Tenterfield Supply Options

DIRECTLINK JOINT VENTURE

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1 EXECUTIVE SUMMARY

This Report has been prepared in response to a request from the ACCC for information on options for a second supply to Tenterfield when one of its two 132kV supply lines is removed for construction of the Dumaresq - Lismore 330kV transmission line. This is to enable a better quantification of the benefits that DirectLink could provide by deferring augmentation works in north-east New South Wales, in particular the works forming Alternative 5 of the DirectLink Alternatives.

Tenterfield is currently supplied by a 132kV transmission line (96T) from Glen Innes in the south and a 132kV transmission line (96L) from Lismore in the east, giving Tenterfield a ring main supply. Removal of line 96L to allow its easement to be used for part of the 330kV line will leave Tenterfield without this N-1 supply unless alternative arrangements are made.

The options that have been developed have been reviewed in terms of lifetime cost and technical merit as measured by quality of supply and level of reliability. Lifetime cost is determined from the present value of capital costs and operating and maintenance (O&M) costs using a real discount rate of 9% over 40 years (analysis at 7% and 11% is provided in Appendix 4). The O&M costs for the transmission supply options are essentially the same as those for 96L.

The Report finds that the three lowest cost options are very comparable in their lifetime costs with only $0.8 million separating them. The ranking is very sensitive to the technical and cost assumptions underpinning each; a small change in one can alter the ranking significantly. This adds a degree of robustness to the task of quantifying the deferral benefits of DirectLink, there being three options very close in lifetime cost. The three lowest cost options in ascending cost order, subject to the caveat of strong sensitivity to technical and cost assumptions, are:

1. Supply from the proposed Dumaresq - Lismore 330kV transmission line ($17.1 M)
2. Supply at 66kV from the Emmaville substation south-west of Tenterfield ($17.7 M)
3. Supply from standby diesel generation at Tenterfield ($18.0 M).

1.1 Options

Five options to provide Tenterfield with an alternative supply are reviewed in detail in this report. Variations on some options have also been considered but not fully analysed because they failed to meet technical requirements or were considerably more costly than the main option analysed. The five options are:

1. Provide supply from the proposed 330kV Dumaresq - Lismore transmission line
2. Provide a second 132kV supply from Glen Innes
3. Provide a 132kV supply from Stanthorpe in Queensland
4. Provide a 66kV supply from Emmaville
5. Provide local standby generation.

Options 1, 2 and 4 maintain an N-1 supply. Option 3 results in a slight supply interruption of a few seconds while Option 5 results in an interruption of the order of a minute while standby generation is automatically brought into service. All five options have been costed over the 40 year nominal life of transmission lines.

Option 1 provides supply from the proposed Dumaresq - Lismore 330kV transmission line. The issues involved in building this line are outside the scope of this Report. The Report only focuses on the cost and technical merits of supply to Tenterfield from this line.

The option would require the construction of a 330/132kV substation near Tenterfield to supply its 6 MVA load[1]. Estimated lifetime cost of this option is $17.1 million assuming the substation can be built adjacent to 96L to enable the existing line between this point and Tenterfield to be used.

This option was initially ruled out because of its high cost as it was originally conceived as involving a standard 330/132kV switchyard with a 132kV line to Tenterfield. However, it has been re-costed on the basis of a minimalist switchyard capable of providing an N-1 supply and using a section of the existing 96L line to eliminate 132kV line costs. Project costs have also been reduced on the basis that the switchyard is treated as an increment to the proposed 330kV line. If these assumptions are not accepted, the cost will increase significantly.

To minimise the time that Tenterfield is without an N-1 supply, the 330kV line would need to be built in two stages. Stage 1 would involve construction of the line from Dumaresq to Tenterfield and construction of the 330/132kV substation. Once this stage was commissioned, the section of 96L to Lismore could be removed and the remainder of the 330kV line built on the easement.

Option 2 involves the construction of a second 132kV transmission line approximately 80km in length from Glen Innes and the augmentation of the 132/66kV Glen Innes substation to provide a 132kV line bay. An alternative of replacing 96T from Glen Innes to Tenterfield with a dual circuit 132kV line has been eliminated because of its high line costs, almost double those of the new line, and technical considerations.

The capital cost of Option 2 is estimated at $28.4 million and is the simplest of the five options in terms of the underlying design and cost assumptions.

Option 3 involves the construction a 132kV line from the 110/33kV substation in Stanthorpe, Queensland to Tenterfield in NSW, a distance of approximately 60 km. In addition, 110kV to 132kV transformation is required at Stanthorpe. The lifetime costs are approximately the same as Option 2. This is because the cost advantage of the shorter distance of the Stanthorpe supply is largely offset by the cost of transformation from 110kV to 132kV.

