NEED/OPPORTUNITY STATEMENT (NOS)

Liverpool Secondary Systems Renewal

NOS- 000000001599 revision 2.0

Ellipse project no.: P0009495
TRIM file: [TRIM No]

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

Approvals

Author	Adam Hoare	Secondary Systems Senior Analyst
Endorsed	Mark Jones	Secondary Systems and Communications Asset Manager
Approved	Lance Wee	M/Asset Strategy
Date submitted for approval	15 November 2016	

Change history

Revision	Date	Amendment
0	17 October 2016	Initial issue
1	15 November 2016	Update to format

1. Background

Liverpool 330/132kV Substation comprises 2x 330kV feeders, 3x 330/132kV transformers and 3x 132kV feeders. The site was established in 1985, and the secondary systems assets have install dates between 1985 and 2015.

Liverpool Substation is a customer connection point supplying the Endeavour Energy 132kV network within the South Western Sydney area. The site will remain a connection point to 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], **Error! Reference source not found.** shows the assets at Liverpool Substation that have been identified for replacement by 2023.

Table 1 - Identified Asset Replacements at Liverpool 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	2	20% 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 620 – Replacement of D21, D22, D202 & D203 Protection Relays	2	33% of all transformer protection relays on site	> Component obsolescence resulting in a lack of spares and no manufacturer support > End of asset life
Need ID 621 – Replacement of DB Series Protection Relays	2	33% 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
Need ID 1376 – Replacement of Alstom Pxxx Protection Relays	3	30% of all line/feeder protection relays on site	> Component obsolescence resulting in a lack of spares and no manufacturer support > End of asset life

[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 1379 – Replacement of GE Multilin Protection Relays	1	17% of all transformer protection relays on site	> Increasing numbers of faults across the GE range. > Issues with the front facia failing and analogue module failures.
Need ID 1381 – Replacement of Siemens 7xx Protection Relays	3	30% of all line/feeder protection relays on site	> Component obsolescence resulting in a lack of spares and no manufacturer support > End of asset life
Need ID 1383 – Replacement of GE FAC Protection Relays	4	100% of all busbar protection relays on site	> Component obsolescence resulting in a lack of spares and no manufacturer support > End of asset life
Need ID 1385 – Replacement of Reyrolle DUOBIAS Protection Relays	1	17% of all transformer protection relays on site	> Component obsolescence resulting in a lack of spares and no manufacturer support > End of asset life
Need ID 1359 – Remote Terminal Unit (RTU) Condition	6	100% of all control RTUs onsite	> Component obsolescence resulting in a lack of spares and no manufacturer support

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

The risk cost associated with all secondary systems at Liverpool is $2.91m 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 323MW as the average of the summer and winter loads in the Transmission Annual Planning Report and an estimated 8 hours to recover the site and load after a failure to operate event. Liverpool 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.

In accordance with TransGrid's Renewal and Maintenance Strategy for Secondary Systems Site Installations4, an opportunity exists to address these risks by performing a full secondary system replacement at Liverpool (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:

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

[4] 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.
- 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 Liverpool that could be fulfilled by completing a Secondary Systems Replacement:

- Need ID 606 – Replacement of THR Protection Relays
- Need ID 620 – Replacement of D21, D22, D202 & D203 Protection Relays
- Need ID 621 – Replacement of DB Series Protection Relays
- Need ID 1376 – Replacement of Alstom Pxxx Protection Relays
- Need ID 1379 – Replacement of GE Multilin Protection Relays
- Need ID 1381 – Replacement of Siemens 7xx Protection Relays
- Need ID 1383 – Replacement of GE FAC Protection Relays
- Need ID 1385 – Replacement of Reyrolle DUOBIAS Protection Relays
- Need ID 1359 – Remote Terminal Unit (RTU) 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.

Current Option Assessment - Risk Summary

Project Name: Liverpool Secondary Systems Renewal

Option Name: 1599 - Base Case

Option Assessment Name: 1599 - 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)
Battery and Charger System	2	Battery	Uncontrolled Electrical Contact / Discharge (Battery and Charger System)	$1.06	Failure	$2.11	9.20%	$0.19	$0.19		$0.00	$0.00		$0.00
Battery and Charger System	2	Battery	Unplanned Outage - HV (Battery and Charger System)	$0.27	Failure	$0.54	9.20%	$0.05	$0.05		$0.00			$0.00
Battery and Charger System	2	Charger	Uncontrolled Electrical Contact / Discharge (Battery and Charger System)	$1.06	Failure	$2.11	9.20%	$0.19	$0.19		$0.00	$0.00		$0.00
Battery and Charger System	2	Charger	Unplanned Outage - HV (Battery and Charger System)	$0.27	Failure	$0.54	9.20%	$0.05	$0.05		$0.00			$0.00
Controls	6	Bay Controller	Unplanned Outage - HV (Controls)	$1.08	Failure	$6.48	6.22%	$0.40	$0.38		$0.02			$0.00
Controls	6	Control Cabling	Unplanned Outage - HV (Controls)	$1.08	Failure	$6.48	6.22%	$0.40	$0.38		$0.02			$0.00
Low Voltage DC Supply	2	DC Low Voltage Board/Panel/Box	Uncontrolled Electrical Contact / Discharge (Low Voltage DC Supply)	$1.04	Failure	$2.08	2.00%	$0.04	$0.04		$0.00	$0.00		$0.00
Low Voltage DC Supply	2	DC Low Voltage Board/Panel/Box	Unplanned Outage - HV (Low Voltage DC Supply)	$1.03	Failure	$2.05	2.00%	$0.04	$0.04		$0.00			$0.00
Low Voltage DC Supply	2	DC Low Voltage Cable	Uncontrolled Electrical Contact / Discharge (Low Voltage DC Supply)	$1.04	Failure	$2.08	2.00%	$0.04	$0.04		$0.00	$0.00		$0.00
Low Voltage DC Supply	2	DC Low Voltage Cable	Unplanned Outage - HV (Low Voltage DC Supply)	$1.03	Failure	$2.05	2.00%	$0.04	$0.04		$0.00			$0.00
Metering	6	Meter	Failed Compliance Obligations (Metering)	$0.11	Failure	$0.67	4.40%	$0.03			$0.03			
Protection - 132kV	3	Protection	Unplanned Outage - HV (Protection - 132kV)	$1.12	Failure	$3.36	3.30%	$0.11	$0.10		$0.01			$0.00
Protection - 132kV	3	Protection Relay	Explosive Failure of Asset (Protection - 132kV)	$0.61	Failure	$1.84	3.30%	$0.06	$0.04		$0.01	$0.00	$0.00	$0.00
Protection - 330kV	7	Protection	Unplanned Outage - HV (Protection - 330kV)	$1.12	Failure	$7.84	4.26%	$0.33	$0.30		$0.03			$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)
Protection - 330kV	7	Protection Relay	Explosive Failure of Asset (Protection - 330kV)	$3.06	Failure	$21.41	4.26%	$0.91	$0.85		$0.02	$0.01	$0.01	$0.01
				$14.97		$61.66		$2.91	$2.68		$0.16	$0.02	$0.01	$0.02

Total VCR Risk: $2.62 Total ENS Risk: $0.02