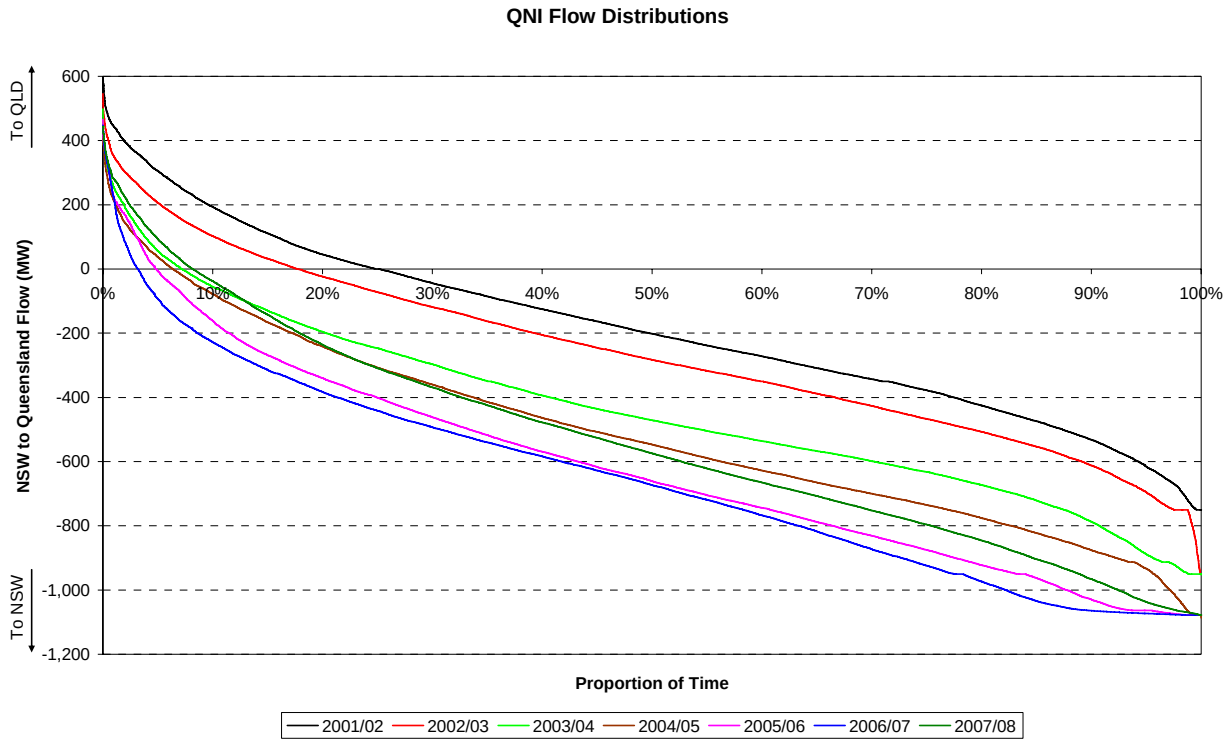
Winter	500 MW Export to QLD on QNI	No Flow on QNI	800 MW Import to NSW on QNI	1,000 MW Import to NSW on QNI
2009	22	40	80	90
2010	20	40	80	90
2011	35	55	95	110
2012	37	55	100	110
2013	55	75	115	128

The level of support required increases with southward flows (import to NSW) on QNI. Since QNI was commissioned flows on it have been primarily southward and, until recently, have increased in magnitude

and duration. High levels of import to NSW are expected to continue over the next several years, although they are not expected to exceed 800 MW at times of high summer demand on the NSW far north coast[2].

Figure 4 below shows the distribution of flows on QNI from 2001/02 to 2007/08.

Figure 4 QNI Flow Distributions



Directlink consists of three nominal 60 MW dc links operating in parallel. Its capability is limited to around 170 MW (delivered at Mullumbimby) with three links in service, 115 MW if one dc link is out of service and 57 MW if two links are out of service. Recent experience indicates that the availability of more than one of the dc links should not be relied upon[3].

The capability of the transmission and distribution networks within Queensland to accommodate high southward flows on Directlink at times of high southeast Queensland load is limited by the thermal rating of the two Mudgeeraba – Terranora 110 kV circuits. These circuits supply both the Terranora (Tweed Shire) load and southward flows on Directlink. As the Terranora load grows the capability to support southward flows on Directlink will diminish.

