NEED/OPPORTUNITY STATEMENT (NOS)

Marulan Secondary Systems Renewal

NOS- 000000001266 revision 2.0

Ellipse project no(s): P0005401
TRIM file: [TRIM No]

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

Approvals

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Approved	Lance Wee	M/Asset Strategy
Date submitted for approval	22 November 2016	

Change history

Revision	Date	Amendment
0	27 April 2016	Initial issue
1	11 October 2016	Update to 2016/17 dollars
2	22 November 2016	Update to format

1. Background

Marulan 330/132kV Substation comprises 6x 330kV feeders, 1x 330/132/11kV transformer and 3x 132kV feeders. The site was established in 1992, and the secondary systems assets have install dates between 1992 and 2014.

Marulan Substation is a customer connection point supplying both Essential Energy and Endeavour Energy 132kV networks in the area inclusive of Moss Vale, Goulburn and planned connection to Taralga Wind Farm. The site will remain a connection point to Essential Energy and Endeavour Energy 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[1] and Metering Systems[2], Table 1 shows the assets at Marulan Substation that have been identified for replacement by 2023.

Table 1 - Identified asset replacements at Marulan Substation from 2014-2023

Need Description	Quantity of Assets to be addressed	% of services at Site	Need Driver
Need ID 602 – Replacement of RADSB Protection Relays	1	50% of all transformer protection relays on site	> Component obsolescence resulting in a lack of spares and no manufacturer support > Limited internal support available ongoing repair and maintenance
Need ID 605 – Replacement of Quadramho Protection Relays	8	44% of all line/feeder protection relays on site	> Component obsolescence resulting in a lack of spares and no manufacturer support > Relays known to become trapped in a logic loop, rendering the relay non-auto and initiating the "Relay Inoperative Alarm"
Need ID 606 – Replacement of THR Protection Relays	4	22% of all line/feeder protection relays on site	> Component obsolescence resulting in a lack of spares and no manufacturer support > Inaccurate measurement of fault angles due to deteriorated internal components
Need ID 621 – Replacement of DB Series Protection Relays	1	50% of all transformer protection relays on site	> Component obsolescence resulting in a lack of spares and no manufacturer support > Faulty harmonic bias circuitry due to component failure > Internal wiring connection problems

[1] Refer SSA Strategy - Renewal and Maintenance - Automation Systems

[2] Refer SSA Strategy - Renewal and Maintenance - Metering Systems

Need Description	Quantity of Assets to be addressed	% of services at Site	Need Driver
Need ID 619 – Replacement of CEWE Energy Meters	4	67% of all market meters on site	> Component obsolescence resulting in a lack of spares and no manufacturer support > Worn gears result in inaccurate metering
Need ID 629 – Replacement of Remote Terminal Units (RTU)	Site Wide Replacement	100%	> Component obsolescence resulting in a lack of spares and no manufacturer support
Need ID 1380 – Protection - Schweitzer SELxxx Condition	3	17% of all line/feeder protection relays on site	> Component obsolescence resulting in a lack of spares and limited manufacturer support

Additionally, condition assessments for all these individual asset types have been completed[3].

The risk cost associated with all secondary systems at Marulan is $3.8m 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 130MW 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. Marulan Substation forms part of the 330kV backbone and carries a risk of a system black event. The risk costs are based on 2015/16 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 several issues with the condition of Low Voltage (LV) 415V AC systems at the site including a lack of Residual Current Devices (RCD) or Earth Leakage Circuit Breaker (ELCB) devices on power circuits. Thes1e issues were identified as part of the recent LV safety survey[4].

In accordance with TransGrid's Renewal and Maintenance Strategy for Secondary Systems Site Installations[5], an opportunity exists to address these risks by performing a full secondary system replacement at Marulan (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:

> 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

[3] Refer NACA-SSAP - Protection, NACA-SSAC - Control, NACA-SSAM - Metering

[4] Refer AM FS 0006 TWR 125 – Low Voltage Safety Survey

[5] Refer SSA Strategy - Renewal and Maintenance -Secondary Systems Site Installations

- Upgrading Transformer Control facilities to allow better control, indication and fault analysis than what is currently available at the site
- Utilising 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

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

- Need ID 602 – Replacement of RADSB Protection Relays
- Need ID 605 – Replacement of Quadramho Protection Relays
- Need ID 606 – Replacement of THR Protection Relays
- Need ID 621 – Replacement of DB Series Protection Relays
- Need ID 619 – Replacement of CEWE Energy Meters
- Need ID 629 – Replacement of Remote Terminal Units (RTU)
- Need ID 1380 – Protection - Schweitzer SELxxx Condition

4. Recommendation

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.

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)
Battery and Charger System	2	Battery	Uncontrolled Electrical Contact / Discharge (Battery and Charger System)	$0.48	Failure	$0.95	9.20%	$0.09	$0.08		$0.00	$0.01		$0.00
Battery and Charger System	2	Battery	Unplanned Outage - HV (Battery and Charger System)	$0.43	Failure	$0.87	9.20%	$0.08	$0.08		$0.00			$0.00
Battery and Charger System	2	Charger	Uncontrolled Electrical Contact / Discharge (Battery and Charger System)	$0.48	Failure	$0.95	9.20%	$0.09	$0.08		$0.00	$0.01		$0.00
Battery and Charger System	2	Charger	Unplanned Outage - HV (Battery and Charger System)	$0.43	Failure	$0.87	9.20%	$0.08	$0.08		$0.00			$0.00
Controls	3	Bay Controller	Unplanned Outage - HV (Controls)	$0.49	Failure	$1.46	1.50%	$0.02	$0.02		$0.00			$0.00
Controls	3	Control Cabling	Unplanned Outage - HV (Controls)	$0.49	Failure	$1.46	1.50%	$0.02	$0.02		$0.00			$0.00
Low Voltage AC Supply	2	AC Low Voltage Board/Panel/Box	Uncontrolled Electrical Contact / Discharge (Low Voltage AC Supply)	$0.85	Failure	$1.70	31.00%	$0.53	$0.26		$0.21	$0.05		$0.01
Low Voltage AC Supply	2	AC Low Voltage Board/Panel/Box	Unplanned Outage - HV (Low Voltage AC Supply)	$1.56	Failure	$3.13	31.00%	$0.97	$0.76		$0.21			$0.00
Low Voltage AC Supply	2	AC Low Voltage Cable	Uncontrolled Electrical Contact / Discharge (Low Voltage AC Supply)	$0.85	Failure	$1.70	3.20%	$0.05	$0.03		$0.02	$0.00		$0.00
Low Voltage AC Supply	2	AC Low Voltage Cable	Unplanned Outage - HV (Low Voltage AC Supply)	$1.56	Failure	$3.13	3.20%	$0.10	$0.08		$0.02			$0.00
Low Voltage DC Supply	2	DC Low Voltage Board/Panel/Box	Uncontrolled Electrical Contact / Discharge (Low Voltage DC Supply)	$0.45	Failure	$0.91	2.00%	$0.02	$0.02		$0.00	$0.00		$0.00
Low Voltage DC Supply	2	DC Low Voltage Board/Panel/Box	Unplanned Outage - HV (Low Voltage DC Supply)	$0.43	Failure	$0.87	2.00%	$0.02	$0.02		$0.00			$0.00
Low Voltage DC Supply	2	DC Low Voltage Cable	Uncontrolled Electrical Contact / Discharge (Low Voltage DC Supply)	$0.45	Failure	$0.91	2.00%	$0.02	$0.02		$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)	$0.43	Failure	$0.87	2.00%	$0.02	$0.02		$0.00			$0.00
Metering	7	Meter	Failed Compliance Obligations (Metering)	$0.11	Failure	$0.78	5.77%	$0.05			$0.05			
Protection - 132kV	4	Protection	Unplanned Outage - HV (Protection - 132kV)	$0.53	Failure	$2.11	4.34%	$0.09	$0.07		$0.02			$0.00
Protection - 132kV	4	Protection Relay	Explosive Failure of Asset (Protection - 132kV)	$0.92	Failure	$3.68	4.34%	$0.16	$0.12		$0.01	$0.01	$0.00	$0.01
Protection - 330kV	9	Protection	Unplanned Outage - HV (Protection - 330kV)	$0.53	Failure	$4.76	3.52%	$0.17	$0.13		$0.03			$0.00
Protection - 330kV	9	Protection Relay	Explosive Failure of Asset (Protection - 330kV)	$3.83	Failure	$34.47	3.52%	$1.21	$1.15		$0.03	$0.02	$0.01	$0.02
				$15.32		$65.57		$3.78	$3.02		$0.62	$0.09	$0.01	$0.04

Total VCR Risk: $2.93 Total ENS Risk: $0.03