

# NEED/OPPORTUNITY STATEMENT (NOS)



Beryl Area Constraint

NOS- 000000001316 revision 1.0

**Ellipse project no(s): P0007638**

**TRIM file: [TRIM No]**

**Project reason:** Reliability - To meet overall network reliability requirements

**Project category:** Prescribed - Augmentation

## Approvals

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Endorsed	Vincent Ong	Network and Connection Analysis Manager
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Date submitted for approval	12 December 2016	

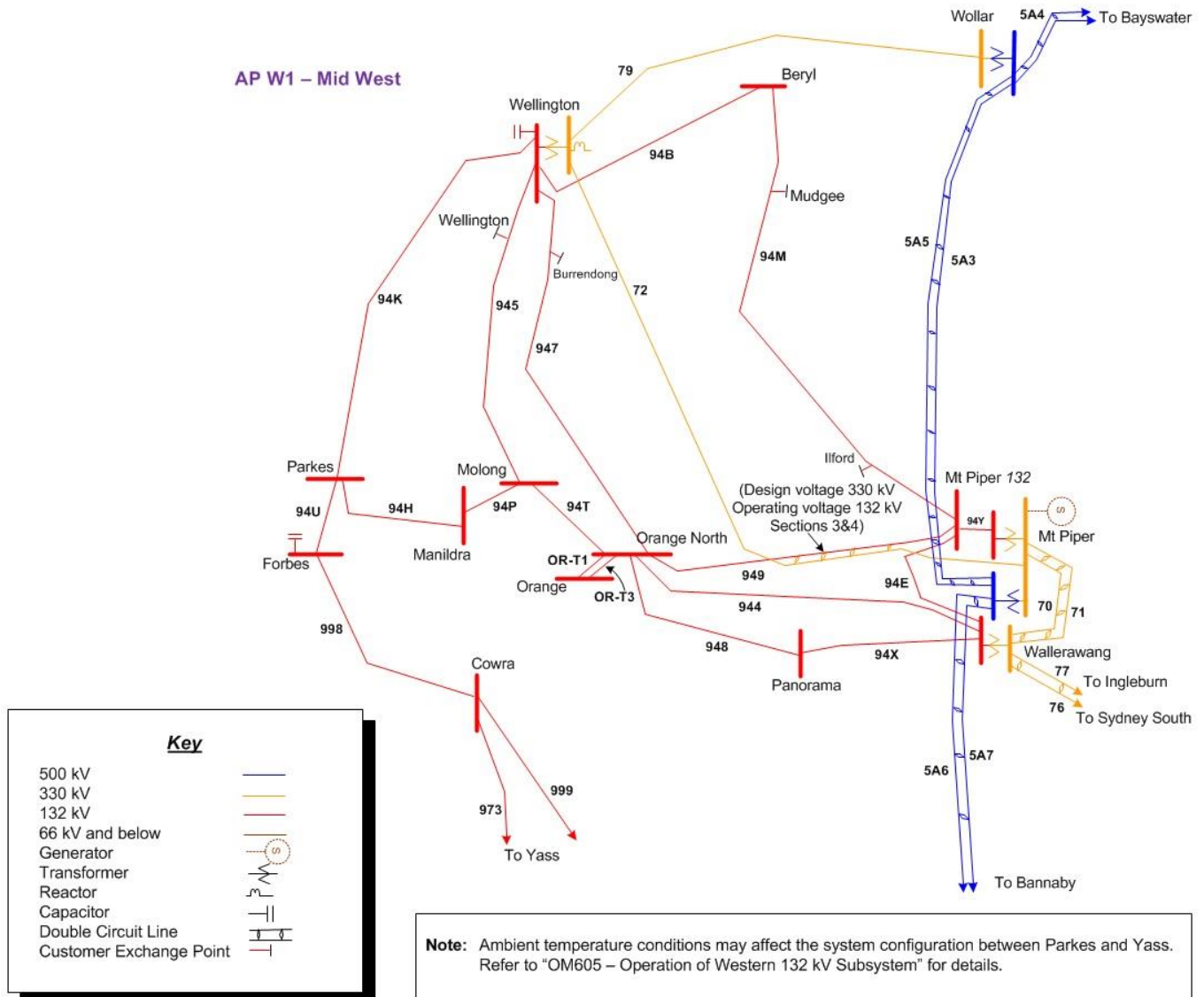
## Change history

Revision	Date	Amendment
0	3/11/2016	Initial issue
1		Clarified risk cost breakdown