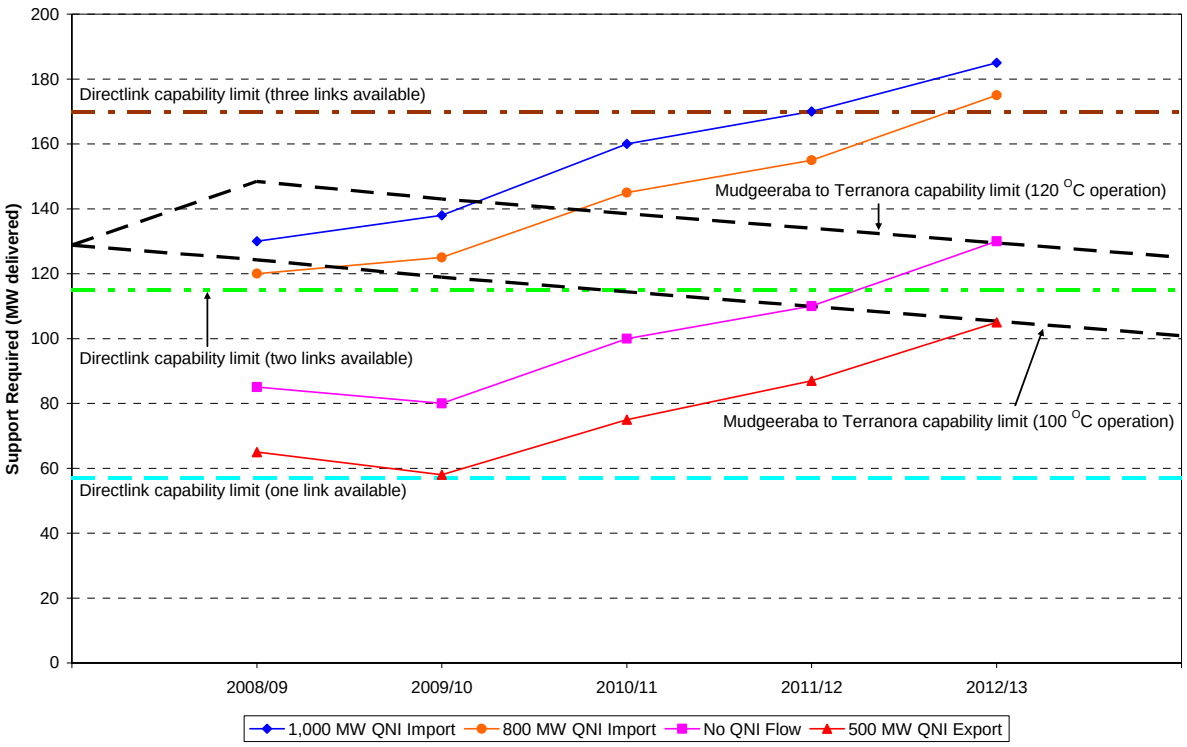
Since the application notice was published, Powerlink has completed works to increase the voltage stability capability into southeast Queensland and Brisbane. These works also increase the voltage stability capability to the Gold Coast. Voltage limitations will continue to be managed by Powerlink to meet ongoing load growth in southeast Queensland and the Gold Coast Tweed area.

[2] An investigation of historical levels of import to NSW via QNI at times of high summer demand on the NSW far north coast shows decreasing levels of import with time. This is likely to reflect a tightening supply / demand balance in Queensland, with consequent reduced capability for exports.

[3] In 2006 the AER issued its final determination on Directlink's application to convert to regulated status. During its assessment of that application the AER used a benchmark availability level of 99%. Once Directlink converted to regulated status information on its availability became available from NEMMCO's dispatch system. That information shows that from mid 2007 only the availability (measured on a rolling annual basis) of "one or more dc links" has approached this benchmark (with the availability of "two or more" and "all three" dc links having fallen well below it). Consequently, TransGrid considers that a maximum of one of the three dc links could be relied upon to be available.

Figure 5 below shows the required level of support in summer for four levels of QNI flow together with the capabilities of Directlink and the Queensland transmission network[4].

Figure 5 Required Level of Support in Summer



2.6.2. Outage of the 89 Coffs Harbour – Lismore 330 kV Line

If the 89 Coffs Harbour – Lismore 330 kV line is out of service at times of high demand the 967 Koolkhan – Lismore 132 kV line and the 96H Coffs Harbour – Koolkhan 132 kV may be overloaded and low voltages may occur at Lismore. The severity of these limitations does not vary with QNI flows. They can be managed by southward power flows on Directlink. Table 7 and Table 8 on the next page show the approximate levels of support (via Directlink or from other sources on the far north coast) required in summer and winter.

