

OPTIONS EVALUATION REPORT (OER)

EE connection for Narrabri Gas

OER- 000000001693 revision 0.0



Ellipse project no(s): P0010122

TRIM file: [TRIM No]

Project reason: Reliability - To meet connection point reliability requirements

Project category: Prescribed - Augmentation

Approvals

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Date submitted for approval	12 December 2016	

Change history

Revision	Date	Amendment
0	28/10/2016	Initial issue
1	12/12/2016	Update to entire document

1. Need/opportunity

In a study commissioned by TransGrid¹, EY has identified a number of projects which may impact the TransGrid network development plan. The EY study identifies, as a further 354 MW in demand forecasts over the upcoming planning horizon. One of these projects is a possible gas project, connected within Essential Energy's 66 kV network near Narrabri, supplied from TransGrid's Narrabri 132/66 kV Substation. The load is estimated to be approximately 40 MW.

TransGrid have analysed the impact of the additional loads and identified that, using the 2020 low, medium and high growth forecasts, following the delivery of the Narrabri Gas Project, voltages at the TransGrid Narrabri Substation would be operating outside of planning criteria for an outage of one of the 132 kV transmission lines supplying Narrabri and Gunnedah from Tamworth (968 or 969 lines) from Winter 2020 coincident with the establishment of the Narrabri Gas Project. TransGrid also identified that loading would exceed the ratings on line 969 for a contingency of 132 kV line 968 during peak demand.

TransGrid's analysis hence determines that voltage stability issues at Narrabri substation necessitates a solution if the uncommitted projects were to occur within the current planning horizon.

TransGrid has estimated a 53.5% weighted likelihood of the Need eventuating within the 2018-23 regulatory period. In a study commissioned by TransGrid², Ernst & Young (EY) has identified a number of projects which may impact the TransGrid network development plan. The EY study identifies, as a minimum, a total of 354 MW not considered by TransGrid in demand forecasts over the upcoming planning horizon. One of these projects is a possible gas project, connected within Essential Energy's 66 kV network near Narrabri, supplied from TransGrid's Narrabri 132/66 kV Substation. The load is estimated to be approximately 40 MW.

TransGrid has analysed the impact of the additional Narrabri spot load in conjunction with the high, medium and low growth forecasts as described in the North West Area Plan³. From this analysis, TransGrid has identified that, using the 2020 low, medium and high growth forecasts with the delivery of the Narrabri Gas Project, there would be the following network constraints:

- > Voltages at the TransGrid Narrabri Substation would be operating outside of planning criteria for an outage of one of the 132 kV transmission lines supplying Narrabri and Gunnedah from Tamworth (968 or 969 lines).
- > The loading of line 969 will exceed its contingency rating for an outage of line 968 during peak demand. This is despite the load shedding schemes employed at the Boggabri Coal and Maules Creek mines as a demand management solution. (details refer to [NOS-1693](#))

The above two network constraints provide an opportunity to strengthen the Narrabri area to manage emerging voltage and thermal limitation due to the possible Narrabri Gas Project in 2020.

TransGrid has estimated a 53.5% weighted likelihood of the Need eventuating within the 2018-23 regulatory period.

2. Related needs/opportunities

- > Need 1489 – Thermal Limitation on 969 Line

¹ EY 2016, Expansion of demand scenarios, Ernst and Young, 10 October 2016.

² EY 2016, Expansion of demand scenarios, Ernst and Young, 10 October 2016.

³ AP N1 – North West December 2016

This project is for upgrading of the 969 Gunnedah to Tamworth 132 kV transmission line in order to remove a thermal limitation at times of high load in the Narrabri and Gunnedah areas.

- > Establishment of Shenhua Liverpool Plains mine

Potential 40 MW load connected in the region of Narrabri – approval granted, however license not yet acquired and commencement date unknown.

3. Options

Base case

The Do Nothing option is to maintain the present Narrabri area network “as is”.

The primary risk of not addressing this Need is voltage instability resulting in a loss of load, that is unserved energy (USE), in the Narrabri and Gunnedah area following a single critical contingency of TransGrid line 969 between Tamworth and Gunnedah or 968 between Tamworth and Narrabri.

The load at risk which is being assessed here is the forecast peak load of 84 MW in 2023 (comprising the Narrabri Gas Plant of 40 MW and the Narrabri area load⁴ 44MW), multiplied by a load factor of 0.8. As this is a new development and there is no load data available yet, the 0.8 factor is used as a reasonable estimate of the likely average demand over summer 2022/23. This equates to $84 * 0.8 = 67$ MW.

