

# OPTIONS EVALUATION REPORT (OER)

Marulan Secondary Systems Renewal

OER 000000001266 revision 2.0



**Ellipse project no.:** P0005393

**TRIM file:** [TRIM No]

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

**Project category:** Prescribed - Replacement

## Approvals

<b>Author</b>	Annie Welvaert	Secondary Systems Analyst
<b>Endorsed</b>	Philip Wong	Secondary Systems Asset Engineer
	Mark Jones	Secondary Systems and Communications Asset Manager
	Azil Khan	Investment Strategy Manager
<b>Approved</b>	Lance Wee	M/Asset Strategy
<b>Date submitted for approval</b>	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	24 November 2016	Update to format
3	24 November 2016	Added OSR reference

## 1. Need/opportunity

---

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 a planned connection to Taralga Wind Farm. A significant portion of secondary systems at Marulan Substation have been identified for replacement.

## 2. Related Needs/opportunities

---

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

- > 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

## 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 \$3.78m 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 are non self-checking and provide no feedback as to the health of the asset, therefore increasing the likelihood of a hazardous event occurring.
- > 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 – IEC-61850 Deployment [[OFR 1266A](#), [OFS 1266A](#)]

Option A is to replace and upgrade all secondary systems assets using IEC-61850 technology and methodologies. 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 \$5.21m. 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 \$33.6k 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 \$300k in the 1<sup>st</sup> year, \$150k in the 2<sup>nd</sup> year and \$75k in the 3<sup>rd</sup> 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 IEC-61850 solution to allow for improvements.

The residual risk associated with this option upon completion amounts to \$1.57m per annum (base case risk cost = \$3.78m). 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 – Complete In-Situ Replacement [[OFR 1266B](#), [OFS 1266B](#)]**

Option B is to replace all secondary systems assets at the Marulan Substation - excluding those associated with Taralga 9UR feeder - with current designs and architectures. This option also replaces DC supplies to account for increase in power.

The expected capital costs for the option total \$4.61m. 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 \$5k per annum based on current maintenance plan settings.

A benefit figure of \$33.6k per annum has been calculated for this option in accordance with TransGrid's Renewal and Maintenance Strategy for Secondary Systems Site Installations<sup>1</sup>.

The residual risk associated with this option upon completion amounts to \$0.32m per annum (base case risk cost = \$3.78m). 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 Replacements [[OFR 1266C](#), [OFS 1266C](#)]**

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 \$2.87m. This costing is estimated using TransGrid's "Success" estimating system. A further \$126k capital investment would be required over the 15 year life cycle of this option through to 2038.

Operating costs have been estimated at \$5k 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 Installations.

The residual risk associated with this option upon completion of the project amounts to \$2.29m per annum (base case risk cost = \$3.78m). The risk reduction is realised through the reduction in the probability of failure for all assets.

---

<sup>1</sup> Refer SSA Strategy – Renewal and Maintenance-Secondary Systems Site Installations

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

## 4. Evaluation

Evaluation of the proposed options has been completed using the ALARP (As Low as Reasonably Practicable) regulatory requirements and economic considerations. The results of this evaluation 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
<b>Base Case</b>	Run-to-fail	N/A	0.005	3.78	N/A	N/A	4
<b>A</b>	IEC-61850 Deployment	5.21	0.010	1.57	8.92	(0.34)	2
<b>B</b>	Complete In-Situ Replacement	4.61	0.005	0.32	16.18	0.97	1
<b>C</b>	Strategic Asset Replacement	2.87	0.005	2.29	4.72	(1.09)	3

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 \$125k for Options A and \$189k for B; Option C only addresses assets that have reached the end of their financial lives.
- > Capital cost is not escalated and it does not include capitalised interest.

Sensitivities on economic 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%
<b>A</b>	IEC-61850 Deployment	6.43	12.82
<b>B</b>	Complete In-Situ Replacement	12.11	22.48
<b>C</b>	Strategic Asset Replacement	3.10	7.39

### 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:

- > Conductor drop/structure 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
<b>Base</b>	Do nothing	N/A	N/A	N/A
<b>A</b>	IEC-61850 Deployment	5,210	15 years	350
<b>B</b>	Complete In-Situ Replacement	4,610	15 years	310
<b>C</b>	Strategic Asset Replacement	2,870	15 years	190

**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
<b>Base</b>	90	3,017	8	N/A	N/A	N/A
<b>A</b>	6	1,339	8	84	1,678	0
<b>B</b>	1	248	1	89	2,768	7
<b>C</b>	13	1,747	1	77	1,269	7

**Table 5 – Reasonably practicable test (\$ thousand)**

Option	Network Safety Risk Reduction <sup>2</sup>	Annualised CAPEX	Reasonably practicable <sup>3</sup> ?
<b>A</b>	421	350	Yes
<b>B</b>	585	310	Yes
<b>C</b>	400	190	Yes

All options are reasonably practicable.

<sup>2</sup> The Network Safety Risk Reduction is calculated as 6 x Bushfire Risk Reduction + 3 x Safety Risk Reduction + 0.1 x Reliability Risk Reduction

<sup>3</sup> 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 B 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 B – 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 Net Present Value (NPV) while achieving the ALARP principles.