[4] The capability of the Queensland transmission network is based on the thermal capacity of the Mudgeeraba – Terranora 110 kV circuits (expressed in MW delivered by Directlink at Mullumbimby, assuming that the Tweed area load is at its forecast maximum). The Mudgeeraba – Terranora 110 kV circuits have recently been uprated to allow operation at 120 degrees. However, it will not be possible to operate these lines at 120 degrees prior to a critical outage occurring. It is expected that pre-contingent flows on these lines will be limited to the 100 degree rating and that higher flows would be possible should a critical contingency occur. In the period between the critical contingency occurring and the 120 degree operation commencing (which would entail invoking different limit equations in NEMMCO's dispatch engine), the 15 minute rating of the 96C Armidale – Coffs Harbour 132 kV line would be utilised.

Figure 5 shows the limitation imposed by both 100 degree and 120 degree ratings for the Mudgeeraba - Terranora circuits.

Table 7 Approximate Level of Support Required During Summer (89 Line Outage)

Summer	Support Required (MW)
2008/09	22
2009/10	32
2010/11	43
2011/12	53
2012/13	62

Table 8 Approximate Level of Support Required During Winter (89 Line Outage)

Winter	Support Required (MW)
2009	-
2010	2
2011	7
2012	14
2013	20

2.6.3. Coffs Harbour 330/132 kV Transformer Capacity Limitations

If the Coffs Harbour 330/132 kV transformer is out of service low voltages can occur at Coffs Harbour 66 kV busbar and on the low voltage busbars of 132 kV substations on the mid north coast.

To accommodate the growing load at Coffs Harbour it is planned to replace the existing 60 MVA 132/66 kV transformers by 120 MVA units by summer 2009/10. The new transformers would have a larger tapping range than the existing units. It is also planned to replace the No.1 66 kV capacitor, which is approaching the end of its serviceable life, by a larger unit. The new transformers and the larger capacitor will help to maintain adequate voltage levels.

The severity of this limitation depends to a small extent on the magnitude and direction of flows on QNI. It is expected to arise in summer 2016/17.

2.6.4. Network Limitations Summary

Table 9 below shows the timing of the expected occurrence of the network limitations described in Sections 2.6.1 to 2.6.3.

Table 9 Onset of Network Limitations

Limitation	Year of Onset
Unacceptably low voltages at Lismore or overloading of the 96C Armidale – Coffs Harbour 132 kV line on outage of the 87 Armidale – Coffs Harbour 330 kV line.	Existing with less than three dc links of Directlink available. Around 2011 with all three dc links of Directlink available.
Unacceptably low voltages at Lismore or overloading of the 967 Armidale – Coffs Harbour 132 kV line on outage of the 89 Coffs Harbour – Lismore 330 kV line.	Existing without Directlink available. Beyond 2011 with one or more dc links of Directlink available.
Unacceptably low voltages at Coffs Harbour on outage of the Coffs Harbour 330/132 kV transformer.	Summer 2016/17.

2.7. Joint Planning

Country Energy and TransGrid have jointly planned the 330 kV and 132 kV network supplying the New South Wales north coast for many years.

TransGrid and Country Energy have carried out joint annual planning reviews as required by Clause 5.6.2 (b) of the Rules. As required by Clause 5.6.2(c) they have identified that the limitations described in Section 2.6 give rise to a need for network augmentations and have carried out joint planning to determine options for these augmentations.

2.8. Reliability Augmentation

It follows from Sections 2.1 – 2.6 that the proposals covered by this final report constitute a reliability augmentation and that the regulatory test should be applied in accordance with Clause 1(a) of the test.

2.9. Material Internetwork Impact

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

TransGrid has determined that none of the options described in Section 3 would impose power transfer constraints or adversely impact on the quality of supply to adjoining transmission networks.

2.10. Consideration of DM and Local Generation

As discussed in Section 1.2 the network limitations described in Section 2.6 have previously been described in TransGrid's Annual Planning Statements and Annual Planning Reports from 1999 to 2007.

In August 2003 TransGrid and Country Energy published a document titled "Emerging Transmission Network Limitations on the New South Wales Far North Coast". That document sought proposals from proponents of developments which may relieve the limitations in the transmission network supplying the area. No responses relating to new developments were received.

