

OPTIONS EVALUATION REPORT (OER)

Regentville Secondary Systems Renewal

OER 000000001258 revision 3.0



Ellipse project no.: P0005381

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	24 November 2016	

Change history

Revision	Date	Amendment
0	27 June 2016	Initial issue
1	31 October 2016	Update to 2016/17 dollars and SFAIRP/ALARP data
2	17 November 2016	Update to format
3	24 November 2016	Added OSR reference

1. Need/opportunity

Regentville Substation is a customer connection point supplying Endeavour Energy's 132kV network in an area which contains the Nepean Hospital and Richmond RAAF Air Base. A significant portion of the secondary systems assets at Regentville Substation have been identified for replacement.

2. Related Needs/opportunities

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

- > Need ID 605 – Replacement of Quadramho (SHPM) Protection Relays
- > Need ID 607 – Replacement of 7SA513 Protection Relays
- > Need ID 608 – Replacement of 7SD511 Protection Relays
- > Need ID 615 – Replacement of LFZP112 Protection Relays
- > Need ID 602 – Replacement of RADSB Protection Relays
- > Need ID 630 – Replacement of Siemens 7EC Meters
- > Need ID 629 – Replacement of Remote Terminal Units (RTU)
- > Need ID 1386 – Protection - Transformer Diff Condition

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 degrading condition of the secondary systems or the risk cost associated with the Need. The risk cost of \$5.19m 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 recovery from asset failure becoming exhausted, increasing the consequence of asset failure.

Key drivers for this risk cost are:

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

Option A — Complete In-Situ Replacement [[OFR 1258A](#), [OFS 1258A](#)]

Option A is to replace all secondary systems assets at the Regentville Substation with current designs and architectures. This option also replaces Direct Current (DC) supplies to account for increase in power requirements and remediates the 415V Alternating Current (AC) distribution in the building and the yard.

The expected capital costs for the option total \$4.30m. This costing is estimated using TransGrid's "Success" estimating system. No further capital investment would be required over the 15 year life cycle of this option through to 2038.

Operating costs have been estimated at \$3k per annum based on current maintenance plan settings.

A benefit figure of \$33k 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 \$0.52m per annum (base case risk cost = \$5.19m). The risk reduction is realised through the reduction in the probability of failure for all assets and remediation of the risk posed by the 415V AC distribution.

Option B — IEC-61850 Deployment [[OFR 1258B](#), [OFS 1258B](#)]

Option B is to replace and upgrade all secondary systems assets using IEC-61850 technology and methodologies. This option also includes the remediation of the 415V AC distribution in the building and the yard.

The expected capital costs for the option total \$4.98m. This costing is estimated using TransGrid's "Success" estimating system. No further capital investment would be required over the 15 year life cycle of this option through to 2038.

Operating costs have been estimated at \$10k per annum based on a standard rate required for defect maintenance.

A benefit figure of \$33k 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 these second and third year is a high level assumption and considers the benefits diminishing due to potential spend in IEC-61850 solution to allow for improvements.

The residual risk associated with this option upon completion amounts to \$3.70m per annum (base case risk cost = \$5.19m). The risk reduction is realised through the reduction in the probability of failure for all assets and remediation of the risk posed by the 415V AC distribution.

Option C — Strategic Asset Replacement [[OFR 1258C](#), [OFS 1258C](#)]

Option C is to carry out individual replacements of assets that are identified for replacement up to 2023. The option is based on a 'like for like' approach whereby the asset is replaced by its modern equivalent. Additional system modifications or additional functionality would not be deployed under this option.

The expected capital costs for the option total \$3.40m. This costing is estimated using TransGrid's "Success" estimating system. A further \$220k capital investment would be required over the 15 year life cycle of this option through to 2038.

Operating costs have been estimated at \$3k per annum for this option based on current maintenance plan settings.

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 \$2.43m per annum (base case risk cost = \$5.19m). The risk reduction is realised through the reduction in the probability of failure for all assets.

Options A, B and C have all been assessed as technically feasible.

