NEED/OPPORTUNITY STATEMENT (NOS)

Making the Grid More Resilient – Tomago 330kV

NOS- 000000001416 revision 2.0

Ellipse project no.: P0008185
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	25 November 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 (e.g. 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.

NER Requirements

TransGrid is required to operate the NSW transmission system according to the provisions of the NER. The NSW main system is planned and operated taking into account single credible contingencies defined under Clause S5.1.2.1 of the NER:

> *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 has 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 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 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.

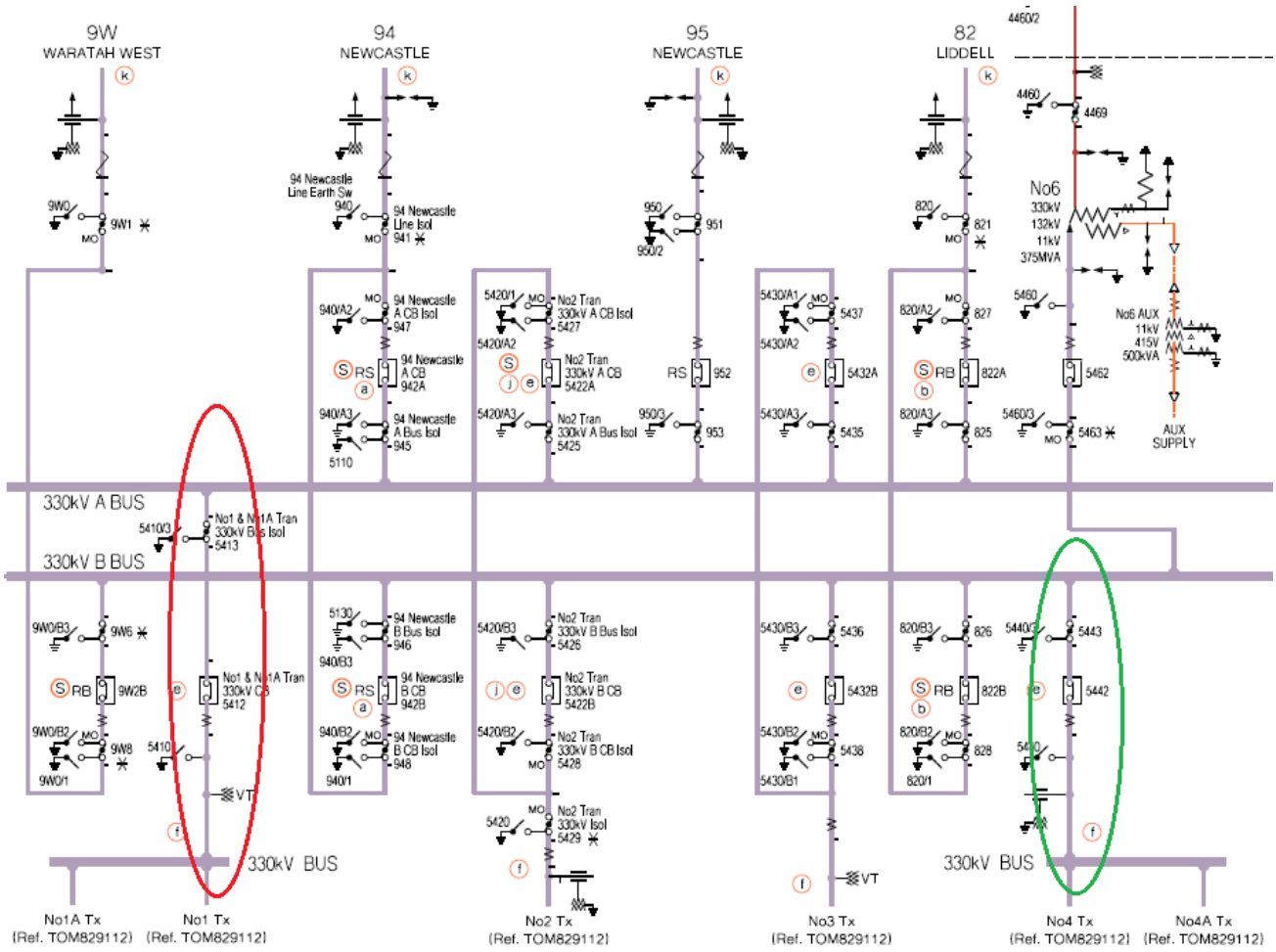
TransGrid review

TransGrid's review of the reliability of supply at Tomago Aluminium Company (TAC) has shown that there is a risk of a high impact-low probability event of busbar faults that may cause the trip of pot-lines at the plant.

Tomago 330/132 kV substation supplies TAC at 330kV and Ausgrid at 132 kV. TAC's three pot lines consume a [redacted]

The 330 kV Tomago switchyard is a double bus arrangement (see Figure 1) with two of the four TAC transformers dual selected (connected to both buses) and two single selected (one to each bus). Three TAC transformers are normally on load, each supplying one pot line, with the fourth on standby.

Figure 1 – High Voltage Operating Diagram of the Tomago 330 kV substation



2. Need/opportunity

During outages that take a TAC transformer out of service, loss of another transformer will interrupt a potline and cause a significant ENS event.

An example of such an event above was on the 5th October 2015, where CB 5432A (see Figure 1) became inoperative in the closed position at Tomago. The System Operator requested Tomago to off-load both Nos.1 and 3 Transformers (i.e. de-energise A Bus) to enable the disconnectors associated with 5432A to be opened. There are three potlines and four transformers; an outage of two transformers requires that one potline be out of service. The A Bus was out of service for 33 minutes, 21 minutes longer than the maximum 12 minutes.

Loss of TAC potlines can have major impact on the NSW interconnector flows and the NEM spot prices.

This opportunity is to reduce the risk of bus trips and failures on TAC, thereby improving spot price outcomes for the NEM.

2.1 Risks

The primary risk to TransGrid is the ENS to TAC, calculated in the investment risk tool with a summary shown in Attachment 1. The first risk is calculated based on a busbar fault that results in a TAC potline being taken out for half an hour until the busbar is restored. This makes up the largest portion of the risk.

The second part of the risk cost is a worst case scenario of the failure of a second circuit breaker while another CB is unavailable, resulting in the disconnection of a potline that may take an extended part of a day to restore. The probability of this occurrence however is very small.

The worst-case total cost of these risks has been calculated in the investment risk tool as $0.9m per annum.

2.2 Need Date

The expected need date to meet this opportunity is by June 2023.

3. Related needs/opportunities

None

4. Recommendation

It is recommended that options be considered to address the identified need/opportunity.

Attachment 1 Risk costs summary

Current Option Assessment - Risk Summary

Project Name: Making the Grid More Resilient – Tomago 330kV

Option Name: 1416 - Base Case

Option Assessment Name: 1416 - 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)
Busbar	12	Busbar	Uncontrolled Electrical Contact / Discharge (Busbar)	$2.37	Structural Failure	$28.40	2.40%	$0.68	$0.58		$0.01			$0.09
Circuit Breaker	2	Electrical	Unplanned Outage - HV (Circuit Breaker)	$187.95	Failure	$375.90	0.06%	$0.22	$0.22		$0.00			$0.00
				$190.32		$404.30		$0.90	$0.80		$0.01			$0.09

Total VCR Risk: $0.80 Total ENS Risk: $0.00

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