In response to the application notice, TransGrid received submissions from parties interested in providing network support. Discussions are continuing with those parties to determine whether a cost effective network support arrangement can be achieved.

3. Options

TransGrid and Country Energy have developed two network options to relieve the network limitations detailed in Section 2.6. They are described in the following sections together with descriptions of other network developments that have been considered but not put forward as reasonable options.

Both options involve uprating the 96C Armidale – Coffs Harbour 132 kV line to allow it to operate with a conductor temperature of 100 ^{O}C. This would increase the summer day contingency rating of 96C by around 20 MVA thus reducing the amount of support required for outages of the 87 Armidale – Coffs Harbour 330 kV line. Table 10, Table 11 and Figure 6 below show the level of support required to manage network limitations for an outage of 87 line under conditions of high import to NSW over QNI.

These works are estimated to cost $11.5 million (± 25%) and could be completed by summer 2010/11.

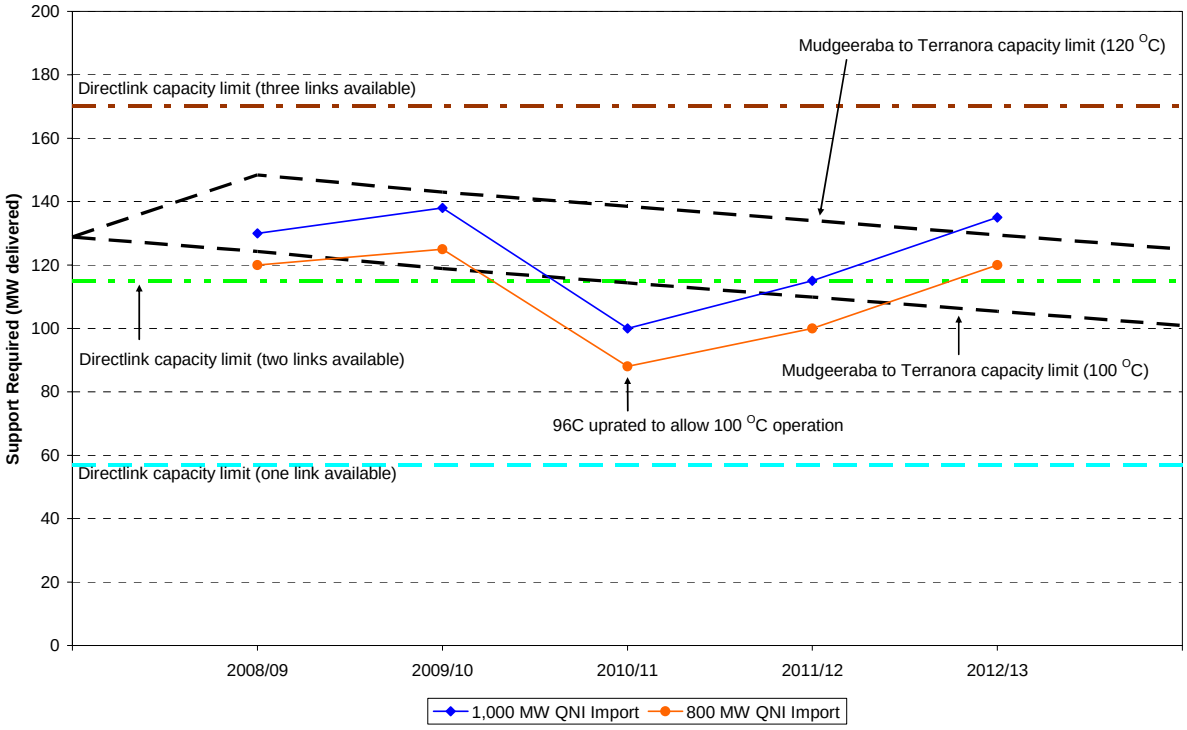
Table 10 Approximate Level of Support Required During Summer (87 Line Outage, 800 MW Import to NSW on QNI)

Summer	96C Not Uprated	96C Uprated
2009/10	125	N/A
2010/11	145	88
2011/12	155	100
2012/13	175	120

Table 11 Approximate Level of Support Required During Summer (87 Line Outage, 1,000 MW Import to NSW on QNI)

Summer	96C Not Uprated	96C Uprated
2009/10	138	N/A
2010/11	160	100
2011/12	170	115
2012/13	185	135

Figure 6 Required Level of Support in Summer (96C Uprated)



As indicated in Section 2.6 the amount of support available via Directlink is subject to a number of uncertainties. Uprating 96C line provides an opportunity to reduce the level of support required thus increasing the likelihood that the required level of support can be delivered.