#### **Capital and operating expenditure**

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

## Attachment 1 – Commercial evaluation report

### Option A NPV calculation

Project_Option Name			Marulan Secondary Systems Renewal - Option A		
1. Financial Evaluation (excludes VCR benefits)					
NPV @ standard discount rate	10.00%	-\$0.34m	NPV / Capital (Ratio)	-0.06	
NPV @ upper bound rate	13.00%	-\$0.83m	Pay Back Period (Yrs)	0.09 Yrs	
NPV @ lower bound rate (WACC)	6.75%	\$0.50m	IRR%	8.51%	
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%	\$8.92m	NPV / Capital (Ratio)	1.71	
NPV @ upper bound rate	13.00%	\$6.43m	Pay Back Period (Yrs)	2.14 Yrs	
NPV @ lower bound rate (WACC)	6.75%	\$12.82m	IRR%	38.95%	
Benefits					
Risk cost	As Is	To Be	Benefit	VCR Benefit	\$1.64m
Systems (reliability)	\$3.02m	\$1.34m	\$1.68m	ENS Penalty	\$0.02m
Financial	\$0.62m	\$0.20m	\$0.43m	All other risk benefits	\$0.55m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$2.21m
People (safety)	\$0.09m	\$0.01m	\$0.08m	Benefits in the financial NPV*	\$0.90m
Environment	\$0.01m	\$0.01m	\$0.00m	*excludes VCR benefits	
Reputation	\$0.04m	\$0.02m	\$0.02m	Benefits in the economic NPV**	\$2.52m
Total Risk benefits	\$3.78m	\$1.57m	\$2.21m	**excludes ENS penalty	
Cost savings and other benefits			\$0.33m		
Total Benefits			\$2.54m		
Other Financial Drivers					
Incremental opex cost pa (no depreciation)			-\$0.01m	Write-off cost	-\$0.12m
Capital - initial \$m			-\$5.21m	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 B NPV calculation

Project\_Option Name

Marulan Secondary Systems Renewal - Option B

### 1. Financial Evaluation (excludes VCR benefits)

NPV @ standard discount rate	10.00%	\$0.97m	NPV / Capital (Ratio)	0.21
NPV @ upper bound rate	13.00%	\$0.20m	Pay Back Period (Yrs)	0.14 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$2.24m	IRR%	13.98%

### 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%	\$16.18m	NPV / Capital (Ratio)	3.51
NPV @ upper bound rate	13.00%	\$12.11m	Pay Back Period (Yrs)	1.33 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$22.48m	IRR%	56.29%

### Benefits

Risk cost	As Is	To Be	Benefit	VCR Benefit	\$2.69m
Systems (reliability)	\$3.02m	\$0.25m	\$2.77m	ENS Penalty	\$0.03m
Financial	\$0.62m	\$0.07m	\$0.56m	All other risk benefits	\$0.74m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$3.46m
People (safety)	\$0.09m	\$0.00m	\$0.09m	Benefits in the financial NPV*	\$0.80m
Environment	\$0.01m	#REF!	#REF!	*excludes VCR benefits	
Reputation	\$0.04m	\$0.00m	\$0.04m	Benefits in the economic NPV**	\$3.46m
Total Risk benefits	\$3.78m	#REF!	#REF!	**excludes ENS penalty	
Cost savings and other benefits			#REF!		
Total Benefits			\$3.49m		

### Other Financial Drivers

Incremental opex cost pa (no depreciation)	-\$0.00m	Write-off cost	-\$0.19m
Capital - initial \$m	-\$4.61m	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			Marulan Secondary Systems Renewal - Option C		
1. Financial Evaluation (excludes VCR benefits)					
NPV @ standard discount rate	10.00%	-\$1.09m	NPV / Capital (Ratio)	-0.38	
NPV @ upper bound rate	13.00%	-\$1.22m	Pay Back Period (Yrs)	0.02 Yrs	
NPV @ lower bound rate (WACC)	6.75%	-\$0.82m	IRR%	2.09%	
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%	\$4.72m	NPV / Capital (Ratio)	1.64	
NPV @ upper bound rate	13.00%	\$3.10m	Pay Back Period (Yrs)	2.03 Yrs	
NPV @ lower bound rate (WACC)	6.75%	\$7.39m	IRR%	28.22%	
Benefits					
Risk cost	As Is	To Be	Benefit	VCR Benefit	\$1.24m
Systems (reliability)	\$3.02m	\$1.75m	\$1.27m	ENS Penalty	\$0.01m
Financial	\$0.62m	\$0.52m	\$0.10m	All other risk benefits	\$0.24m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$1.49m
People (safety)	\$0.09m	\$0.01m	\$0.08m		
Environment	\$0.01m	\$0.00m	\$0.01m	Benefits in the financial NPV*	\$0.25m
Reputation	\$0.04m	\$0.01m	\$0.03m	*excludes VCR benefits	
Total Risk benefits	\$3.78m	\$2.29m	\$1.49m		
Cost savings and other benefits			\$0.00m	Benefits in the economic NPV**	\$1.48m
Total Benefits			\$1.49m	**excludes ENS penalty	
Other Financial Drivers					
Incremental opex cost pa (no depreciation)			-\$0.00m	Write-off cost	\$0.00m
Capital - initial \$m			-\$2.87m	Major Asset Life (Yrs)	15.00 Yrs
Residual Value - initial investment			\$0.00m	Re-investment capital	-\$0.13m
Capitalisation period			5.00 Yrs	Start of the re-investment period	2024-25