## 1. Background

TransGrid's Beryl 132/66 kV Substation is supplied via 132 kV Line 94B from Wellington and Line 94M from Mt Piper via Ilford and Mudgee. Beryl Substation has two 60 MVA 132/66 kV transformers connected to a 66 kV busbar supplying Essential Energy's loads. Beryl Substation has two existing 66 kV capacitor banks, 8 MVAR and 10 MVAR, with a further 18 MVAR 66 kV capacitor bank being installed under Need DCN190.

**Figure 1: Mid-West Area Network**



## 2. Need/opportunity

In a study commissioned by TransGrid<sup>1</sup>, Ernst & Young (EY) has identified a number of potential projects which, should they eventuate, would result in additional spot loads imposed on the TransGrid network and may require additional TransGrid network works. The EY study identified, as a minimum, a total of 354 MW of spot loads that are not committed, hence are not included TransGrid's demand forecasts over the upcoming planning horizon. This additional load growth may result in additional network limitations, within the planning horizon, and which would need to be managed by TransGrid.

Several identified projects would result in additional load growth coincident with increases in production for existing mines connected to the Essential Energy 66 kV network in the Beryl area. Other identified projects are related to new connections, expected in Essential Energy and/or Endeavour Energy's networks between Mudgee and Mt Piper. The EY study provides probabilities of completion of individual projects for the high, medium and low load demand growth scenarios as well as estimated project completion dates. The relevant projects for the Beryl area are shown below in Table 1:

**Table 1: Additional potential future spot loads**

Project	Location	Additional Load	Estimated Date
Bowdens Silver Project	25km away from Mudgee	+20 MVA	Mid 2017
Cockatoo Mine	Near Ilford	+13 MVA +3-4 MVA	Winter 2017 2021

TransGrid has analysed the impact of these additional spot loads in conjunction with the high, medium and low growth forecasts as described in the latest Mid West Area Plan<sup>2</sup>. It would be reasonable to include these spot loads in the high and medium growth scenarios, as the probability of their emergence is greater than 50% for each of these growth scenarios, refer Table 2.

From this analysis, TransGrid has identified the following network constraints:

- > Under the existing Beryl demand forecast, the reactive margin following an outage of the 132 kV 94B Wellington to Beryl line would be 11 MVAR. The reactive margin will be approximately 7 MVAR if the additional loads identified in Table 1 are included. This resulting reactive margin does not comply with TransGrid's planning criteria for reactive support and voltage stability:

*"It is necessary to maintain voltage stability, with voltages within acceptable levels, following the loss of a single element in the power system at times of peak system loading. The single element includes a generator, a single transmission circuit, a cable and single items of reactive support plant.*

*To cover fluctuations in system operating conditions, uncertainties of load levels, measurement errors and errors in the setting of control operating points, it is necessary to maintain a margin from operating points that may result in a loss of voltage control. A reactive power margin is maintained over the point of voltage instability or alternatively a margin is maintained with respect to the power transfer compared to the maximum feasible power transfer."*

*TransGrid follows the NER clause S5.1.83 which recommends a minimum reactive margin of 1% of fault level at the location (in the case of Beryl, this is 7 MVAR which is the threshold value). In*

<sup>1</sup> EY 2016, *Expansion of demand scenarios*, Ernst and Young, 10 October 2016.

<sup>2</sup> *AP W1 – Mid West* (December 2016).

<sup>3</sup> National Electricity Rule Version 86, Clause S5.1.8, <http://www.aemc.gov.au/getattachment/4405bfe4-343b-4c2b-b05d-dc78a14779a8/National-Electricity-Rules-Version-86.aspx>

*addition, there is a preference for the reactive margin to be at least equal to the size of the largest capacitor at the site, which in this case is 18 MVAR on completion of project DCN190.*

Regardless of overall NSW demand (medium or high growth), this issue arises based on increased demand levels in the Beryl and Mudgee/Ilford area. In other words, once the load in the Beryl area exceeds 75 MW +25 MVAR, an outage of 94B causes voltage stability to become an issue.

- > Operationally, following a double outage of the 66 kV 18 MVAR capacitor bank and 94B line during peak load, the reactive margin at Beryl is below the minimum required reactive margin level. This will result in potential voltage collapse in the area and is considered a High Impact Low Probability (HILP) event.

During peak load in Summer 2021/22 with the additional area spot loads, it is expected that approximately 45 MW of load would be at risk immediately following an outage of 94B. It is likely that voltage stability issues would also occur within the Essential Energy network.

The above two network constraints provide an opportunity to strengthen the Beryl area to manage emerging voltage limitations due to the possible growth of sport loads in the area.

## 2.1 Date to Address the Need

The timing is dependent on the demand in the area with an estimated Need date of Summer 2021/22 for high and medium load growth scenarios as detailed in the Mid West Area Plan<sup>4</sup>.

## 2.2 Risks

The primary risk of not addressing this Need is voltage instability resulting in a loss of load that is unserved energy (USE), in the Beryl area following a single critical contingency of TransGrid line 94B between Wellington and Beryl.

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

- > exposing customer load of 45 MW (peak) to risk of being lost upon for an hour immediately after an outage event on line 94B
- > exposing customer load of 14 MW (peak) to risk of being lost for the outage duration until line 94B is restored
- > damage to TransGrid's reputation (negative media coverage).
- > litigation by customers/consumer groups.

A risk-cost summary extract from the Investment Risk Tool appears in Attachment 1.

The expected total risk cost will be \$3.65 million per annum.

### Probability of Need emerging in 2018-23

EY have 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 Mid 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.

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<sup>4</sup> AP W1 – Mid West December 2016

**Table 2: Calculation of probability weighted likelihood of additional spot loads<sup>5</sup>**

Demand scenario likelihood	Demand Probability	Project probability in demand scenario	Project probability
High	10.0%	60.0%	6.0%
Medium	60.0%	60.0%	36.0%
Low	30.0%	30.0%	9.0%
<b>Overall weighted likelihood (sum):</b>			<b>51.0%</b>

The impact on the Need is that there is an estimated overall 51% 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 ID DCN190 - Supply to Beryl area

This project was for the installation of an 18 MVar 66 kV capacitor bank at Beryl Substation to help with existing voltage constraints, with completion expected at the end of 2016. Other options included an option for a Beryl 330 kV Substation.

- > Need ID 0705 - Beryl 330kV Substation Site - Strategic Property Acquisition

Strategic property acquisition of land for a future Beryl 330/132 kV Substation.

### 4. Recommendation

It is recommended that options be considered to address the identified Need to manage the emerging voltage limitation at Beryl.

<sup>5</sup> EY Report to TransGrid on load developments 2016-10-10C.

## Attachment 1 Risk cost summary

### Current Option Assessment - Risk Summary



Project Name: Beryl Area Constraint

Option Name: Base Case

Option Assessment Name: Option 1 - 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)
Circuit Breaker 94B line out	1	Electrical	Unplanned Outage - HV (Circuit Breaker 94B line out)	\$4.07	Failure	\$4.07	17.10%	\$0.70	\$0.69		\$0.00			\$0.00
Circuit Breaker 94B line still out	1	Electrical	Unplanned Outage - HV (Circuit Breaker 94B line still out)	\$17.27	Failure	\$17.27	17.10%	\$2.95	\$2.95		\$0.00			\$0.00
				\$21.34		\$21.34		\$3.65	\$3.64		\$0.00			\$0.00

Total VCR Risk: \$3.26

Total ENS Risk: \$0.38