3.1. Option 1: Dumaresq – Lismore 330 kV Line

This option would involve:

- Uprating of the 96C Armidale – Coffs Harbour 132 kV line to a conductor temperature of 100 °C;
- Construction of a new 330 kV line between Dumaresq 330 kV switching station and Lismore 330/132 kV substation;
- Provision of 330 kV switchgear at Dumaresq and Lismore to connect the new line;
- Provision of a 50 MVAr 330 kV line connected shunt reactor at Lismore and a 30 MVAr line connected shunt reactor at Dumaresq;
- Provision of two 40 MVAr 132 kV capacitors at each of Lismore and Coffs Harbour 330/132 kV substations; and
- Provision of a second 330/132 kV transformer and related 330 kV and 132 kV switchgear at Coffs Harbour 330/132 kV substation.

The new line would be around 215 km in length. It is anticipated that it could utilise parts of the route of the existing 96L Tenterfield – Lismore 132 kV line. However to enable the 132 kV supply to Casino to be retained the line route between the Casino area and Lismore 330/132 kV substation would be new.

These works are estimated to cost $227 million (± 25%) and could be completed by late 2011.

This option would overcome the limitations described in Section 2.6 over at least a ten year planning horizon.

3.2. Option 2: Armidale – Lismore 330 kV Line

This option would involve:

- Uprating of the 96C Armidale – Coffs Harbour 132 kV line to a conductor temperature of 100 °C;
- Construction of a new 330 kV line between Armidale 330/132 kV substation and Lismore 330/132 kV substation;

- Provision of 330 kV switchgear at Armidale and Lismore to connect the new line;
- Provision of 50 MVAr 330 kV line connected shunt reactors at Armidale and Lismore;
- Provision of two 40 MVAr 132 kV capacitors at each of Lismore and Coffs Harbour 330/132 kV substations; and
- Provision of a second 330/132 kV transformer and related 330 kV and 132 kV switchgear at Coffs Harbour 330/132 kV substation.

The new line would be around 300 km in length. As per Option 1 it is anticipated that it could utilise parts of the route of the existing 96L Tenterfield – Lismore 132 kV line.

These works are estimated to cost $280 million (± 25%) and could be completed by late 2011.

This option would overcome the limitations described in Section 2.6 over at least a ten year planning horizon.

3.3. Consideration of Other Network Developments

3.3.1. Armidale – Kempsey Area 330 kV Line and Kempsey 330/132 kV Substation

Consideration has been given to the development of a new 330 kV line between Armidale 330/132 kV substation and a new 330/132 kV substation in the Kempsey/Port Macquarie area. The 330 kV line would utilise parts of the route of the existing 965 Armidale – Kempsey 132 kV line.

This development would involve:

- Reconstruction of 965 line from Armidale to a location just to the west of Kempsey as a single circuit 330 kV line and reconstruction of the remaining section to Kempsey as a high capacity double circuit 132 kV line; and
- Establishing a 330/132 kV substation just to the west of Kempsey.

Establishment of an Armidale – Kempsey area 330 kV line is expected to be a later stage in the development of a 330 kV network serving the mid north coast. However, implementing it as an initial stage of that development is not practical as it would exacerbate limitations within the 132 kV network between the Newcastle area and Taree (particularly for northward flows on QNI). Thus, this is not a technically acceptable option.

In addition, it would not be possible to take the 965 line out of service to reconstruct it until both circuits of the Coffs Harbour – Kempsey double circuit 132 kV line are operating at 132 kV. It is anticipated that it could not be completed until late 2013 (two years later than Options 1 and 2).

Consequently, this is not a reasonable option and will not be considered further.

3.3.2. Ebenezer – Lismore 330 kV Line

Consideration has been given to the development of a 330 kV line between the Ebenezer area near Ipswich in southeast Queensland and Lismore. The Ebenezer area is a possible location of a future Powerlink Queensland 500/330/275 kV substation that would connect major transmission lines supplying southeast Queensland and Brisbane.