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

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 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	N/A	0.003	5.18	N/A	N/A	4
A	Complete In-Situ Replacement	4.30	0.003	0.52	4.11	23.43	1
B	IEC-61850 Deployment	4.98	0.010	3.70	(9.59)	5.10	3
C	Strategic Asset Replacement	3.40	0.003	2.43	2.12	10.34	2

The commercial evaluation is based on:

- > Economic life of the assets is assumed 15 years; hence this assessment period has been applied.
- > Write-offs have been estimated at \$179k for Option A and \$125k for Option B. Option C only addresses assets that have reached the end of their financial lives, and as such write-offs will not occur.
- > Capital cost is not escalated and it does not include capitalised interest.

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

Table 2 – Discount rate sensitivities (\$ million)

Option	Description	Economic NPV @13%	Economic NPV @6.75%
A	Complete In-Situ Replacement	17.79	32.13
B	IEC-61850 Deployment	3.42	7.74
C	Strategic Asset Replacement	7.20	15.47

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:

- > Catastrophic failure of asset/uncontrolled discharge or contact with electricity/ unauthorised access to site - 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	4,300	15 years	290
B	IEC-61850 Deployment	4,980	15 years	330
C	Strategic Asset Replacement	3,400	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	11	3,604	1	N/A	N/A	N/A
A	2	164	0	9	3,440	1
B	11	1,002	3	0	2,602	(1) ²
C	8	1,827	0	2	1,776	1

Table 5 – Reasonably practicable test (\$ thousand)

Option	Network Safety Risk Reduction ³	Annualised CAPEX	Reasonably practicable ⁴ ?
A	377	290	Yes
B	251	330	No
C	190	230	No

Option A is reasonably practicable.

Options B and C are not reasonably practicable.

² As IEC-61850 technology is untested, a conservative risk assessment has been used. This has a higher probability of failure for some transmission line protection assets post investment.

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

4.3 Preferred option

The outcome of the SFAIRP/ALARP evaluation is that Option A is the preferred option as it is reasonably practicable and provides the greatest network safety risk reduction, and is therefore 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 while achieving the ALARP principles.

Capital and operating expenditure

There is negligible difference in predicted ongoing operational expenditure between Option A and the 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 that Option A – Complete In-Situ Replacement be scoped in detail.

Attachment 1 – Commercial evaluation report

Option A NPV calculation

Project_Option Name			Regentville Secondary Systems Renewal - Option A		
1. Financial Evaluation (excludes VCR benefits)					
NPV @ standard discount rate	10.00%	\$4.11m	NPV / Capital (Ratio)	0.96	
NPV @ upper bound rate	13.00%	\$2.66m	Pay Back Period (Yrs)	0.25 Yrs	
NPV @ lower bound rate (WACC)	6.75%	\$6.42m	IRR%	24.66%	
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%	\$23.43m	NPV / Capital (Ratio)	5.45	
NPV @ upper bound rate	13.00%	\$17.79m	Pay Back Period (Yrs)	Not measurable	
NPV @ lower bound rate (WACC)	6.75%	\$32.13m	IRR%	68.41%	
Benefits					
Risk cost	As Is	To Be	Benefit	VCR Benefit	\$3.38m
Systems (reliability)	\$3.60m	\$0.16m	\$3.44m	ENS Penalty	\$0.00m
Financial	\$1.56m	\$0.36m	\$1.20m	All other risk benefits	\$1.28m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$4.66m
People (safety)	\$0.01m	\$0.00m	\$0.01m		
Environment	\$0.00m	#REF!	#REF!	Benefits in the financial NPV*	\$1.31m
Reputation	\$0.01m	\$0.00m	\$0.01m	*excludes VCR benefits	
Total Risk benefits	\$5.18m	#REF!	#REF!	Benefits in the economic NPV**	\$4.69m
Cost savings and other benefits			#REF!	**excludes ENS penalty	
Total Benefits			\$4.69m		
Other Financial Drivers					
Incremental opex cost pa (no depreciation)			-\$0.00m	Write-off cost	-\$0.18m
Capital - initial \$m			-\$4.30m	Major Asset Life (Yrs)	15.00 Yrs
Residual Value - initial investment			\$0.29m	Re-investment capital	\$0.00m
Capitalisation period			3.00 Yrs	Start of the re-investment period	0.00 Yrs

Option B NPV calculation

Project_Option Name			Regentville Secondary Systems Renewal - Option B		
1. Financial Evaluation (excludes VCR benefits)					
NPV @ standard discount rate	10.00%	-\$9.59m	NPV / Capital (Ratio)	-1.93	
NPV @ upper bound rate	13.00%	-\$8.09m	Pay Back Period (Yrs)	Not measurable	
NPV @ lower bound rate (WACC)	6.75%	-\$11.81m	IRR%	Not measurable	
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%	\$5.10m	NPV / Capital (Ratio)	1.02	
NPV @ upper bound rate	13.00%	\$3.42m	Pay Back Period (Yrs)	2.85 Yrs	
NPV @ lower bound rate (WACC)	6.75%	\$7.74m	IRR%	27.13%	
Benefits					
Risk cost	As Is	To Be	Benefit	VCR Benefit	\$2.57m
Systems (reliability)	\$3.60m	\$1.00m	\$2.60m	ENS Penalty	\$0.00m
Financial	\$1.56m	\$2.68m	-\$1.12m	All other risk benefits	-\$1.09m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$1.48m
People (safety)	\$0.01m	\$0.01m	-\$0.00m	Benefits in the financial NPV*	-\$0.66m
Environment	\$0.00m	\$0.00m	-\$0.00m	*excludes VCR benefits	
Reputation	\$0.01m	\$0.01m	\$0.00m	Benefits in the economic NPV**	\$1.91m
Total Risk benefits	\$5.18m	\$3.70m	\$1.48m	**excludes ENS penalty	
Cost savings and other benefits			\$0.43m		
Total Benefits			\$1.91m		
Other Financial Drivers					
Incremental opex cost pa (no depreciation)			-\$0.01m	Write-off cost	-\$0.13m
Capital - initial \$m			-\$4.98m	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

Option C NPV calculation

Project_Option Name

Regentville Secondary Systems Renewal - Option C

1. Financial Evaluation (excludes VCR benefits)

NPV @ standard discount rate	10.00%	\$2.12m	NPV / Capital (Ratio)	0.62
NPV @ upper bound rate	13.00%	\$1.09m	Pay Back Period (Yrs)	0.19 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$3.85m	IRR%	18.55%

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%	\$10.34m	NPV / Capital (Ratio)	3.04
NPV @ upper bound rate	13.00%	\$7.20m	Pay Back Period (Yrs)	1.26 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$15.47m	IRR%	37.72%

Benefits

Risk cost	As Is	To Be	Benefit	VCR Benefit	\$1.74m
Systems (reliability)	\$3.60m	\$1.83m	\$1.78m	ENS Penalty	\$0.00m
Financial	\$1.56m	\$0.59m	\$0.97m	All other risk benefits	\$1.01m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$2.75m
People (safety)	\$0.01m	\$0.01m	\$0.00m	Benefits in the financial NPV*	\$1.01m
Environment	\$0.00m	\$0.00m	\$0.00m	*excludes VCR benefits	
Reputation	\$0.01m	\$0.00m	\$0.01m	Benefits in the economic NPV**	\$2.75m
Total Risk benefits	\$5.18m	\$2.43m	\$2.75m	**excludes ENS penalty	
Cost savings and other benefits			\$0.00m		
Total Benefits			\$2.75m		

Other Financial Drivers

Incremental opex cost pa (no depreciation)	-\$0.00m	Write-off cost	\$0.00m
Capital - initial \$m	-\$3.40m	Major Asset Life (Yrs)	15.00 Yrs
Residual Value - initial investment	\$0.00m	Re-investment capital	-\$0.22m
Capitalisation period	5.00 Yrs	Start of the re-investment period	2021-22