[1] The maximum demand of Tenterfield is estimated to increase to 6 MVA over the next decade. Current maximum demand is approximately 5.3 MVA which is projected to grow at approximately 1% p.a. [Source: Country Energy “Electricity System Development Review – 2003”].

However Option 3 results in a slight reduction in quality of service to Tenterfield because the line would normally be left open to prevent complications from paralleling with the Queensland system. The line would automatically close on following loss of the 132kV supply to Tenterfield. This operating arrangement would result in an interruption to supply of a few seconds on loss of 96T and upon its restoration.

Option 4 entails the construction of a 66kV transmission line from Emmaville, augmentation of the Emmaville substation to provide a 66kV line bay, 66/22kV transformation at Tenterfield and installation of a 66kV capacitor bank at Tenterfield. The lifetime cost of this option is estimated at $17.7 million. The line also requires the acquisition of easements for a route that would likely follow the New England Highway due to the rugged nature of the surrounding countryside.

Supply from within Country Energy's sub-transmission system was initially ruled out on technical grounds. Further analysis identified this option provided technical limitations could be overcome.

Option 5 is the only non-transmission option. It involves the installation of five diesel generators, each 1.5MVA in capacity, at Tenterfield substation to meet the near-term maximum demand of 6 MVA. The fifth genset is required for contingencies such as the failure of one to start. A further two gensets would be required over the 40 years to meet projected load growth.

As the diesel generation operates on a standby basis there would be a short interruption to supply following loss of 96T to bring the diesel gensets into operation and progressively take load. The interruption is estimated to be of the order of one minute if the gensets are kept on warm standby.

The lifetime cost of Option 5 is estimated at $18.0 million. This estimate has been made on the basis of an independent owner/operator responding to a competitive tender to build, own and operate a standby power supply at Tenterfield.

Gas turbines running on distillate as a possibility for Option 5 have been discounted on technical grounds. Though they have comparable capital costs to diesel gensets, they have relatively long start-up times of the order of 10 minutes compared to one minute for rapid-start diesel gensets.

Other Options that have been considered are local renewable generation and demand management. Neither has been analysed in this report because they do not provide an N-1 or reliable standby supply.

1.2 Options Summary

A summary of Options 1 through 5 is provided in the following table.

SUMMARY COMPARISON OF SUPPLY OPTIONS			
ID	**Description**	**Lifetime Cost at 9% DR ($M)**	**Issue**
1	330kV supply from Dumaresq – Lismore T/L with transformation to 132kV near Tenterfield	17.1	Confirm fault levels & system operation
2	Second 132kV supply from Glen Innes	28.4	Easement acquisition
3	Supply from 110kV system at Stanthorpe with 132kV transformation	Comparable to Option 2	Easement acquisition and reduced service quality
4	Supply at 66kV from Emmaville with 22kV at Tenterfield	17.7	Easement acquisition, supply quality & reliability
5	Standby diesel gensets at Tenterfield substation	18.0	Not an N-1 supply

1.3 Conclusions

The three lowest cost options are very close in magnitude with only $0.9 million separating the lowest from the highest in lifetime costs. This is within the level of accuracy of the analysis and should be borne in mind in comparing the options. A small change in some technical and cost assumptions can change the order among the three. This adds significant robustness to the determination of the deferral benefits available from DirectLink.

The least cost option, Option 1, involves supplying a 6 MVA load from a 330kV supply. This may be considered unusual. It will certainly require a very low capacity 330/132kV transformer that will need to be specially designed and built. This option also requires additional technical study with regard to fault levels and system operation. The minimalist design has a significant bearing on the cost as does the assumption that the project costs will be low as it can be treated as an increment to the 330kV line rather than as a stand alone project in its own right.

Option 4 (a 66kV supply from Emmaville) provides the second least cost N-1 supply option but at a lower reliability than that Tenterfield currently receives from two 132kV supplies. This is due to the additional switchgear, transformation and compensation equipment required to achieve this option.

Option 2 (a second 132kV transmission line from Glen Innes) is the third lowest N-1 supply. It is the most comparable to Tenterfield's current N-1 supply from two 132kV transmission lines. It provides a similar quality of service and level of reliability to that which Tenterfield currently experiences.

Whilst Option 5 (standby diesel generation) is the third lowest cost option it does not provide a true N-1 supply, requiring a short interruption to supply while the standby generation is brought into service.

2 BACKGROUND

Tenterfield has two 132kV supplies, one from Glen Innes (96T) in the south and one from Lismore (96L) in the east, that form part of a 132kV ring main between Glen Innes and Lismore. This configuration gives Tenterfield an N-1 supply with no loss of supply should either transmission line fail. This level of supply security is unusual for a maximum load of 6 MVA.