To meet the network limitations described in section 2.6 this development would involve:

- Establishment of a new 330/275 kV substation in the Ebenezer area;
- Construction of a new 330 kV line between Ebenezer and Lismore 330/132 kV substation;
- Provision of 330 kV switchgear at Lismore to connect the new line;
- Provision of 50 MVAr 330 kV line connected shunt reactors at Ebenezer and Lismore;
- Provision of two 40 MVAr 132 kV capacitors at each of Lismore and Coffs Harbour 330/132 kV substations; and
- Provision of a second 330/132 kV transformer and related 330 kV and 132 kV switchgear at Coffs Harbour 330/132 kV substation.

The new substation at Ebenezer would be a significant advancement of works for the development of supply to southeast Queensland and Brisbane that would not otherwise be required until well into the

future. The Ebenezer - Lismore connection would also advance other future works for the development of supply to these areas.

The Ebenezer - Lismore new line would be around 200 km in length. As per Option 1 it is anticipated that it could utilise parts of the route of the existing 96L Tenterfield – Lismore 132 kV line.

This development is not considered to be a feasible option and will not be considered further as it:

- Faces difficulties in obtaining the line route from Ebenezer to Lismore due to the presence of environmentally sensitive and protected areas including National Parks and World Heritage Areas; and
- Would significantly advance future major works that would otherwise not be required for the development of supply to southeast Queensland and Brisbane until well into the future.

3.3.3. Armidale – Coffs Harbour – Lismore 330 kV Line

Consideration has been given to the development of a new 330 kV line between Armidale 330/132 kV substation and Lismore 330 kV substation via the Coffs Harbour area.

This development is not considered to be a reasonable option and will not be considered further as:

- A new line route between Armidale and Coffs Harbour would be required and this would be very difficult to obtain (particularly around the escarpment where there are a number of National Parks and Conservation Areas);
- A new 330 kV switching station would be required in the Coffs Harbour area because it would not be possible to connect the new line at the existing Coffs Harbour 330/132 kV substation;
- To overcome the limitation described in Section 2.6.2 it would be necessary to construct a 330 kV line between the Coffs Harbour 330 kV switching station and Lismore. The route for such a line would be very difficult to obtain; and
- Overall around 300 km of new 330 kV line would be required, together with a new 330 kV switching station, making this option significantly more costly than Option 1 and Option 2.

3.3.4. 132 kV Line Developments

Over the distances involved (greater than 200 km) the capacity of 132 kV transmission lines is limited by voltage drop considerations to around 40 MW to 50 MW (significantly less than the typical thermal rating of a single circuit 132 kV line). The far north coast load is forecast to grow at around 15 MW to 20 MW p.a. which would necessitate an additional 132 kV circuit about every three years.

The environmental and community impact of proliferating 132 kV lines was recognised in the 1970s. Consequently all major lines supplying the Coffs Harbour to Lismore area from the early 1980s have been of 330 kV construction.

132 kV line developments are not considered to be reasonable options and will not be considered further due to the associated adverse environmental and community impacts.

4. Application of the Regulatory Test

An application of the regulatory test, considering Options 1 and 2, has been carried out. A summary of the results is provided in the following sections.

4.1. Form of the Regulatory Test

As discussed in Section 2 the options covered by this final report are a reliability augmentation and the regulatory test is to be applied in accordance with clause 1(a) of the test:

> (a) in the event the option is necessitated principally by inability to meet the service standards linked to the technical requirements of schedule 5.1 of the Rules or in applicable regulatory instruments - the option minimises the costs of meeting those requirements, compared with alternative option/s in a majority of reasonable scenarios;

TransGrid's interpretation of the regulatory test for reliability augmentations is as follows.

The following costs should be included:

- Capital costs of options;
- O&M costs of options; and
- Costs of complying with laws, regulations and applicable administrative requirements in relation to the option;

The following avoided costs should not be included:

- Reductions in electrical losses;
- Reductions in unserved energy;
- Deferrals or avoidance of generation or transmission investment elsewhere in the NEM (ie not associated with the option); and
- Avoided fuel costs elsewhere in the NEM.

Market development scenarios are only relevant to the extent that they affect the timing of the onset of network limitations and/or the ability of options to meet those limitations.

4.2. Regulatory Test Application – Summary

4.2.1. Costs

For the regulatory test application only the capital and operating & maintenance costs of Options 1 and 2 have been explicitly included[5].

There are no known existing or anticipated government tax or subsidy schemes that would apply differently to the operation of Options 1 and 2.

There are no known emerging network limitations in the area (other than those described in Section 2.6) for which the solution would be differently affected by either of these options.