The risk cost of not addressing this Need is therefore composed of the following components:

- > exposing area load of 84 MW (peak) to risk of being lost upon an outage event on line 968
- > exposing area load of 84 MW (peak) to risk of being lost upon an outage event on line 969
- > damage to TransGrid’s reputation (negative media coverage).
- > litigation by customers/consumer groups.

The risk components are a reliability risk (\$15.03 million), financial risk (\$0.20 million) and a reputational risk (\$0.01 million).

The expected total risk cost will be \$15.24 million per annum.

Option A — Install reactive support at Narrabri 132/66 kV Substation [OSA 1693, OFS 1693A] and uprate the 132 kV line 969

This option involves the installation of two new 15 MVar 132 kV Capacitor Banks at Narrabri 132/66 kV Substation, where the 2 x 132 kV 15 MVar capacitors will need to be switched in automatically in the event of a trip of line 969 and line 968. Under different system conditions, the required combination of capacitor banks switched in can differ which would require further detailed analysis should a load increase proceed.

The following scope of works would be required under this option:

- > Installation of 2 x 132 kV 15 MVar capacitor banks.*
- > Installation of associated POW Circuit Breaker switchbays.
- > Installation of control, protection and cabling associated with the capacitors and switchbays to control the operation of the capacitor banks.

The scope to uprate line 969 is not included within this Need, refer to Need ID 1489.

The associated 132 kV switchbays are to be short circuit rated for 31.5 kA. No change to any existing 132 kV feeder bay at Narrabri Substation is expected to be required.

⁴ TransGrid Transmission Annual Planning Report 2016 Table A1.6 – Essential Energy (North) bulk supply point winter maximum demand

The [OFS-1693A](#) estimates the cost of this option to be \$4.8 million \pm 25% in 2016-17 AUD.

Option B – Construction of a Second 132 kV Circuit between Tamworth and Gunnedah

This option includes duplication of existing 132 kV 969 between Tamworth and Gunnedah. As a major network augmentation, this option involves much greater environmental and community impact, and significantly higher property and line easement acquisition risks compared to Option A.

Hence this option is not further considered.

Option C — Non-network solutions

- New communications and protection scheme for a load tripping scheme

A possible non-network option is to install a protection grade (< 20msec operation) load tripping scheme (LSS). The scheme would trigger on outage of either 968 or 969 lines. As the maximum mining load supplyable under critical contingency is 25 MW, the LSS would need to shed around 15 MW of the mining load. However, this option would require communications infrastructure augmentation in Essential Energy's network out of Narrabri. The cost of this work would be non-prescribed and would be paid in full by the mine owner as part of its connection costs paid to Essential Energy. Should the mine agree to install this infrastructure, TransGrid would investigate the installation of the appropriate LSS.

Therefore, this option is not being assessed further.

- Contract the mine to install local generation to offset peak demand

This non-network option is to pay the mine to install local generation, such as gas-fired reciprocating engines, to offset peak demand. This may include replacement of electric motor(s) with gas driven motors. The feasibility of this option depends on environmental approvals. It would be necessary to contract at least 15 MW gas-fired engines in order to enable the mine to operate at its full 40 MW capacity under all network conditions. The cost of this option would be determined in a Request for Proposals (RfP) and through the RIT-T process.

Therefore, this option is not being assessed further.

4. Evaluation

4.1 Technical evaluation

Option A – Option C are technically feasible. However Option B has a much larger environmental and community impact, and significant higher property and line easement acquisition risks compared to Option A, hence is not considered further. Option C new communication and protection system for a load tripping scheme involves communications infrastructure augmentation within Essential Energy's network; while Option C contract the mine to install local generation to offset peak demand involves the installation of at least 15MW gas-fired engines. Option C would be non-prescribed work and would be paid in full by the mine owner, therefore it is not considered further.

Therefore only Option A is compared in Table 1 to the base case option.

4.2 Commercial evaluation

The commercial evaluations of the technically feasible options are set out in Table 1. The full financial and economic evaluations are shown in Appendix A.

Table 1 — Commercial evaluation (\$ million)

Option	Description	Total capex (\$ m)	Annual opex (\$ m)	Annual post project risk cost (\$ m)	Economic NPV @ 10%	Financial NPV @10%	Rank
Base case	'Do nothing' – no investment	0	0	15.24	0	0	-
A	Install reactive support at Narrabri 132/66 kV Substation and uprate the 969 line	4.8	0.096	0	101.05	(3.26)	1

The commercial evaluation is based on:

- > a 10% discount rate with sensitivities based on TransGrid's current AER-determined pre-tax real regulatory WACC of 6.75% for the lower bound and 13% for the upper bound provided in Appendix A.
- > The applied sensitivities on the discount rate given the following NPVs for the Options.

Table 2 — Discount rate sensitivities (\$ million)

Option	Description	Economic NPV @ 13% (\$ m)	Economic NPV @ 6.75% (\$ m)
A	Install reactive support at Narrabri 132/66 kV Substation and uprate the 969 line	73.91	148.58

4.3 ALARP evaluation

An ALARP assessment is triggered by the following hazard and the disproportionate factor:

- > Unplanned outage of HV equipment → 3 times the safety risk reduction and taking 10% of the reliability risk reduction as being applicable to safety.

However, as this will only produce 30% of the benefit derived in the economic evaluation, a full ALARP evaluation will not produce an alternative preferred solution.

4.4 Preferred option

The preferred Option A is to install reactive support at Narrabri 132/66 kV Substation and uprate the 969 line as it ranks 1 under both commercial and sensitivity analysis.

Capital and operating expenditure

The yearly incremental operating expenditure of Option A is estimated to be 2% of the upfront capital cost of the option, which equates to \$0.096 million, escalated at a rate of 2.9% per annum.⁵

Regulatory Investment Test – Transmission

Option A will not be subject to the RIT-T process as it has an estimated cost less than the mandated \$6 million threshold.

⁵ TransGrid Success Database as at May 2016.

5. Recommendation

Based on the option evaluations, Option A - to install reactive support at Narrabri 132/66 kV Substation and uprate the 969 line, is the preferred option with the highest benefit, to address the need as it:

- > Enables TransGrid to meet its supply obligations under the National Electricity Rules.
- > Significantly reduces TransGrid's risk exposure and reduces the annual risk cost from \$15.24m to \$0.

Appendix A – Commercial evaluation report

Project_Option Name

1693 - EE Connection of Narrabri Gas Project - Option A

1. Financial Evaluation (excludes VCR benefits)

NPV @ standard discount rate	10.00%	-\$3.26m	NPV / Capital (Ratio)	-0.68
NPV @ upper bound rate	13.00%	-\$3.26m	Pay Back Period (Yrs)	Not measurable
NPV @ lower bound rate (WACC)	6.75%	-\$3.09m	IRR%	-0.84%

2. Economic Evaluation (includes VCR benefits but excludes tax benefits from non-cash transactions, ENS penalty and overall tax cost)

NPV @ standard discount rate	10.00%	\$101.05m	NPV / Capital (Ratio)	21.05
NPV @ upper bound rate	13.00%	\$73.91m	Pay Back Period (Yrs)	Not measurable
NPV @ lower bound rate (WACC)	6.75%	\$148.58m	IRR%	127.00%

Benefits

Risk cost	As Is	To Be	Benefit	VCR Benefit	\$15.03m
Systems (reliability)	\$15.03m	\$0.00m	\$15.03m	ENS Penalty	\$0.00m
Financial	\$0.20m	\$0.00m	\$0.20m	All other risk benefits	\$0.21m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$15.24m
People (safety)	\$0.00m	\$0.00m	\$0.00m	Benefits in the financial NPV*	\$0.21m
Environment	\$0.00m	\$0.00m	\$0.00m	*excludes VCR benefits	
Reputation	\$0.01m	\$0.00m	\$0.01m	Benefits in the economic NPV**	\$15.24m
Total Risk benefits	\$15.24m	\$0.00m	\$15.24m	**excludes ENS penalty	
Cost savings and other benefits			\$0.00m		
Total Benefits			\$15.24m		

Other Financial Drivers

Incremental opex cost pa (no depreciation)	-\$0.10m	Write-off cost	\$0.00m
Capital - initial \$m	-\$4.80m	Major Asset Life (Yrs)	50.00 Yrs
Residual Value - initial investment	\$2.21m	Re-investment capital	\$0.00m
Capitalisation period	3.00 Yrs	Start of the re-investment period	0.00 Yrs