NEED/OPPORTUNITY STATEMENT (NOS)

Making the Grid More Resilience - Yass 330kV Bus CB Capacity Augmentation

NOS- 000000001399 revision 1.0

Ellipse project no.:
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	13 December 2016	

1. Background

The National Electricity Rules (NER), TransGrid's Planning Criteria and the NSW Transmission Network Development and Reliability Standard (the Standard) require TransGrid to consider the effects of non-credible (eg multiple) contingencies that may give rise to cascading failures. AEMO, AEMC and TransGrid have all identified the need for investment to prevent or minimise the effects of interruptions following a non-credible event.

Planning Criteria and NER Requirements

TransGrid apply a set of planning criteria when determining the need for system augmentation. TransGrid's planning criteria are in line with the NSW Government published Transmission Network Design and Reliability Standard for NSW (December 2010) and the National Electricity Rules (NER). The NSW main system is planned and operated taking into account single credible contingencies defined under Clause S5.1.2.1 of the National Electricity Rules (NER) and also described in the NSW Planning Criteria:

> *Network Service Providers must plan, design, maintain and operate their transmission networks and distribution networks to allow the transfer of power from generating units to Customers with all facilities or equipment associated with the power system in service and may be required by a Registered Participant under a connection agreement to continue to allow the transfer of power with certain facilities or plant associated with the power system out of service, whether or not accompanied by the occurrence of certain faults (called credible contingency events).*

In addition to planning for and managing credible contingencies, Clause S5.1.8 of the NER specifies requirements for non-credible contingencies including provision for emergency controls to minimise disruption to the transmission network and to significantly reduce the probability of cascading failure:

> *In planning a network a Network Service Provider must consider non-credible contingency events such as busbar faults which result in tripping of several circuits, uncleared faults, double circuit faults and multiple contingencies which could potentially endanger the stability of the power system. In those cases where the consequences to any network or to any Registered Participant of such events are likely to be severe disruption a Network Service Provider and/or a Registered Participant must install emergency controls within the Network Service Provider's or Registered Participant's system or in both, as necessary, to minimise disruption to any transmission or distribution network and to significantly reduce the probability of cascading failure.* In the event of a partial or system wide collapse, there are potential impacts, including market impacts, associated with the loss of intra-regional or inter-regional transfers, loss of supply to large load areas and high market prices.

AEMO review

AEMO have undertaken a study under existing and future load growth and generation scenarios and have identified several non-credible contingencies that may result in voltage and/or frequency collapse within the NSW transmission system. AEMO have commissioned a report titled *Potential sites for emergency control schemes (ECS) in the NEM* – 29 April 2013. This report states that significant stability constraints may arise under a number of non-credible conditions and states that these conditions show potential for the implementation of emergency control schemes to prevent widespread impacts on the network.