4.2.2. Scenarios

Only a single market development scenario has been considered which corresponds to a medium economic growth outcome and which does not explicitly model future generation or demand management developments. This is due to:

- The need for network augmentation being within the lead time of all known reasonable options.
- There being no known committed or advanced generation or demand management developments that are likely to affect the timing of the onset of the network limitations or the ability of any reasonable option to meet them.

[5] The capital costs have been updated to 2008/09 dollars. They also reflect recently available cost data and include refinements to the scope of the options where these have been made.

4.2.3. Results

The present value of the costs of each option has been calculated for a base case of financial and technical assumptions and the options ranked accordingly. Sensitivity tests of these calculations due to reasonable variations to the major assumptions have been carried out.

The base case assumptions and the range over which sensitivity tests were conducted are shown in Table 12. The results of the analysis are shown in Table 13 and Table 14. Details of the costing model for the base case assumptions are shown in Appendix A.

Table 12 Base Case Values and Range of Values Used in Sensitivity Checks

Parameter	Base Case Value	Sensitivity Checks at
Real Discount Rate	9%	6% and 12%
Annual O&M Cost	2% of Capital Cost	1% and 3% of Capital Cost
Asset Lifetimes		
Substations	30 years	20 and 40 years
Transmission Lines	45 years	30 and 60 years
Capital Costs	Nominal Value	±25% variation

Table 13 Comparison of Options – Base Case

Option	Capital Costs ($M)	PV of Costs ($M)	Rank
Option 1	226.7	108.4	1
Option 2	280.4	134.5	2

Table 14 Comparison of Options - Results of Sensitivity Studies

Sensitivity Case	Option 1	Rank	Option 2	Rank
Base Case	108.4	1	134.5	2
12% Discount Rate	107.1	1	133.0	2
6% Discount Rate	105.3	1	130.5	2
25% Increase in Capital Costs	135.5	1	168.1	2
25% Decrease in Capital Costs	81.3	1	100.9	2
Decrease in Asset Lives	115.8	1	143.5	2
Increase in Asset Lives	104.7	1	130.0	2
Decreased O&M Cost	100.6	1	124.7	2
Increased O&M Cost	116.3	1	144.3	2

In each case Option 1 has lower present value of costs and is therefore the highest ranked option.

5. Conclusions and Proposed Actions

TransGrid and Country Energy conclude that Option 1 would satisfy the regulatory test. The preferred actions are for TransGrid to:

- Proceed with construction of Option 1 as described in Section 3.1; and
- Continue discussions with the proponents of non-network developments to determine whether implementation of one or more of those developments is feasible and would be cost effective in deferring the date by which Option 1 is to be completed.

6. Notice of Disputes

Persons wishing to dispute the contents, findings, assumptions 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 A – Network Limitations on Outage of the 87 Armidale – Coffs Harbour 330 kV Line

Limitations

On outage of 87 line the transmission network may be affected by the following limitations:

- Overloading of the 96C Armidale – Coffs Harbour 132 kV line.

  The extent of this overload depends primarily on the loads in the Coffs Harbour area and the mid north coast and on the magnitude and direction of flows on QNI.

- Low voltages at Lismore or on the mid north coast.

  For an 87 line outage the 89 Coffs Harbour – Lismore 330 kV line remains in service. The transformer tapchanger control schemes at Coffs Harbour and Lismore 330/132 kV substations enable the 132 kV voltage level at Coffs Harbour to be managed provided that the output of the Lismore SVC remains within its capability.

  Voltage levels on the mid north coast depend primarily on the local load, the magnitude and direction of flows on QNI and future augmentations of the network supplying the mid north coast. The augmentations included in TransGrid's analysis are:

  - Operation of both circuits of the Coffs Harbour – Nambucca – Kempsey double circuit 132 kV line at 132 kV by summer 2009/10.
  - Provision of a second 132 kV circuit between Kempsey and Port Macquarie by summer 2010/11.
  - Establishment of a 330/132 kV substation at Tomago (in the Newcastle area) by summer 2009/10 and installation of a third 375 MVA transformer at that substation by summer 2011/12.

The limitation relating to the loading on 965 Armidale – Kempsey 132 kV line, which was mentioned in the application notice, has been relieved by the commissioning of a phase angle regulator at Armidale.

TransGrid's analysis determines the amount of support required (via Directlink or from other sources on the far north coast) to manage each of these limitations (individually) for a range of flows on QNI. The results are shown in Table A1 and Table A2 below. Table 5 and Table 6 (both in Section 2.6.1) show the amount of support required to manage all of the limitations concurrently.

Directlink Capability

Directlink comprises three nominal 60 MVA dc links operating in parallel. Allowing for losses the maximum southward flow (delivered at Mullumbimby) is around 170 MW. Should one of the three dc links be out of service the maximum southward capability is around 115 MW and with two of the dc links out of service it is around 57 MW.

The reliability of Directlink was an issue during the AER's consideration (during 2005 and early 2006) of the application by Directlink Joint Ventures (DJV) to convert Directlink to regulated status. At that time Directlink's availability was around 80% (well below typical availability levels for transmission networks) and DJV gave undertakings to improve this. In its consideration of DJV's application the AER used a benchmark availability level of 99% as an acceptable availability level.

One or more of the dc links have been out of service on occasions recently. Analysis of availability data shows that:

- the (rolling annual) availability of two or more links remains well below the 99% benchmark (as does the availability of all three links); and
- while the (rolling annual) availability of one or more links is also below 99%, it may be possible to remedy this.

On this basis, TransGrid considers that a maximum of one link could be relied upon to be available.

Queensland Network Capability

Powerlink Queensland has recently completed works to increase the voltage stability capability into southeast Queensland and Brisbane. By their very nature, these works also increase the voltage stability capability to the Gold Coast area. Voltage limitations will continue to be managed by Powerlink to meet ongoing load growth in southeast Queensland and the Gold Coast Tweed areas.

The Mudgeeraba – Terranora double circuit 110 kV line has also been uprated (by Powerlink and Country Energy) to allow operation at a conductor temperature of 120 ^{O}C (the maximum practical), thereby increasing its capacity to supply the Tweed Shire and support southward flows on Directlink.

Table A1 – Level of Support Required During Summer

Summer	500 MW Export on QNI		Zero Flow on QNI		800 MW Import on QNI		1,000 MW Import on QNI	
	96C Loading	Voltages	96C Loading	Voltages	96C Loading	Voltages	96C Loading	Voltages
2008/09	65	5	85	5	120	13	130	17
2009/10	58	9	80	9	125	19	138	23
2010/11	75	29	100	29	145	40	160	45
2011/12	87	52	110	51	155	61	170	65
2012/13	105	80	130	75	175	90	185	95

Note: At times of high far north coast load in summer imports to NSW via QNI are not expected to exceed 800 MW over the next few years.

Table A2 – Level of Support Required During Winter

Winter	500 MW Export on QNI		Zero Flow on QNI		800 MW Import on QNI		1,000 MW Import on QNI	
	96C Loading	Voltages	96C Loading	Voltages	96C Loading	Voltages	96C Loading	Voltages
2009	22	-	40	-	80	-	90	-
2010	20	-	40	-	80	-	90	-
2011	35	-	55	-	95	2	110	6
2012	37	3	55	3	100	11	110	15
2013	55	22	75	20	115	29	128	33

Appendix B - Present Value Cost Analysis of Base Case

Supply to the NSW Far North Coast: Application of the Regulatory Test: Option 1

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Residual
96C Uprate			11.5									-9.2
Dumaresq - Lismore Line				161.0								-132.4
Dumaresq - Lismore Line Property				24.1								-19.8
Dumaresq SS Switchbays & reactor				8.1								-5.9
Lismore SS Switchbays & reactor + caps				10.9								-8.0
Coffs Harbour Caps + Transformer									11.1			-10.0
O+M Costs				0.23	4.31	4.31	4.31	4.31	4.31	4.53	4.53	
Total Expenditure			11.54	204.3	4.3	4.3	4.3	4.3	15.4	4.5	4.5	-185.3
PV of Costs ($Million)	**108.4**											
Total Capex Costs ($Million)	**226.7**											

Supply to the NSW Far North Coast: Application of the Regulatory Test: Option 2

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Residual
96C Uprate			11.5									-9.2
Armidale - Lismore Line				207.4								-170.5
Armidale - Lismore Line Property				34.2								-28.1
Armidale SS Switchbay				5.3								-3.9
Lismore SS Switchbays & reactor + caps				10.9								-8.0
Coffs Harbour Caps + Transformer									11.1			-10.0
O+M Costs				0.23	5.39	5.39	5.39	5.39	5.39	5.61	5.61	
Total Expenditure			11.54	258.0	5.4	5.4	5.4	5.4	16.5	5.6	5.6	-229.7
PV of Costs ($Million)	**134.5**											
Total Capex Costs ($Million)	**280.4**											