TransGrid proposes to build a 330kV transmission line from Dumaresq in the west running past Tenterfield to Lismore in the east. This is to provide a second 330kV supply to Lismore to meet projected load growth. This new line would involve the removal of 96L in order to free its easement for the 330kV line. This would result in Tenterfield having only a single supply, the 132kV line from Glen Innes. Any failure of this line or any outage for maintenance would result in an interruption of supply to Tenterfield.

At its hearing on 12 April 2005 into DirectLink[2] the ACCC requested a report on the options for maintaining an N-1 supply to Tenterfield should 96L be removed to make way for the second 330kV supply to Lismore.

An aerial photo of the existing Tenterfield 132/22/11kV substation and surrounding property is shown below. The 132kV switchyard is to the left of centre, the 22kV in the centre and the 11kV to the right of centre. The two 132kV lines are on the extreme left of centre. The control building and depot are in the lower half. There would appear to be sufficient room to accommodate any of the five options discussed in this Report. Additional information is provided in the Appendices.

TENTERFIELD 132/22/11KV SUBSTATION.

[2] The DirectLink Joint Venture (DJV) has applied for DirectLink to become a regulated asset.

3 OPTION 1: SUPPLY FROM 330KV SYSTEM

Supply from the proposed 330kV transmission line from Dumaresq to Lismore could be achieved by the construction of a 330/132kV substation adjacent to 96L at the point where the 330kV line is to cut into the easement of 96L. This location would enable the existing section of 96L between this point and Tenterfield to be utilised to connect the two substations, thus significantly reducing the cost of this option.

As a result, the capital cost of this option is that of a 330kV substation with two 330kV line bays, one 132kV bay, one 330/132kV transformer bay, a control room and turn in of 96L. These costs do not include the cost of design and construction of the 330kV Dumaresq - Lismore line on the basis that this line is taken as a given and would be built regardless of the second supply option for Tenterfield. The costs, advantages and disadvantages of this option are discussed below.

3.1 Costs

The estimated present value of the lifetime cost over 40 years at a real discount rate of 9% is $17.2 million for Option 1. The breakdown of this cost is given in the following table.

ESTIMATED LIFETIME COSTS	
Activity	**$M (2005)**
Planning & development	0.9
Approvals	1.1
Easement & site acquisition	0.3
Project management	0.5
Equipment spares	0.2
Installed equipment	9.7
Contingency (10%)	1.3
Interest During Construction (9%)	1.5
Operations & Maintenance[3]	1.7
TOTAL	**17.1**

3.2 Program

The time from conception to commissioning of the 330/132kV substation for Tenterfield is estimated to take three years as detailed in the following table of program assumptions. The work would be carried out as part of the design and construction of the 330kV line from Dumaresq to Lismore. To minimise the time that Tenterfield was without an N-1 supply the 330kV line could be

[3] The O&M costs for the four transmission options in this Report are an estimate of the incremental cost. They are indicative only and applied to all for comparison purposes in this Report. They are already included in Alternative 5 referred to in the Executive Summary.

built in two stages. Stage 1 would involve construction of the line from Dumaresq to Tenterfield and construction of the 330/132kV substation adjacent to 96L. Once this stage was commissioned, the section of 96L to Lismore could be removed and the remainder of the 330kV line built to give Lismore its second 330kV supply.

PROGRAM ASSUMPTIONS	
Activity	**Timing**
Planning & development	Year 2
Planning approvals	Complete end year 2
Easement acquisition	Complete end year 2
Construction	Complete end year 3

It is assumed that the planning approvals are obtained as part of the process to acquire approval for the 330kV line. This and other assumptions relating to project costs have been made on the basis that the substation is treated as an increment to the process of obtaining approval and managing the project for the 330kV line. If the switchyard is treated as a stand alone project, its project costs would rise significantly.

3.3 Advantages

The main advantages of the 330/132kV supply option are:

- It involves no additional transmission lines assuming that the 330/132kV substation can be built adjacent to 96L.
- It provides a very solid N-1 supply to Tenterfield.
- It could help to justify the Dumaresq - Lismore 330kV transmission line to the local Tenterfield community through whose territory it must pass, on the basis that it will improve their quality of service.

3.4 Disadvantages

The main disadvantages of the 330/132kV supply option are:

- It may increase the fault levels at Tenterfield to unacceptable levels or give other system problems (this needs to be confirmed).
- It would result in a slight reduction in the reliability of the Dumaresq – Lismore 330kV transmission line because of the additional switchgear and protection that are required to supply Tenterfield.

3.5 Comments

At first instance the provision of a 330kV supply in order to provide an N-1 supply for a 6 MVA load may seem excessive. However, given the current N-1 arrangement and the difficulty in securing easements for new lines, especially at 330kV, this option could justifiably be promoted as in the

interests of Tenterfield. This is an example of a non-price issue that needs to be considered. This option also requires the design and construction of a special low capacity 330/132kV transformer in the range of 10 to 20 MVA, more than an order of magnitude smaller than typical 330/132kV transformers. Discussions with TransGrid are required if Option 1 is to be further investigated.

