

OPTIONS EVALUATION REPORT (OER)

Coleambally Secondary Systems Renewal

OER 000000001196 revision 3.0



Ellipse project no.: P0005247

TRIM file: [TRIM No]

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

Project category: Prescribed - Replacement

Approvals

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Date submitted for approval	6 January 2017	

Change history

Revision	Date	Amendment
0	24 June 2016	Initial issue
1	28 October 2016	Update to 2016/17 dollars and SFAIRP/ALARP data
2	16 November 2016	Update to format
3	24 November 2016	Added OSR reference
4	06 January 2017	Correction of invalid reference

1. Need/opportunity

Coleambally 132/33kV Substation is a shared TransGrid and Essential Energy assets. TransGrid assets comprises of 2x132kV feeders and a 132kV busbar. The remainder belongs to Essential Energy. The site was established in 1993, and the secondary systems assets have install dates between 2001 and 2003.

The Secondary Systems assets have been identified as reaching end of life and require addressing at the site. Additionally, there is an opportunity to improve the operational capacity of the site by modernising the automation philosophy to current design standards and practices.

2. Related Needs/opportunities

The assets proposed to be replaced under this Secondary System Replacement were identified in the following Needs:

- > Need ID 610 – Replacement of EDM1 MK3 Energy Meters
- > Need ID 1356 – Replacement of Reyrolle OHx Protection Relays
- > Need ID 1364 – Replacement of Gyr ZMD Energy Meters
- > Need ID 1376 – Replacement of Alstom Pxxx Protection Relays

3. Options

The options scoped for this need were identified as per the Options Screening Report – Secondary System Renewal.

All dollar values in this document are expressed in un-escalated 2016/17 dollars.

Base Case

The Base Case for this Need is to continue with TransGrid's operation and maintenance (O&M) for the site. This approach does not address the technological obsolescence, spares unavailability, manufacturer non-support, component deterioration of the secondary systems, and inaccurate measurement or the risk cost associated with the Need. The risk cost associated with all secondary system at Coleambally Substation of \$0.39m per annum will increase due to:

- > the probability of failure increasing as the assets move further past their expected life; and
- > TransGrid's means of mitigating and repairing these failures being almost exhausted.

Coleambally Substation is a customer connection point supplying the Essential Energy 33kV network in the area inclusive of Coleambally, Egansford and Darlington Point. Key drivers for this risk cost are:

- > The majority of relays protecting TransGrid's 132kV line and busbar assets at this site have reached their end of life, with limited spares and no manufacturer support. This increases the likelihood of a hazardous event occurring and decreases TransGrid's ability to react to mitigate or repair any failures.

Increasing maintenance on the equipment cannot reduce the probability of failure in order to reduce the risk cost.

Option A — In-Situ Replacement [[OFR 1196A](#), [OFS 1196A](#)]

Option A is to carry out the complete upgrade and renewal of the secondary systems at Coleambally 132 kV Substation by reusing the existing building, tunnel boards and where practicable, the cabling. This option will

modernise the automation philosophy to current design standards and practices and will provide additional operational benefits.

This option assumes that the new secondary systems will be designed to be accommodated within a similar panel arrangement as the existing installation. Redundant panels and tunnel boards in the ASB relay room will need to be progressively decommissioned and removed as the new secondary systems are cut-over and commissioned.

The expected capital costs for this option total \$1.72m. This costing is estimated using TransGrid's 'Success' estimating system. No capital expenditure would be required over the 15 year life cycle of this option through to 2038 as this is a complete in-situ replacement option.

Operating costs have been estimated at \$1k per annum for this option based on current maintenance schedule.

A benefit figure of \$21k per annum has been calculated for this option in accordance with TransGrid's Renewal and Maintenance Strategy for Secondary Systems Site Installations.

The residual risk associated with this option upon completion of the project amounts to \$0.04m per annum (base case risk cost = \$0.39m). The risk reduction is realised through the reduction in the probability of failure for all assets and the reduction in likelihood of a hazardous event due to the installation of self-checking relays.

Option B — Strategic Asset Replacement [OFR 1196B, OFS 1196B]

Option B is to carry out the replacement of individual secondary system assets at Coleambally 132 kV Substation that are in need of renewal during the 2019-2023 regulatory period. This option involves replacing the old assets "like for like" with a modern equivalent asset by utilising the existing building, tunnel boards and where practicable, the cabling. This option excludes additional system modification or delivery of additional functionality.

The expected capital cost for this option total \$1.08m. This costing is estimated using TransGrid's 'Success' estimating system. Further capital expenditure is not required in this instance.

Operating costs have been estimated at \$1k per annum for this option based on current maintenance schedules.

Due to the "like for like" nature of this option, no benefit has been calculated in accordance with TransGrid's Renewal and Maintenance Strategy for Secondary Systems Site Installations¹.

The residual risk associated with this option upon completion of the project amounts to \$0.34m per annum (base case risk cost = \$0.39m). The risk reduction is realised through the reduction in the probability of failure for all assets and reduction in likelihood of a hazardous event due to the installation of self-checking relays.

Option C — IEC-61850 Replacement [OFR 1196C, OFS 1196C]

Option C is to carry out complete replacement of the secondary system at Coleambally 132 kV Substation by new IEC-61850 based secondary systems technology. This option will modernise the automation philosophy and will provide additional operational benefits. This option will utilise IEC-61850 protocol for unmanned substation site involving automation system, Supervisory Control And Data Acquisition (SCADA) system, substation surveillance and condition monitoring. This option assumes that reasonable advancements have been made in the IEC-61850 roll out program for a Secondary Systems Renewal across TransGrid.

The expected capital costs for this option total \$3.5m. This costing is estimated using TransGrid's 'Success' estimating system. No capital expenditure would be required over the 15 year life cycle of this option through to 2038 as this is a complete replacement option.

Operating costs have been estimated at \$10k per annum for this option based on current maintenance schedule.

¹ Refer SSA Strategy - Renewal and Maintenance - Secondary Systems Site Installations

A benefit figure of \$21k per annum has been calculated for this option in accordance with TransGrid's Renewal and Maintenance Strategy for Secondary Systems Site Installations. Additional benefit of \$400k in the 1st year, \$200k in the 2nd year and \$100k in the 3rd year is also included to account for gain due to standard development. The savings in the second year and third year is a high level assumption and considers the benefits diminishing due to potential spend in IE61850 solution to allow for improvements.

The residual risk associated with this option upon completion of the project amounts to \$0.28m per annum (base case risk cost = \$0.39m). The risk reduction is realised through the reduction in the probability of failure for all assets and the reduction in likelihood of a hazardous event due to the installation of self-checking relays.

All options have been assessed as technically feasible.

4. Evaluation

Evaluation of the proposed options has been completed using both commercial considerations and the ALARP (as low as reasonably practical) regulatory requirements. The results of these evaluations are outlined below.

4.1 Commercial evaluation

The result of commercial evaluation for each of the options is summarised in the Table 1.

Table 1 – Commercial evaluation (\$ million)

Option	Description	Total capex	Annual opex	Annual post project risk cost	Economic NPV @10%	Financial NPV @10%	Rank
Base case	'Run-to-fail' (O&M continues)	-	-	0.387	-	-	4
A	In-Situ Replacement	1.72	0.001	0.040	0.46	0.23	1
B	Strategic Asset Replacement	1.08	0.001	0.340	(0.66)	(0.66)	2
C	IEC-61850 Replacement	3.50	0.010	0.280	(1.74)	(1.91)	3

The commercial evaluation is based on:

- > Economic life of assets is assumed 15 years. Therefore the Net Present Value (NPV) assessment period is also 15 years.
- > Write-offs have been evaluated from the fixed asset register at \$27k in June 2023 for Option A & C as this option retires few assets before the end of their financial lives.
- > Capex excludes interest during construction.

Sensitivities on NPV for all options with changing discount rates are shown in Table 2.

Table 2 – Discount rate sensitivities (\$ million)

Option	Description	Economic NPV @13%	Economic NPV @6.75%
A	In-Situ Replacement	0.13	1.04
B	Strategic Asset Replacement	(0.65)	(0.67)

Option	Description	Economic NPV @13%	Economic NPV @6.75%
C	IEC-61850 Replacement	(1.76)	(1.65)

4.2 SFAIRP/ALARP evaluation

Options to reduce the network safety risk as per the risk treatment hierarchy have been considered in other lifecycle stages of the asset, and it has been determined that no reasonably practicable options exist to reduce the risk further than those capital investment options listed below.

Evaluation of the proposed options has been completed against the SFAIRP (So Far As Is Reasonably Practicable)/ALARP (As Low As Reasonably Practical) obligation, as required by the Electricity Supply (Safety and Network Management) Regulation 2014 and the Work Health and Safety Act 2011. The Key Hazardous Events and the disproportionality multipliers considered in the evaluation are as follows:

- > Explosive failure - 6 times the bushfire risk, 3 times the safety risk and 10% of the reliability risk (applicable to safety)

The results of this evaluation are summarised in the tables below.

