

NEED/OPPORTUNITY STATEMENT (NOS)



Thermal Limitation on 969 Line

NOS- 000000001489 revision 5.0

Ellipse project description:

TRIM file: [TRIM No]

Project reason: Reliability - To meet overall network reliability requirements

Project category: Prescribed - Augmentation

Approvals

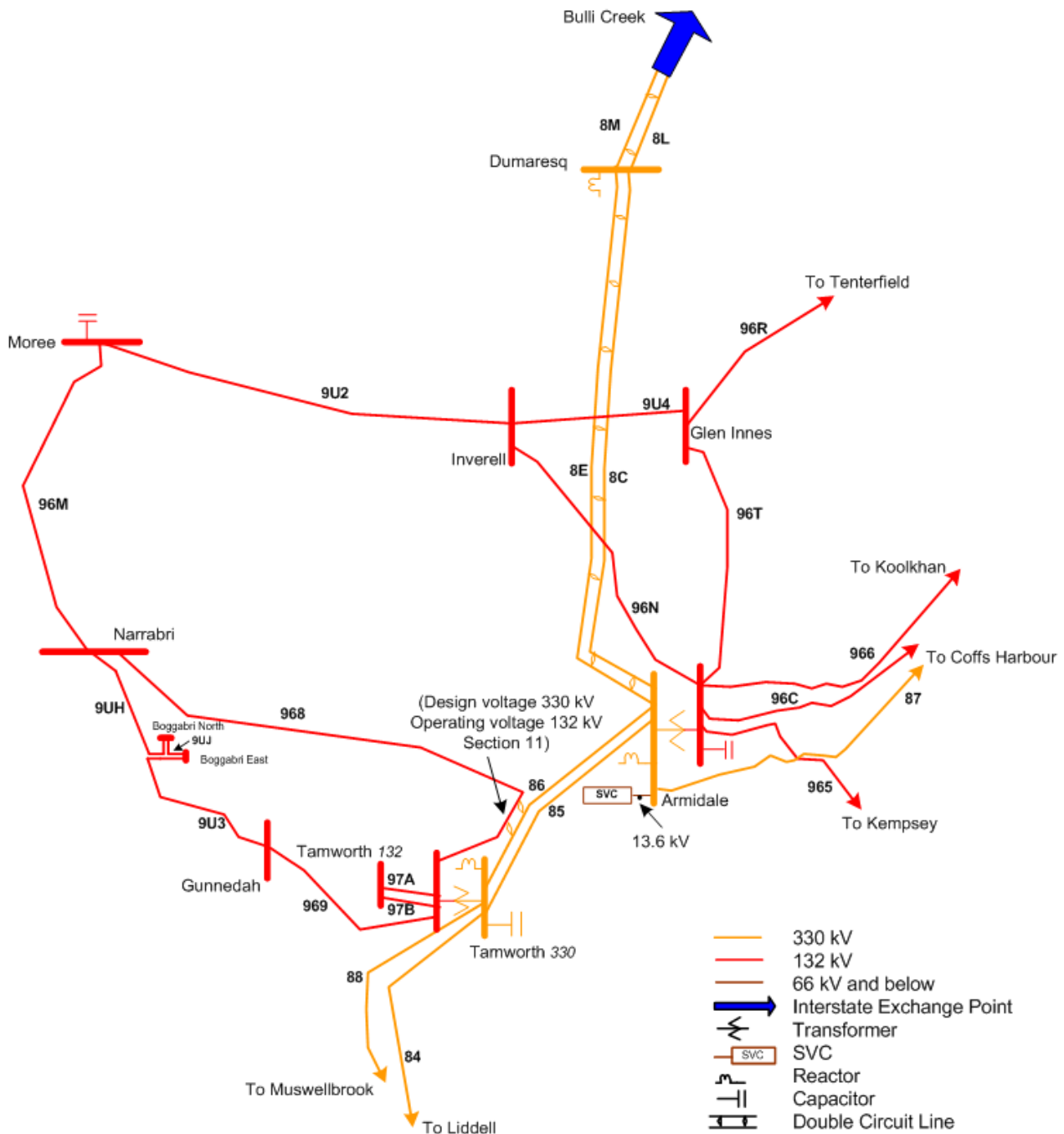
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Date submitted for approval	9 January 2017	

1. Background

The Gunnedah/Narrabri area in north west NSW is primarily supplied by the 969 Tamworth to Gunnedah and 968 Tamworth to Narrabri 132 kV transmission lines, supplied from Tamworth 330/132 kV Substation. This part of the network is parallel to the 330 kV main system, connected to QLD, hence power flows on 969 and 968 lines are affected by power flows on the NSW/QLD interconnectors QNI and Directlink. At times of heavy import/export conditions, the power flows on 968 and 969 lines can change significantly.

Figure 1 depicts the existing network in the north-west area network of NSW.