4 OPTION 2: SECOND 132KV SUPPLY FROM GLEN INNES

Option 2 involves the construction of new 132kV line from Glen Innes to Tenterfield on a different route to 96T. Augmentation of the 132/66kV Glen Innes substation is also required to provide a 132kV line bay. The costs, advantages and disadvantages of this option are discussed below.

4.1 Costs

The estimated present value of the lifetime cost over 40 years at a real discount rate of 9% is $28.5 million for Option 2. The breakdown of this cost is given in the following table.

ESTIMATED LIFETIME COSTS	
Activity	**$M (2005)**
Planning & development	1.6
Approvals	2.9
Easement & site acquisition	1.3
Project management	1.3
Equipment spares	0.3
Installed equipment	14.7
Contingency (10%)	2.2
Interest During Construction (9%)	2.7
Operations & Maintenance	1.7
TOTAL	**28.4**

4.2 Program

The time from conception to commissioning of the second 132 kV supply is estimated to take four years as detailed in the following table.

PROGRAM ASSUMPTIONS	
Activity	**Timing**
Planning & development	Years 1 & 2
Planning approvals	Complete end year 2
Easement acquisition	Complete end year 3
Construction	Complete end year 4

4.3 Advantages

The main advantage of a new 132kV line is that it provides a similar level of supply quality to that currently experienced by Country Energy's customers at Tenterfield. This is an important consideration given that they will lose a 132kV supply to make way for a 330kV supply near their

town that will provide no obvious benefit to them unless that supply is used to provide Tenterfield with an N-1 supply.

4.4 Disadvantages

While Option 2 is a higher cost option to a 66kV supply, it offers a higher level of service quality. In common with the 66kV supply option, it entails the acquisition of a line easement in much the same corridor between Glen Innes and Tenterfield.

4.5 Comment

This option is the simplest of the five in terms of design and cost assumptions. It results in the closest arrangement to that which already exists.

An alternative to a new 132kV transmission line between Glen Innes and Tenterfield is the replacement of 96T with a dual circuit line. However, this variation on a second 132kV supply from Glen Innes has not been pursued because of significantly higher costs and technical issues as follow:

- The line cost (the dominant cost in Option 2) would be almost twice that of a new single circuit line. Dual circuit lines are approximately 1.8 times the cost of single circuit lines and in this case there is the additional cost of removal of 96T. Admittedly there would be no additional easement costs but these are relatively low compared to the line cost.
- Tenterfield would be without an N-1 supply during the construction of the dual circuit line.
- A dual circuit line has slightly lower reliability than two independent lines as both lines in a dual circuit arrangement can be lost by the same cause (eg lightning strike, pole failure, tree fall etc).

Discussions with TransGrid are required if Option 2 is to be further investigated.

5 OPTION 3: SUPPLY FROM QUEENSLAND

Option 3 involves supply from Queensland achieved through the construction of a 132kV line from Stanthorpe to Tenterfield along a route of approximately 60 km that largely follows the New England highway to avoid the rugged terrain. Transformation from the system voltage of 110kV at Stanthorpe to 132kV would be carried out by augmentation of the Stanthorpe substation to include both a transformer bay and a 132kV line bay. The costs, advantages and disadvantages of this option are discussed below.

5.1 Costs

The lifetime costs are approximately the same as Option 2. This is because the cost advantage of the shorter distance of approximately 20 km for the Stanthorpe supply is largely offset by the cost of transformation from 110kV to 132kV at Stanthorpe and additional control equipment. The latter is needed to control resynchronisation of the Queensland and New South Wales systems upon restoration of the 132kV supply from Glen Innes should other links to Queensland not be in service.

The estimated present value of the lifetime cost over 40 years at a real discount rate of 9% is $28.5 million for Option 3. The breakdown of this cost is given in the following table.

ESTIMATED LIFETIME COSTS	
Activity	**$M 2005**
Planning & development	1.6
Approvals	2.9
Easement & site acquisition	1.3
Project management	1.3
Equipment spares	0.3
Installed equipment	14.7
Contingency (10%)	2.2
Interest During Construction (9%)	2.7
Operations & Maintenance	1.7
TOTAL	**28.4**

5.2 Program

The time from conception to commissioning of the 110/132 kV supply is estimated to take four years as detailed in the following table.

PROGRAM ASSUMPTIONS	
Activity	**Timing**
Planning & development	Years 1&2
Planning approvals	Complete end year 2
Easement acquisition	Complete end year 3
Construction	Complete end year 4

5.3 Advantages

The advantages of this option are similar to those of the second 132kV supply from Glen Innes (Option 2). An additional advantage could be a slight increase in reliability as the two 132kV supplies would come from different substations in different systems. This may be balanced by a slight reduction in reliability of the Stanthorpe supply due to the need for transformation from 110kV to 132kV.

5.4 Disadvantages

This option results in a slight reduction in quality of service to Tenterfield because the line would normally be left open to prevent complications from paralleling with the Queensland system. The line would automatically close on following loss of the 132kV supply to Tenterfield. This operating arrangement would result in an interruption to supply of a few seconds.

Restoration of the 132kV supply from NSW would also result in an interruption to supply for a few seconds as it would first require tripping of the 132kV supply from Queensland. This to avoid the possible need to synchronise the two state systems if the other links to Queensland are not in service.

5.5 Comment

Joint discussions with TransGrid and PowerLink are required if this option is to be further investigated.

6 OPTION 4: SUPPLY FROM COUNTRY ENERGY

Option 4 involves a 66kV supply from Country Energy's Emmaville substation to the south-west of Tenterfield. This supply requires:

- the construction of a 75km 66kV line from Emmaville to Tenterfield
- the augmentation of the 66/22/11kV Emmaville substation to provide a 66kV line bay (see Appendix 2)
- the augmentation of the 132/22/11kV Tenterfield substation to provide:
    - a 66/22kV transformer bay
    - a 66kV line bay
    - a 66kV capacitor bank for voltage control
    - extension of the 22kV bus to accommodate the transformer bay.

Given the nature of the terrain between Emmaville and Tenterfield, it is assumed that the 66kV line will follow the road from Emmaville to the New England Highway and then that highway to Tenterfield. The costs, advantages and disadvantages of this option are discussed below.

6.1 Costs

The estimated present value of the lifetime cost over 40 years at a real discount rate of 9% is $17.7 million for Option 4. The breakdown of this cost is given in the following table.

ESTIMATED LIFETIME COSTS	
Activity	**$M (2005)**
Planning & development	1.4
Approvals	2.0
Easement & site acquisition	1.1
Project management	1.1
Equipment spares	0.2
Installed equipment	7.5
Contingency (10%)	1.3
Interest During Construction (9%)	1.4
Operations & Maintenance	1.7
TOTAL	**17.7**

Its installed equipment cost is $7.5 million compared to an equipment cost of $9.7 million for Option 1 (330kV supply). However, its project costs are higher because it includes a transmission line and it cannot be treated as part of a significantly larger project as the 330/132kV switchyard can in Option 1.

6.2 Program

The time from conception to commissioning of the 66/22kV supply is estimated to take four years based on the following table.

PROGRAM ASSUMPTIONS	
Activity	**Timing**
Planning & development	Years 1&2
Planning approvals	Complete end year 2
Easement acquisition	Complete end year 3
Construction	Complete end year 4

6.3 Advantages

This is the second lowest cost option given the technical assumptions and cost estimates used.

6.4 Disadvantages

This option results in a reduction in reliability of supply compared to the existing arrangement and the options of a second 132kV supply from Glen Innes (Option 2) or supply from the planned Dumaresq – Lismore 330kV line (Option 1).

Reliability is lowered by the additional switchgear, transformation and compensation equipment required. Rather than two 132kV circuit breakers as required for Option 2, this option requires a total of six 66kV circuit breakers (two existing), two 22kV circuit breakers, a 66/22kV transformer and a 66kV, 5MVA capacitor bank. In addition to reliability issues, this additional equipment will require longer maintenance, thus increasing the time that Tenterfield is without an N-1 supply compared to maintaining the 132kV line switchgear.

6.5 Comments

Emmaville substation provides the closest source of 66kV supply to Tenterfield, just over half the distance to the next 66kV supply point at either Ashford to the west or Texas to the north-west in Queensland.

Technical considerations relating to voltage control under certain operating conditions are addressed by the inclusion of 66kV capacitor banks at Tenterfield. The 22kV and 11kV supplies at Emmaville substation were ruled out on technical grounds associated with capacity and voltage control. More detailed discussions with Country Energy will be required if Option 4 is to be further investigated. As discussed previously, the cost of this option is dependent on key design and project assumptions that if altered, could change the ranking of the options.

7 OPTION 5: LOCAL GENERATION BACKUP

Option 5 involves the provision of standby generation plant at Tenterfield to supply the 6 MVA load in the event of loss of the 132kV supply from Glen Innes. Initially five diesel generators, each of 1.5 MVA capacity installed at Tenterfield substation would meet the near-term maximum demand.

Though four such gensets would meet this load, a fifth genset is required for contingencies such as the failure of one to start. A sixth genset will be required after 12 years and a seventh after 34 years to meet projected load growth over the next 40 years assuming a 1% annual load growth on average. An allowance has been made for refurbishment of the gensets after 20 years, their nominal life under normal duty.

Each genset is self-contained in its own weather-proof acoustic enclosure. Output is at 415V with a common step-up transformer to 22kV for supply to the 22kV bus. A common 40,000 litre fuel tank provides sufficient storage for 24 hours continuous operation at full load.

As the diesel generation operates on a standby basis there would be a short interruption to supply following loss of 96T to bring the diesel gensets into operation and progressively take load. The interruption is estimated to be of the order of one minute if the gensets are kept on warm standby. Each genset is equipped with electric heating to enable such a rapid start which is automatically initiated on loss of the 132kV supply. Shut-down automatically follows on synchronisation with the grid upon restoration of the 132kV supply.

7.1 Costs

The estimated present value of the lifetime cost over 40 years at a real discount rate of 9% is $18.0 million for Option 5. These costs have been estimated on the basis of an independent owner/operator responding to a competitive tender to build, own and operate a standby power supply at Tenterfield and are summarised in the following table.

ESTIMATED LIFETIME COSTS	
Activity	**$M(2005)**
Planning & development	0.5
Approvals	0.5
Project management	0.5
Equipment spares	0.1
Installed equipment	11.2
Contingency (10%)	1.3
Interest During Construction (9%)	0.9
Operations & Maintenance	3.1
TOTAL	**18.0**

This option is particularly sensitive to assumptions on annual operating time. For example, an increase in operation from the assumed 2.5 days a year to 10 days a year would increase the total cost to $23.0 million, an increase of 28%.

7.2 Program

The time from conception to commissioning of the standby diesel generation is estimated to take two years as detailed in the following table.

PROGRAM ASSUMPTIONS	
Activity	**Timing**
Planning & development	Year 1
Planning approvals	Complete end year 1
Easement acquisition	Not applicable
Construction	Complete end year 2

7.3 Advantages

The engineering, procurement and construction program is approximately half that of the transmission options, thus reducing interest during construction and giving greater flexibility in timing. No easement acquisition is required as there is sufficient space to install the gensets in the existing Tenterfield substation.

7.4 Disadvantages

The greatest disadvantage of this option over the four transmission options is that the standby generation does not provide an N-1 supply. Customers would experience an interruption to supply of approximately one minute as opposed to no interruption on loss of a transmission line in the other options. Such an arrangement would normally be satisfactory for a radial load of 6 MVA. This is not the case with Tenterfield whose inhabitants currently experience an N-1 supply.

There is a minor risk that the gensets will fail to start. This is mitigated by a monthly testing program and the provision of a spare genset should one fail to start.

7.5 Comments

Gas turbines running on distillate have been discounted on technical grounds. Though they have comparable capital costs to diesel gensets, they have relatively long start-up times of the order of 10 minutes compared to one minute for rapid-start diesel gensets. There is also less flexibility in sizing at the Tenterfield load of 6 MVA. Diesel gensets are typically used as standby generation at this load in industrial and commercial operations and maintenance is relatively simple.

8 CONCLUSIONS

The three lowest cost options are very close in magnitude with only $0.8 million separating the lowest from the highest. This is within the level of accuracy of the analysis and should be borne in mind in comparing the options. A small change in some technical and cost assumptions will change the order among the three. This could be the subject of a further sensitivity analysis if it was deemed appropriate. However, the closeness in costs of the options adds significant robustness to the task of quantifying the deferral benefits of DirectLink, there being three options very close in lifetime cost. The choice of actual option would be made after significantly more planning and analysis closer to the time the supply was needed.

The least cost option, Option 1, involves supplying a 6 MVA load from a 330kV supply. This may be considered unusual. It will certainly require a very low capacity 330/132kV transformer that will need to be specially designed and built. This option also requires additional technical study with regard to fault levels and system operation. The minimalist design has a significant bearing on the cost as does the assumption that the project costs will be low as it can be treated as and increment to the 330kV line rather than as a stand alone project in its own right.

Option 4 (a 66kV supply from Emmaville) provides the next least cost N-1 supply option but at a lower reliability than that Tenterfield currently receives from two 132kV supplies. This is due to the additional switchgear, transformation and compensation equipment required to achieve this option.

Option 2 (a second 132kV transmission line from Glen Innes) is the third lowest N-1 supply. It is the most comparable to Tenterfield's current N-1 supply from two 132kV transmission lines. It provides a similar quality of service and level of reliability to that which Tenterfield currently experiences.

Option 3 (a 132kV supply from Stanthorpe) is a comparable cost to Option 2. However, it results in a lower quality of service as there would be a short break of a few seconds on loss of 96T until the Stanthorpe supply closed on. There would be a similar break before supply from 96T could be restored. This is to avoid potential paralleling and synchronisation problems between NSW and Queensland.

Option 5 (standby diesel generation) is a higher cost option than Option 4. It does not provide a true N-1 supply, requiring a short interruption to supply while the standby generation is brought into service. Such an arrangement would normally be satisfactory for a radial load of 6 MVA. This is not the case with Tenterfield whose inhabitants currently receive an N-1 supply.

Appendices

A.1 Country Energy: Tablelands SLD

A.2 Country Energy: Inverell - Glen Innes Area Sub-Transmission SLD

A.3 Country Energy: Tenterfield 22/11kV Zone Substation SLD

A4. Present Value at 7% and 11% Discount Rates

Appendix 1

Country Energy: Tablelands SLD

See following page.

Tablelands

countryenergy

TransGrid Substations	Country Energy Zone Substations		Transmission & Sub-trans. Lines
132/66 kV	22/11 kV	66/22 kV	132 kV
132/22 kV	66 kV Sw Stn	66/22/11 kV	66 kV
Private	66/11 kV	66/33/22 kV	33 kV
G P. Stn			

Last updated 07/05/04

Appendix 2

Country Energy: Inverell - Glen Innes Area Sub-Transmission SLD

See following page.

TRANSGRID GLEN INNES
132/66 kV SUBTRANSMISSION

TRANSGRID INVERELL
132/66 kV SUBTRANSMISSION

GLEN INNES
GNI

GUYRA
GYA

BORTHWICK ST
BTS

BINGARA
BGA

WARIALDA
WRA

BUNDARRA
BDA

EMMAVILLE
EME

WYNNE ST
INV

COPETON HYDRO

COPETON DAM
CPD

PINDARI DAM
PDI

PINDARI DAM HYDRO

ASHFORD
AFD

COOLATAI
CTI

YALLAROI
YLI

WALLANGRA

GOONDIWINDI
GDI

GLENARBON

TEXAS
TXS

DUAL CIRCUIT

DCB IS ALSO PROTECTED FROM BOTH TRANSFORMERS

1 OPERATION TO LOCKOUT OPERATED BY TRANSFORMER BUCHHOLZ.

CASTELL SYSTEM INTERLOCKING ISOLATOR 6501 AND CIRCUIT BREAKER 6502.

WARNING
COMPLETE BUS ISOLATION REQUIRES REMOVAL OF THE LINE VT SECONDARY FUSES.

DO NOT CLOSE ISOLATOR 6F10 UNLESS REGULATOR IS IN MANUAL AND IN NEUTRAL TAP.

FIXED CHEMICAL FUSES

19.1 SWER DUAL CIRCUIT FOR APPROX 5 KM FROM SUBSTATION

CUNNINGHAM HWY YELARBON WEST OF RAILWAY

EXTENSIVE 3 PHASE SWER OFF THIS LINE

NO 1 PROTECTION RELAY
NO 2 PROTECTION RELAY

SECTION 1
SECTION 2
SECTION 2
SECTION 3

NOTES

DRAWN	M Kennedy 15/05/98
DESIGN/CHECKED	M Pilgrim 15/05/98
APPROVED	M Pilgrim 22/05/98