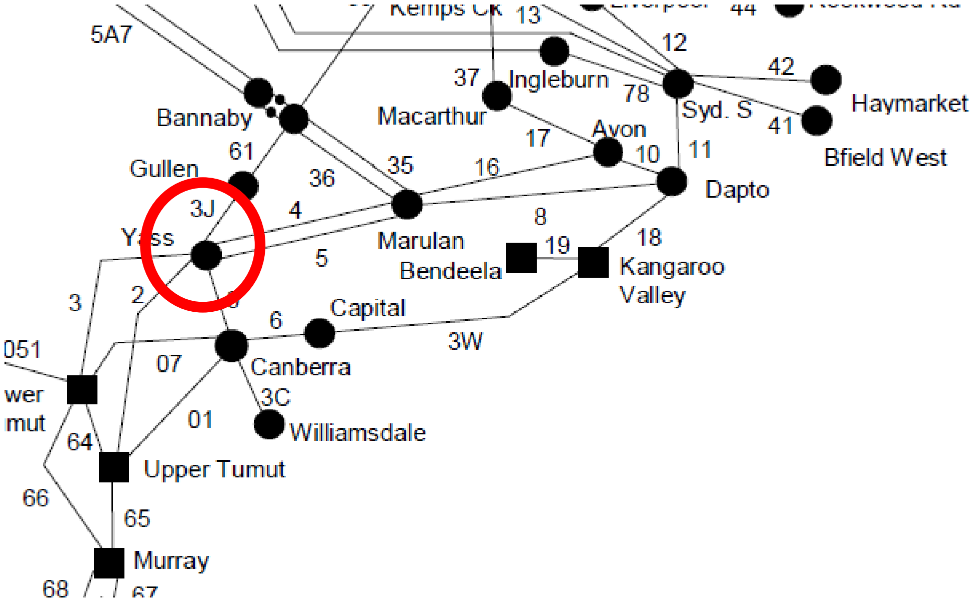
AEMC review

On 4 August 2010, the AEMC published the final report for the *Review of the Effectiveness of NEM Security and Reliability Arrangements in light of Extreme Weather Events*. This report was commissioned in response to an extreme weather event (heat wave) in late January 2009 in Victoria and South Australia which resulted in supply interruptions to business and residential customers. The Ministerial Council on Energy (MCE) (now the Standing Council on Energy and Resources (SCER)) provided a review of this report in June 2012. In this review the SCER supported further review of existing reliability and planning standards, including the NER to consider high impact-low probability events caused by Extreme Weather Events such as bushfires, drought or lightning which may result in significant loss of supply.

TransGrid Studies

TransGrid studies[1] have shown that under system normal the Snowy–NSW transfer (cut-set) thermal limit is 3100MW. However, upon a double busbar outage at Yass, the thermal limit for this cut-set is reduced to 995 MW[2], a reduction of about 2100 MW. Refer Figure 1 for a network overview.

Figure 1 - Network Diagram



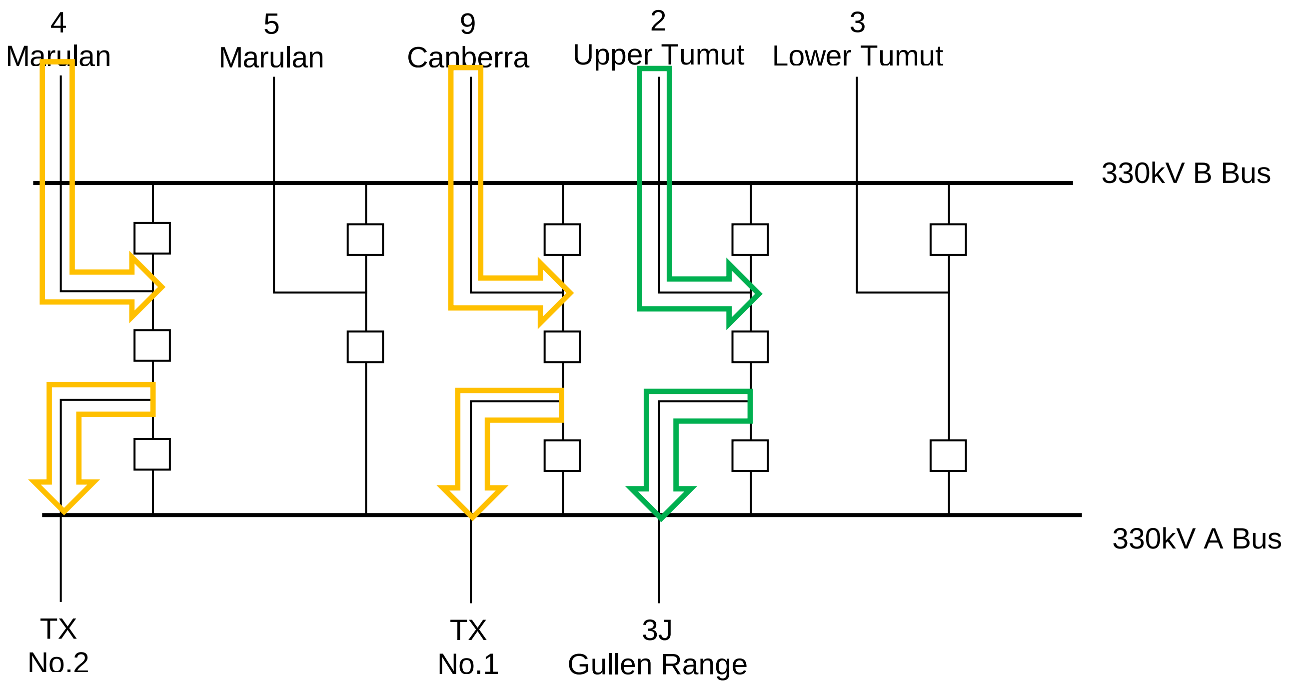
In a situation where there is high power flow (approximately 3,000 MW) from Snowy to NSW, a double 330 kV busbar outage at Yass will (refer to Figure 2):

- Disconnect lines 3 and 5;
- Lines 4 and 9 are connected to the transformers and supply local loads;
- Result in only lines 2 and 3J remaining intact to carry the power transfer from Snowy to NSW.