Figure 1: Existing North West NSW Network



The Boggabri Coal and Maules Creek mines are connected to the TransGrid network via the Boggabri East and Boggabri North switching stations. The agreed maximum capacity of these two mines is 5 MVA and 15 MVA respectively. Prior to the connection of these two mines, 969 line was approaching its thermal limit at times of high load on outage of 968 line. Connection of these mines has resulted in the thermal ratings of 969 line being exceeded under an N-1 situation. The mines are connected on an opportunity basis (that is, they would be disconnected if necessary) prior to the 969 line thermal limitation being relieved. This is currently managed¹ by line overload load shedding schemes installed at the two mines. However, TransGrid indicated to the mines prior to their connections that the North West transmission network would be reinforced post their connections and they would be released from the load shedding requirement once the thermal limitation of 969 line is addressed.

Moree Solar Farm (MSF) is connected to TransGrid's Moree 132/66 kV Substation via Essential Energy's 66 kV network. It has a maximum generation capacity of 56 MW and was completed in February 2016.

White Rock Wind Farm (WRWF) is committed and will connect into 9U4 Glen Innes to Inverell 132 kV line. It has a maximum generation capacity of 170 MW.

Where available, generation from these two local generators will reduce the thermal overload of 969 line.

2. Need/opportunity

In a study commissioned by TransGrid², Ernst & Young (EY) has identified a number of projects which, should they eventuate, would result in additional spot loads imposed on the TransGrid network and 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. This localised spot load growth may result in additional network limitations, within the planning horizon, which would need to be managed by TransGrid.

One of these projects is a possible 40 MW Shenhua coal mine, connected within Essential Energy's network near Gunnedah, supplied from TransGrid's Gunnedah 132/66 kV substation.

The EY study provides probabilities of completion of individual projects for the high, medium and low load demand growth scenarios³ as well as estimated project completion dates:

Table 1: Additional potential future spot loads

Project	Location	Additional Load	Estimated Date
Narrabri Gas Project	Narrabri	+40 MW	2020 ⁴
Shenhua Mine	Gunnedah	+40 MW	2023

TransGrid is concurrently considering the impact of the Narrabri Gas Project in the Narrabri/Gunnedah region in separate Need-1693.

TransGrid has analysed the impact of the additional Shenhua Coal Mine in conjunction with the high, medium and low growth forecasts as described in the North West Area Plan. It would be reasonable to include this spot load in the high and medium growth scenarios, as the probability is greater than 50% for each of these growth scenarios. From this analysis, TransGrid has identified that using the 2020 low, medium and high growth forecasts, with the delivery of the Shenhua Coal Mine, there would be the following network constraints:

¹ Up to 1 MW of load in addition to the Boggabri Coal and Maules Creek mine loads could be at risk. However, it is considered to be within the error margin of the 50% PoE BSP forecasts for the area and the forecasts for the mines.

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

³ The high, medium and low load growth scenarios are defined in Area Plan *AP N1 – North West* (December 2016).

⁴ Note the EY has estimated a date of 2018, however TransGrid has allowed for an additional 2 years based on discussions with Essential Energy via the Joint Planning process.

Existing constraints managed by load shedding schemes

The Boggabri Coal and Maules Creek mines are connected to TransGrid's network and commenced operation in 2015. Analysis using Essential Energy's 2015 50% Probability of Exceedance (PoE) Bulk Supply Point (BSP) forecast, and the Boggabri Coal and Maules Creek mines forecasts results in 969 line being overloaded on outage of 968 line at times of high load from Summer 2019/20 and Winter 2020 onwards.

TransGrid is obliged as a transmission network services provider to comply with the relevant clauses of the National Electricity Rules. Relevant to this Need is that is that TransGrid must operate the network in a *satisfactory operating state* as defined in the NER clause 4.2.2, specifically:

The power system is defined as being in a satisfactory operating state when:

(b) the voltage magnitudes at all energised busbars at any switchyard or substation of the power system are within the relevant limits set by the relevant Network Service Providers in accordance with clause S5.1.4 of schedule 5.1;

(c) the current flows on all transmission lines of the power system are within the ratings (accounting for time dependency in the case of emergency ratings) as defined by the relevant Network Service Providers in accordance with schedule 5.1;

In order to comply with their obligations, the thermal constraints are presently managed by a load shedding scheme at Boggabri East (Boggabri Coal) and Boggabri North (Maules Creek) substation as a demand management solution. The amount of northerly power flow on QNI and Directlink (i.e. towards QLD) could also further exacerbate the 969 line overload.

Level of Network Support Required (MW) – Summer								
2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25
0	0	0	8	8	8	8	8	8

Level of Network Support Required (MW) – Winter								
2017	2018	2019	2020	2021	2022	2023	2024	2025
0	0	0	2	2	2	2	2	2

Emerging thermal constraint following establishment of Shenhua Coal mine

Following the connection of the Shenhua Coal mine, 969 line is forecast to be overloaded under system normal operation, and voltage stability issues are expected following a contingency on 968 line for the high, medium and low growth scenarios. It is estimated the Shenhua mine can be reliably supplied up to 20-25 MW before the 969 line is overloaded under system normal conditions at times of high area load.