Table 3 – Feasible options (\$ thousand)

Option	Description	CAPEX	Expected Life	Annualised CAPEX
Base	Do nothing	N/A	N/A	N/A
A	Complete In-Situ Replacement	1,720	15 years	110
B	Strategic Asset Replacement	1,080	15 years	70
C	IEC-61850 Replacement	3,500	15 years	230

Table 4 – Annual risk calculations (\$ thousand)

Option	Annual Residual Risk			Annual Risk Savings		
	Safety Risk	Reliability Risk	Bushfire Risk	Safety Risk	Reliability Risk	Bushfire Risk
Base	5	124	7	N/A	N/A	N/A
A	0	13	3	5	111	4
B	4	116	2	0	8	5
C	0	80	20	4	44	(13) ²

² Due to untested IEC61850 technology, there is a higher probability of failure for some transmission lines from status quo

Table 5 – Reasonably practicable test (\$ thousand)

Option	Network Safety Risk Reduction ³	Annualised CAPEX	Reasonably practicable ⁴ ?
A	49	110	No
B	31	70	No
C	0	230	No

Options A, B and C are not reasonably practicable.

4.3 Preferred option

The outcome of the SFAIRP/ALARP evaluation is that none of the options presented are reasonably practicable, and are therefore not required to satisfy the organisation's SFAIRP/ALARP obligations.

The preferred option to address the condition of the secondary systems is Option A – Complete In-Situ Replacement.

This option has been selected due to its technical viability and reduction in reliability risk. This option provides significant technical benefits and provides the greatest positive NPV.

Capital and operating expenditure

There is negligible difference in predicted ongoing operational expenditure between the three options and base case. Deploying the Complete In-Situ Replacement option will provide benefits in terms of remote monitoring, control and interrogation, responding to faults more efficiently and phasing out of obsolete legacy systems. These have been captured as benefits for delivering the project.

Regulatory Investment Test

A Regulatory Investment Test for Transmission (RIT-T) is not required as this is an asset replacement project with no augmentation component.

5. Recommendation

It is recommended to proceed with scoping Option A – Complete In-Situ Replacement in detail.

³ The Network Safety Risk Reduction is calculated as 6 x Bushfire Risk Reduction + 3 x Safety Risk Reduction + 0.1 x Reliability Risk Reduction

⁴ Reasonably practicable is defined as whether the annualised CAPEX is less than the Network Safety Risk Reduction

Attachment 1 – Commercial evaluation report

Option A NPV calculation

Project_Option Name			Coleambally Secondary System Renewal - Option A (Commercial)		
1. Financial Evaluation (excludes VCR benefits)					
NPV @ standard discount rate	10.00%	\$0.23m	NPV / Capital (Ratio)	0.13	
NPV @ upper bound rate	13.00%	-\$0.04m	Pay Back Period (Yrs)	0.12 Yrs	
NPV @ lower bound rate (WACC)	6.75%	\$0.70m	IRR%	12.41%	
2. Economic Evaluation (includes VCR benefits but excludes tax benefits from non-cash transactions, ENS penalty and overall tax cost)					
NPV @ standard discount rate	10.00%	\$0.46m	NPV / Capital (Ratio)	0.27	
NPV @ upper bound rate	13.00%	\$0.13m	Pay Back Period (Yrs)	4.92 Yrs	
NPV @ lower bound rate (WACC)	6.75%	\$1.04m	IRR%	14.70%	
Benefits					
Risk cost	As Is	To Be	Benefit	VCR Benefit	\$0.07m
Systems (reliability)	\$0.12m	\$0.01m	\$0.11m	ENS Penalty	\$0.02m
Financial	\$0.23m	\$0.02m	\$0.21m	All other risk benefits	\$0.26m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$0.35m
People (safety)	\$0.00m	\$0.00m	\$0.00m	Benefits in the financial NPV*	\$0.30m
Environment	\$0.01m	\$0.00m	\$0.01m	*excludes VCR benefits	
Reputation	\$0.02m	\$0.01m	\$0.01m	Benefits in the economic NPV**	\$0.35m
Total Risk benefits	\$0.39m	\$0.04m	\$0.35m	**excludes ENS penalty	
Cost savings and other benefits			\$0.02m		
Total Benefits			\$0.37m		
Other Financial Drivers					
Incremental opex cost pa (no depreciation)			-\$0.00m	Write-off cost	-\$0.03m
Capital - initial \$m			-\$1.72m	Major Asset Life (Yrs)	15.00 Yrs
Residual Value - initial investment			\$0.11m	Re-investment capital	\$0.00m
Capitalisation period			5.00 Yrs	Start of the re-investment period	0.00 Yrs

Option B NPV calculation

Project_Option Name

Coleambally Secondary System Renewal - Option B (Commercial)

1. Financial Evaluation (excludes VCR benefits)

NPV @ standard discount rate	10.00%	-\$0.66m	NPV / Capital (Ratio)	-0.60
NPV @ upper bound rate	13.00%	-\$0.65m	Pay Back Period (Yrs)	-0.07 Yrs
NPV @ lower bound rate (WACC)	6.75%	-\$0.67m	IRR%	-6.55%

2. Economic Evaluation (includes VCR benefits but excludes tax benefits from non-cash transactions, ENS penalty and overall tax cost)

NPV @ standard discount rate	10.00%	-\$0.66m	NPV / Capital (Ratio)	-0.60
NPV @ upper bound rate	13.00%	-\$0.65m	Pay Back Period (Yrs)	Not measurable
NPV @ lower bound rate (WACC)	6.75%	-\$0.67m	IRR%	-6.55%

Benefits

Risk cost	As Is	To Be	Benefit	VCR Benefit	\$0.01m
Systems (reliability)	\$0.12m	\$0.12m	\$0.01m	ENS Penalty	\$0.01m
Financial	\$0.23m	\$0.21m	\$0.02m	All other risk benefits	\$0.03m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$0.05m
People (safety)	\$0.00m	\$0.00m	\$0.00m		
Environment	\$0.01m	\$0.00m	\$0.00m	Benefits in the financial NPV*	\$0.04m
Reputation	\$0.02m	\$0.01m	\$0.01m	*excludes VCR benefits	
Total Risk benefits	\$0.39m	\$0.34m	\$0.05m	Benefits in the economic NPV**	\$0.04m
Cost savings and other benefits			-\$0.00m	**excludes ENS penalty	
Total Benefits			\$0.05m		

Other Financial Drivers

Incremental opex cost pa (no depreciation)	-\$0.00m	Write-off cost	\$0.00m
Capital - initial \$m	-\$1.10m	Major Asset Life (Yrs)	15.00 Yrs
Residual Value - initial investment	\$0.00m	Re-investment capital	\$0.00m
Capitalisation period	5.00 Yrs	Start of the re-investment period	0.00 Yrs

Option C NPV calculation

Project_Option Name

Coleambally Secondary System Renewal - Option C (Commercial)

1. Financial Evaluation (excludes VCR benefits)

NPV @ standard discount rate	10.00%	-\$1.91m	NPV / Capital (Ratio)	-0.55
NPV @ upper bound rate	13.00%	-\$1.90m	Pay Back Period (Yrs)	-0.08 Yrs
NPV @ lower bound rate (WACC)	6.75%	-\$1.88m	IRR%	-7.60%

2. Economic Evaluation (includes VCR benefits but excludes tax benefits from non-cash transactions, ENS penalty and overall tax cost)

NPV @ standard discount rate	10.00%	-\$1.74m	NPV / Capital (Ratio)	-0.50
NPV @ upper bound rate	13.00%	-\$1.76m	Pay Back Period (Yrs)	Not measurable
NPV @ lower bound rate (WACC)	6.75%	-\$1.65m	IRR%	-4.93%

Benefits

Risk cost	As Is	To Be	Benefit	VCR Benefit	\$0.04m
Systems (reliability)	\$0.12m	\$0.08m	\$0.04m	ENS Penalty	\$0.01m
Financial	\$0.23m	\$0.13m	\$0.10m	All other risk benefits	\$0.06m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$0.11m
People (safety)	\$0.00m	\$0.00m	\$0.00m	Benefits in the financial NPV*	\$0.49m
Environment	\$0.01m	\$0.02m	-\$0.01m	*excludes VCR benefits	
Reputation	\$0.02m	\$0.05m	-\$0.03m	Benefits in the economic NPV**	\$0.52m
Total Risk benefits	\$0.39m	\$0.28m	\$0.11m	**excludes ENS penalty	
Cost savings and other benefits			\$0.42m		
Total Benefits			\$0.53m		

Other Financial Drivers

Incremental opex cost pa (no depreciation)	-\$0.01m	Write-off cost	-\$0.03m
Capital - initial \$m	-\$3.50m	Major Asset Life (Yrs)	15.00 Yrs
Residual Value - initial investment	\$0.00m	Re-investment capital	\$0.00m
Capitalisation period	3.00 Yrs	Start of the re-investment period	0.00 Yrs