The system will potentially shut down due to stability of voltage following these multiple contingencies.

[1] TransGrid Operating Manual – OM520 Operation of main grid under normal conditions
[2] TransGrid Operating Manual – OM304 Ratings of main grid circuits

Figure 2 - Present Yass Arrangement



2. Need/opportunity

Yass 330kV substation has two 330kV busbars and a number of critical 330kV connections. It is situated at the bottle neck of the Northern and Southern NSW network as shown in Figure 1 above. In order to meet the NER requirements to protect the NSW high voltage transmission system against high impact low probability multiple simultaneous contingencies, there is a need for TransGrid to implement control, protection or other systems to manage the stability of both frequency and voltage following these multiple contingencies.

2.1 Risks

On a warm day, the combined Sydney–Wollongong–Newcastle load is at least 8,000 MW. The primary risk of TransGrid not addressing this need is a cost of unsupplied demand to customers in the Dapto, Wollongong and Sydney South area. A double 330 kV busbar outage at Yass may result in an 8,000 MW load loss for a duration of 8 hours, however restoration can begin immediately after an incident so a factor of 0.5 is used to account for this in the calculation.

The unserved energy has been calculated using the following data:

> 330 kV bay CB unplanned outage rate that will cause a bus outage = 0.079 / unit /annum[3]
> 330 kV bay CB failure rate that could lead to a bus trip = 0.024 / unit /annum[4]
> No. of CB failures that could lead to a bus unplanned outage/trip[5] = 5
> The value of customer reliability (VCR) for NSW is $38,350/ MWh[6]
> Probability where cut-set flow exceeds the secure limit[7] = 108/(24* 365) = 1.3% of the time/year

[3] Based on TransGrid historical CB unplanned outage rates(refer file CB Unplanned Outage Stats.xlsx in PDGS)

[4] Based on TransGrid historical CB failure rates(refer file CB Unplanned Outage Stats.xlsx in PDGS)

[5] Based on No. of CBs connected to Bus A and Bus B at Yass 330 kV substation

[6] AEMO, Value of Customer Reliability – Application Guide.

[7] The cut-set flow to maintain transient stability is about 1150 MW. Based on historical Canberra- Yass to north cut-set flows – refer file “1399 - Historical Yass-Canberra cut-set flows.xlsx” in PDGS

Therefore, the risk cost if calculated as follows:

$$Unserved\ Energy = (Load\ at\ risk) * P_{unplaned\ outage\ of\ one\ 330kV\ bus} * P_{failure\ of\ one\ 330\ kV\ bus} * P_{cut-set\ flow\ exceeds\ the\ secure\ limit} * D_{load\ interruption}$$

$$Unserved\ Energy = 8000\ MW * (0.079 * 5) * (0.024 * 5) * (\frac{1.3}{100}) * (0.5 * 8\ hrs)$$

$$\therefore\ Unserved\ Energy = 19.72\ MWh$$

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

$$Risk\ Cost\ of\ Unserved\ Energy = Unserved\ Energy * VCR$$

$$Risk\ Cost\ of\ Unserved\ Energy = 19.72\ MWh * \frac{\$38{,}350}{MWh}$$

$$\therefore\ \boldsymbol{Risk\ Cost\ of\ Unserved\ Energy = \$0.76\ million\ per\ year}$$

In addition, there is an operational/compliance risk of $0.01 million.

Therefore the total risk is $0.77 million.

3. Recommendation

It is recommended that options be evaluated to address the identified need by improving system security and reliability within the 2018-2023 regulatory period.

Attachment 1 Risk costs summary

Current Option Assessment - Risk Summary

Project Name: Yass 330kV Bus Section CBs Augementation

Option Name: 1399 - Base Case

Option Assessment Name: 1399 - 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)
System Restart Event	1	Steel Structure	Unplanned Outage - HV (System Restart Event)	$1,256.05	Structural Failure	$1,256.05	0.06%	$0.77	$0.76		$0.00			$0.01
				$1,256.05		$1,256.05		$0.77	$0.76		$0.00			$0.01

Total VCR Risk: $0.76 Total ENS Risk:

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