Therefore TransGrid has determined that establishment of a large spot load of the proposed magnitude at Gunnedah Substation would cause operation of the network outside of the *satisfactory operating state*.

Under these circumstances, TransGrid would not be able to connect the mine(s) to the HV network without augmentation to the network.

TransGrid's analysis hence determines that voltage issues in the Gunnedah and Narrabri region and rating issues on 969 line necessitates a solution if the projects were to occur within the current planning horizon.

The above network constraints provide an opportunity to strength the Gunnedah area to manage emerging voltage and thermal limitation due to Shenhua Coal Mine project in 2023.

2.1 Date to Address the Need

The Need date is coincident with the establishment of the additional spot load, presently estimated as 2023 for the high and medium load growth scenarios.

2.2 Risks

The primary risk of not addressing this Need is voltage instability and thermal limitation 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.

Unserved Energy Risk Cost

Unserved energy is calculated as:

$$\text{Unserved Energy} = 430 \text{ MWh}^5$$

The risk cost of unserved energy has been calculated as follows:

$$\text{Risk Cost of Unserved Energy} = \text{Unserved Energy} * \text{VCR}$$

$$\text{Risk Cost of Unserved Energy} = 430 \text{ MWh} * \$33,460/\text{MWh}^6$$

$$\therefore \text{Risk Cost of Unserved Energy} = \$14.39 \text{ million per annum}$$

Reliability Risk Cost

There is an additional reliability risk cost of \$0.06 million.

Other Risk Cost

There are financial and reputational risk costs of \$0.06 million per annum.⁷

Total Risk Cost

Total risk cost = Unserved energy risk cost + other risk costs

$$\therefore \text{Total risk cost} = \$14.46 \text{ million per annum.}$$

Probability of Need emerging in 2018-23

EY has assigned a probability to the identified projects for inclusion in a Low, Medium or High demand growth scenario and also for the likelihood of the project proceeding. These are shown in Table 2. Within the table, the demand scenario corresponds with those used in the North West Area Plan. The demand probability corresponds to the relative likelihood of each demand scenario occurring and the project probability in demand scenario corresponds to EY's estimate of the likelihood of the uncommitted projects occurring coincident with the demand scenario. The demand probability and project probability in demand scenario are multiplied together to determine a project probability for each demand scenario.

Table 2: Calculation of probability weighted likelihood of additional block loads

Demand scenario likelihood	Demand Probability	Project probability in demand scenario	Project probability
High	10.0%	70.0%	7.0%
Medium	60.0%	60.0%	36.0%
Low	30.0%	35.0%	10.5%
Overall weighted likelihood (sum):			53.5%

⁵ Calculated using scaled 2015 hourly data.

⁶ TransGrid's Investment Risk Tool bases the Value of Customer Reliability (VCR) on figures published by AEMO in its Value of Customer Reliability Review - Final Report, September 2014. In this case we use the mixed residential/industrial figure of \$38,350/MWh.

⁷ These risk costs are due to this type of low probability event occurring and derived from the risk tool

The impact on the Need is that there is an estimated overall 53.5% weighted likelihood of the Need occurring within the 2018-23 regulatory period. TransGrid will use the calculated overall project probability, together with the consequence to assess the overall risk of the Need and the requirement for risk mitigation measures.

3. Related needs/opportunities

- > Need 1693 voltage stability limitation at Narrabri

This need is a projected voltage stability limitation in the Narrabri and Gunnedah area due to a potential 40 MW load from the proposed Narrabri gas project.

4. Recommendation

It is recommended that options be considered to address the identified Need.

Attachment 1 Risk cost summary

Current Option Assessment - Risk Summary

Project Name: Thermal Limitation on 969 Line

Option Name: 1489 - Base Case

Option Assessment Name: 1489 - Base Case - Assessment 1

Rev Reset Period: Next (2018-23)



Major Component	No.	Minor Component	Sel. Hazardous Event	LoC x CoF (\$M)	Failure Mechanism	NoxLoC xCoF (\$M)	PoF (Yr 1)	Total Risk (\$M)	Risk (\$M) (Rel)	Risk (\$M) (Op)	Risk (\$M) (Fin)	Risk (\$M) (Peo)	Risk (\$M) (Env)	Risk (\$M) (Rep)
968 Conductor trip	1	Conductor (inc Joints)	Unplanned Outage - HV (968 Conductor trip)	\$14.46	Break	\$14.46	100.00%	\$14.46	\$14.40		\$0.01			\$0.05
				\$14.46		\$14.46		\$14.46	\$14.40		\$0.01			\$0.05

Total VCR Risk: \$14.39

Total ENS Risk: