

# NEED/OPPORTUNITY STATEMENT (NOS)



Muswellbrook Secondary Systems Renewal

NOS- 000000001247 revision 2.0

**Ellipse project no.:** P005231

**TRIM file:** [TRIM No]

**Project reason:** Capability - Asset Replacement for end of life condition

**Project category:** Prescribed - Replacement

## Approvals

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<b>Endorsed</b>	Mark Jones	Secondary Systems and Communications Asset Manager
<b>Approved</b>	Lance Wee	M/Asset Strategy
<b>Date submitted for approval</b>	9 November 2016	

## Change history

Revision	Date	Amendment
0	27 April 2016	Initial issue
1	11 October 2016	Update to 2016/17 dollars
2	9 November 2016	Update to format

## 1. Background

Muswellbrook 330/132kV Substation comprises 2x 330kV feeders, 2x 330/132/11kV transformers, 4x 132kV feeders and 1x 132kV capacitor bank. The site was established in 1983, and the secondary systems assets have install dates between 1984 and 2012.

Muswellbrook Substation is a customer connection point supplying Ausgrid's 132kV network in the area inclusive of Muswellbrook, Singleton, Mitchell Line and Barnard River. The site will remain a connection point to Ausgrid into the foreseeable future as outlined in the load forecasts of the 2015 Transmission Annual Planning Report.

## 2. Need/opportunity

In accordance with TransGrid's Renewal and Maintenance Strategies for Automation<sup>1</sup> and Metering Systems<sup>2</sup>, Table 1 shows the following assets at Muswellbrook Substation that have been identified for replacement by 2023.

**Table 1 - Identified asset replacements at Muswellbrook Substation from 2014-2023**

Need Description	Quantity of Assets to be addressed	% of services at Site	Need Driver
Need ID 606 – Replacement of THR Protection Relays	4	33% of all line/feeder protection relays on site	<ul style="list-style-type: none"> <li>&gt; Component obsolescence resulting in a lack of spares and no manufacturer support</li> <li>&gt; Inaccurate measurement of fault angles due to deteriorated internal components</li> </ul>
Need ID 620 – Replacement of D Series Protection Relays	2	50% of all transformer protection relays on site	<ul style="list-style-type: none"> <li>&gt; Component obsolescence resulting in a lack of spares and no manufacturer support</li> <li>&gt; Known history of tripping unnecessarily at transformer energisation due to harmonic content inrush currents</li> </ul>
Need ID 621 – Replacement of DB Series Protection Relays	2	50% of all transformer protection relays on site	<ul style="list-style-type: none"> <li>&gt; Component obsolescence resulting in a lack of spares and no manufacturer support</li> <li>&gt; Faulty harmonic bias circuitry due to component failure</li> <li>&gt; Internal wiring connection problems</li> </ul>
Need ID 629 – Replacement of Remote Terminal Unit (RTUs)	1	25% of all RTUs on site	<ul style="list-style-type: none"> <li>&gt; Component obsolescence resulting in a lack of spares and no manufacturer support</li> </ul>

<sup>1</sup> Refer SSA Strategy - Renewal and Maintenance - Automation Systems

<sup>2</sup> Refer SSA Strategy - Renewal and Maintenance - Metering Systems

Need Description	Quantity of Assets to be addressed	% of services at Site	Need Driver
Need ID 637 – Replacement of YTG Protection Relays	4	33% of all line/feeder protection relays on site	<ul style="list-style-type: none"> <li>&gt; Component obsolescence resulting in a lack of spares and no manufacturer support</li> <li>&gt; Inaccurate measurement of fault angles due to deteriorated internal components</li> </ul>
Need ID 1359 – Remote Terminal Unit (RTU) Condition	1	75% of all RTUs on site	<ul style="list-style-type: none"> <li>&gt; Component obsolescence resulting in a lack of spares and no manufacturer support</li> </ul>
Need ID 615 – Replacement of Optimho LFZP112 Protection Relays	2	17% of all line/feeder protection relays	<ul style="list-style-type: none"> <li>&gt; Component obsolescence resulting in limited spares and limited manufacturer support</li> <li>&gt; Increasing defect rates</li> </ul>
Need ID 1380 – Protection - Schweitzer SELxxx Condition	2	17% of all line/feeder protections	<ul style="list-style-type: none"> <li>&gt; Component obsolescence resulting in a reduction of spares and limited manufacturer support</li> </ul>

Additionally, condition assessments for all these individual asset types have been completed<sup>3</sup>.

The risk cost associated with all secondary systems at Muswellbrook is \$4.02m per annum. The most significant element of concern is the reliability consequence associated with a protection system failing to operate during a genuine fault due to the malfunction of the protection relays identified for replacement above. This hazard can result in a number of different outcomes including load shedding, explosive failure of associated primary assets, offloading generation or in the most extreme case, black start of the entire network. There is a mixed customer load at the site with a forecast 205MW as the average of the summer and winter loads in the Transmission Annual Planning Report and an estimated 16 hours to recover the site and load after a hazardous event. Muswellbrook Substation carries a risk of a system black event. The risk costs are based on 2016/17 probabilities of failure taken as a trend of existing defect rates of applicable asset types derived from the condition assessments. These probabilities are forecast to continue increasing over the coming years, with the consequence of failure also likely to escalate due to TransGrid's means of mitigating and repairing these failures being almost exhausted.

There is additional risk identified from market meters (which considers repair and potential litigation costs). Furthermore several issues have been identified with the condition of Low Voltage (LV) 415V AC systems at the site including cracked and broken fuse holders. These issues were identified as part of the recent LV safety survey<sup>4</sup>.

In accordance with TransGrid's Renewal and Maintenance Strategy for Secondary Systems Site Installations<sup>5</sup>, an opportunity exists to address these risks by performing a full secondary system replacement at Muswellbrook as listed in the risk summary in Attachment 1. This opportunity is due to the high concentration of the secondary system assets required to be addressed. It is expected that this would provide additional benefits for the organisation including:

<sup>3</sup> Refer NACA-SSAP - Protection, NACA-SSAC - Control, NACA-SSAM - Metering

<sup>4</sup> Refer AM FS 0006 TWR 125 – Low Voltage Safety Survey

<sup>5</sup> Refer SSA Strategy - Renewal and Maintenance -Secondary Systems Site Installations

- > Moving from a centralised Alarm and Control platform to a distributed control architecture that improves operational control and reliability while reducing the consequence of equipment failure
- > Upgrading Auto Reclose facilities to allow better control, indication and fault analysis than what is currently available at the site
- > Upgrading Transformer Control facilities to allow better control, indication and fault analysis than what is currently available at the site
- > Optimising the current implementation of TransGrid's High Capacity Telecommunications to the site by upgrading all ancillary systems to TransGrid's latest design standard which provides the greatest amount of real time operational and condition data to better support the planning, operation and maintenance of the Network

### 3. Related Needs/opportunities

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The following related Needs contain works for Muswellbrook that could be fulfilled by completing a Secondary Systems Replacement:

- > Need ID 606 – Replacement of THR Protection Relays
- > Need ID 620 – Replacement of D Series Protection Relays
- > Need ID 621 – Replacement of DB Series Protection Relays
- > Need ID 629 – Replacement of Remote Terminal Unit (RTUs)
- > Need ID 637 – Replacement of YTG Protection Relays
- > Need ID 1359 – Remote Terminal Unit (RTU) Condition
- > Need ID 615 – Replacement of Optimho LFZP112 Protection Relays
- > Need ID 1380 – Protection - Schweitzer SELxxx Condition

### 4. Recommendation

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

# Attachment 1 – Risk costs summary

Summary of results is attached below. Refer to supporting document in PDGS for full risk assessment.

## Current Option Assessment - Risk Summary

Project Name: Muswellbrook Secondary Systems Renewal

Option Name: 1247 - Base Case

Option Assessment Name: 1247 - 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) (Env)	Risk (\$M) (Rep)
Battery and Charger System	2	Battery	Uncontrolled Electrical Contact / Discharge (Battery and Charger System)	\$0.67	Failure	\$1.34	9.20%	\$0.12	\$0.12	\$0.00	\$0.00	\$0.00	\$0.00
Battery and Charger System	2	Battery	Unplanned Outage - HV (Battery and Charger System)	\$0.66	Failure	\$1.33	9.20%	\$0.12	\$0.12	\$0.00	\$0.00	\$0.00	\$0.00
Battery and Charger System	2	Charger	Uncontrolled Electrical Contact / Discharge (Battery and Charger System)	\$0.67	Failure	\$1.34	9.20%	\$0.12	\$0.12	\$0.00	\$0.00	\$0.00	\$0.00
Battery and Charger System	2	Charger	Unplanned Outage - HV (Battery and Charger System)	\$0.66	Failure	\$1.33	9.20%	\$0.12	\$0.12	\$0.00	\$0.00	\$0.00	\$0.00
Controls	4	Bay Controller	Unplanned Outage - HV (Controls)	\$0.72	Failure	\$2.87	2.75%	\$0.08	\$0.07	\$0.01	\$0.00	\$0.00	\$0.00
Controls	4	Control Cabling	Unplanned Outage - HV (Controls)	\$0.72	Failure	\$2.87	2.75%	\$0.08	\$0.07	\$0.01	\$0.00	\$0.00	\$0.00
Low Voltage AC Supply	2	AC Low Voltage Board/Panel/Box	Uncontrolled Electrical Contact / Discharge (Low Voltage AC Supply)	\$0.93	Failure	\$1.86	31.00%	\$0.58	\$0.40	\$0.17	\$0.00	\$0.00	\$0.00
Low Voltage AC Supply	2	AC Low Voltage Board/Panel/Box	Unplanned Outage - HV (Low Voltage AC Supply)	\$2.18	Failure	\$4.36	31.00%	\$1.35	\$1.18	\$0.17	\$0.00	\$0.00	\$0.00
Low Voltage AC Supply	2	AC Low Voltage Cable	Uncontrolled Electrical Contact / Discharge (Low Voltage AC Supply)	\$0.93	Failure	\$1.86	3.20%	\$0.06	\$0.04	\$0.02	\$0.00	\$0.00	\$0.00
Low Voltage AC Supply	2	AC Low Voltage Cable	Unplanned Outage - HV (Low Voltage AC Supply)	\$2.18	Failure	\$4.36	3.20%	\$0.14	\$0.12	\$0.02	\$0.00	\$0.00	\$0.00
Low Voltage DC Supply	2	DC Low Voltage Board/Panel/Box	Uncontrolled Electrical Contact / Discharge (Low Voltage DC Supply)	\$0.67	Failure	\$1.33	2.00%	\$0.03	\$0.03	\$0.00	\$0.00	\$0.00	\$0.00
Low Voltage DC Supply	2	DC Low Voltage Board/Panel/Box	Unplanned Outage - HV (Low Voltage DC Supply)	\$0.67	Failure	\$1.33	2.00%	\$0.03	\$0.03	\$0.00	\$0.00	\$0.00	\$0.00
Low Voltage DC Supply	2	DC Low Voltage Cable	Uncontrolled Electrical Contact / Discharge (Low Voltage DC Supply)	\$0.67	Failure	\$1.33	2.00%	\$0.03	\$0.03	\$0.00	\$0.00	\$0.00	\$0.00

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)
Low Voltage DC Supply	2	DC Low Voltage Cable	Unplanned Outage - HV (Low Voltage DC Supply)	\$0.67	Failure	\$1.33	2.00%	\$0.03	\$0.03	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Metering	6	Meter	Failed Compliance Obligations (Metering)	\$0.11	Failure	\$0.67	4.40%	\$0.03	\$0.03	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Protection - 132kV	7	Protection	Unplanned Outage - HV (Protection - 132kV)	\$0.76	Failure	\$5.31	5.21%	\$0.24	\$0.24	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Protection - 132kV	7	Protection Relay	Explosive Failure of Asset (Protection - 132kV)	\$1.36	Failure	\$9.53	5.21%	\$0.46	\$0.46	\$0.00	\$0.00	\$0.00	\$0.00	\$0.01
Protection - 330kV	4	Protection	Unplanned Outage - HV (Protection - 330kV)	\$0.76	Failure	\$3.03	2.28%	\$0.06	\$0.06	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Protection - 330kV	4	Protection Relay	Explosive Failure of Asset (Protection - 330kV)	\$2.89	Failure	\$11.57	2.28%	\$0.25	\$0.25	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
				\$18.87		\$58.97		\$4.02	\$3.49	\$0.51	\$0.01	\$0.00	\$0.01	\$0.01

Total VCR Risk: \$3.40      Total ENS Risk: \$0.03