INVERELL & GLEN INNES
AREA SUBTRANSMISSION

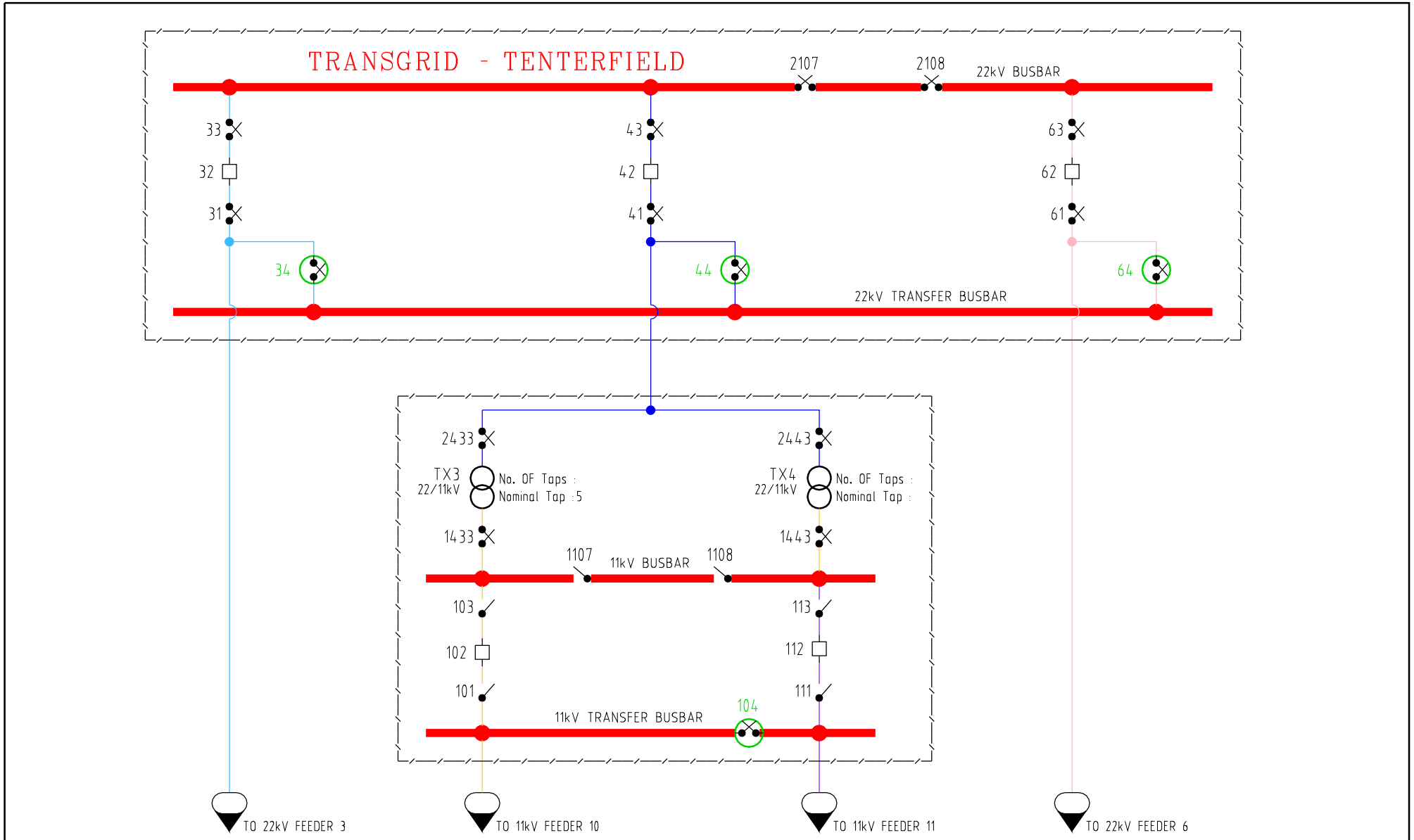
TRANSMISSION SYSTEM

SHT	DRAWING NUMBER	AMENDMENT
1/1	GLEN_INV	F 18/07/01

Appendix 3

Country Energy: Tenterfield 22/11kV Zone Substation SLD

See following page.



NOTES

DRAWN : M KENNEDY 31/05/99

DESIGN/CHECKED :

APPROVED : W PILGRIM 31/05/99

TENTERFIELD

ZONE SUBSTATION

NorthPower

ZONE SUBSTATION SYSTEM

SHT	DRAWING NUMBER	AMENDMENT
1/1	TENTERFIELD	A : 31/05/99

Appendix 4: Present Value Analysis at 7%, 9% and 11% Discount Rates

Summary Comparison of Supply Options						
DR	**ID**	**Description**	**PV Cap ($M)**	**PV IDC ($M)**	**PV O&M ($M)**	**PV Total ($M)**
9%	1	330kV supply from Dumaresq – Lismore T/L with transformation to 132kV near Tenterfield	14.0	1.5	1.7	**17.1**
	2	Second 132kV supply from Glen Innes	24.2	2.6	1.7	**28.4**
	3	Supply from 110kV system at Stanthorpe with 132kV transformation	24.2	2.6	1.7	**28.4**
	4	Supply at 66kV from Emmaville with 22kV at Tenterfield	14.6	1.4	1.7	**17.7**
	5	Standby diesel gensets at Tenterfield substation	14.0	0.9	3.1	**18.0**
7%	1	330kV supply from Dumaresq – Lismore T/L with transformation to 132kV near Tenterfield	14.0	1.2	2.0	**17.2**
	2	Second 132kV supply from Glen Innes	24.2	2.0	2.0	**28.2**
	3	Supply from 110kV system at Stanthorpe with 132kV transformation	24.2	2.0	2.0	**28.2**
	4	Supply at 66kV from Emmaville with 22kV at Tenterfield	14.6	1.1	2.0	**17.7**
	5	Standby diesel gensets at Tenterfield substation	14.4	0.7	3.9	**19.0**
11%	1	330kV supply from Dumaresq – Lismore T/L with transformation to 132kV near Tenterfield	14.0	1.8	1.4	**17.2**
	2	Second 132kV supply from Glen Innes	24.2	3.2	1.4	**28.8**
	3	Supply from 110kV system at Stanthorpe with 132kV transformation	24.2	3.2	1.4	**28.8**
	4	Supply at 66kV from Emmaville with 22kV at Tenterfield	14.6	1.7	1.4	**17.7**
	5	Standby diesel gensets at Tenterfield substation	13.8	1.1	2.5	**17.4**

The only change in cost order for 7% & 11% compared to 9% base is between options 4 & 5.