

# OPTIONS EVALUATION REPORT (OER)

Panorama Secondary Systems Renewal

OER 000000001246 revision 3.0



**Ellipse project no.:** P0005233

**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	28 June 2016	Initial issue
1	28 October 2016	Update to 2016/17 dollars and SFAIRP/ALARP data
2	31 October 2016	Minor amendment
3	17 November 2016	Update to format
4	24 November 2016	Added OSR reference

## 1. Need/opportunity

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Panorama 132/66kV Substation comprises 2×132kV feeders, 2×132/66/11kV transformers and 5×66kV feeders. The site was established in 1979, and the secondary systems assets have install dates between 1977 and 2012. This site is a customer connection point supplying Essential Energy's 66kV network in the area inclusive of Bathurst which contains Bathurst Correctional Centre and Hospitals.

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

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

- > Need ID 606 – Replacement of THR Protection Relays
- > Need ID 622 – Replacement of Feeder OC and EF Protection Relays
- > Need ID 629 – Replacement of Remote Terminal Replacement (RTUs)
- > Need ID 637 – Replacement of YTG Relays
- > Need ID 610 – Replacement of EDM I MKIII Meters
- > Need ID 1382 – Protection - GE FAC Condition

The following Need also has an impact on the residual risks associated with the site:

- > Need ID DCN463 – Panorama Oil Containment

## 3. Options

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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 Panorama Substation of \$2.4m 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.

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 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 1246A, OFS 1246A]**

Option A is to carry out the complete upgrade and renewal of the secondary systems at Panorama 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 may involve installing new panels in the exact location as the existing control and protection panels. However, if this is not feasible, there are also spare panels which can be used to accommodate the new panels and allow for a staged replacement.

The expected capital costs for this option total \$4.32m. 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 \$4k per annum for this option based on current maintenance schedule.

A benefit figure of \$31.5k 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 \$0.33m per annum (base case risk cost = \$2.4m). 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 — IEC-61850 Replacement [OFR 1246B, OFS 1246B]**

Option B is to carry out complete replacement of the secondary system at Panorama 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 \$5.13m. 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.

A benefit figure of \$43k 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 1<sup>st</sup> year, \$200k in the 2<sup>nd</sup> year and \$100k 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 IEC61850 solution to allow for improvements.

The residual risk associated with this option upon completion of the project amounts to \$0.72m per annum (base case risk cost = \$2.4m). 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 C — Strategic Asset Replacement [OFR 1246C, OFS 1246C]**

Option C is to carry out the replacement of individual secondary system assets at Panorama 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 \$2.87m. This costing is estimated using TransGrid's 'Success' estimating system. A further \$1.98m of capital expenditure would be required over the 15 year life cycle of this option through to 2038.

Operating costs have been estimated at \$4k 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 Installations<sup>1</sup>.

The residual risk associated with this option upon completion of the project amounts to \$1.48m per annum (base case risk cost = \$2.4m). 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.

## 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
<b>Base Case</b>	‘Run-to-fail’ (O&M continues)	-	0.004	2.40	-	-	4
<b>A</b>	In-Situ Replacement	4.32	0.004	0.33	7.60	1.01	1
<b>B</b>	IEC-61850 Replacement	5.13	0.010	0.72	5.81	(0.82)	2
<b>C</b>	Strategic Asset Replacement	2.87	0.004	1.48	1.35	(1.10)	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 \$9,398 in June 2023 for Option A and Option B as these two options retire few assets before the end of their financial lives.
- > Capex excludes interest during construction.

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>	In-Situ Replacement	5.30	11.31

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

Option	Description	Economic NPV @13%	Economic NPV @6.75%
<b>B</b>	IEC-61850	3.89	8.80
<b>C</b>	Strategic Asset Replacement	0.52	2.82

## 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 , 6 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>	In-Situ Replacement	4,320	15 years	290
<b>B</b>	IEC-61850	5,130	15 years	340
<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>	19	1,584	30	N/A	N/A	N/A
<b>A</b>	2	170	16	16	1,414	14
<b>B</b>	6	310	43	13	1,274	(13)
<b>C</b>	16	982	9	3	602	21

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

Option	Network Safety Risk Reduction <sup>2</sup>	Annualised CAPEX	Reasonably practicable <sup>3</sup> ?
A	275	290	No
B	86	340	No
C	192	190	Yes

Options C just satisfies the reasonably practicable criteria, however this does not recognise the continued investment required during the expected life of Options A and B, that is considered in the NPV analysis.

Options A and B are not reasonably practicable.

### 4.3 Preferred option

The outcome of the SFAIRP/ALARP evaluation is that Option C just satisfies the reasonably practicable criteria. Option A provides the greatest Network Safety Risk Reduction while also providing the greatest NPV.

For these reasons, the preferred option to address the condition of the secondary system assets at Panorama 132kV Substation is Option A – In-Situ Replacement.

This option has been selected due to its technical viability, reduction in reliability risk and provision of operational benefits. This option provides significant technical benefits and provides the greatest positive NPV and greatest reduction in network safety risk.

As no project has yet been delivered using the technology described in Option B – IEC-61850, there is potential that the capital estimate may be further refined as TransGrid's capabilities with this technology increase. For that reason, it is proposed that Option B be further scoped to confirm the preferred option.

#### Capital and operating expenditure

There is negligible difference in predicted ongoing operational expenditure between the option and Base Case. Implementing Option A will reduce callouts to address defects and this benefit has been captured in the economic evaluation. 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 the recommendation that:

- > Option A – In-Situ Replacement be scoped in detail.
- > At such time in the future when the organisation is more experienced with the deployment of IEC-61850 systems onto the network, Option B – IEC-61850 be scoped in detail.

<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

## Attachment 1 – Commercial evaluation report

### Option A NPV calculation

Project\_Option Name

Panorama Secondary System Renewal - Option A (Commercial

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

NPV @ standard discount rate	10.00%	\$1.01m	NPV / Capital (Ratio)	0.23
NPV @ upper bound rate	13.00%	\$0.27m	Pay Back Period (Yrs)	0.15 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$2.26m	IRR%	14.50%

#### 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%	\$7.60m	NPV / Capital (Ratio)	1.76
NPV @ upper bound rate	13.00%	\$5.30m	Pay Back Period (Yrs)	2.10 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$11.31m	IRR%	36.47%

#### Benefits

Risk cost	As Is	To Be	Benefit	VCR Benefit	\$1.31m
Systems (reliability)	\$1.58m	\$0.17m	\$1.41m	ENS Penalty	\$0.04m
Financial	\$0.61m	\$0.07m	\$0.55m	All other risk benefits	\$0.72m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$2.07m
People (safety)	\$0.02m	\$0.00m	\$0.02m	Benefits in the financial NPV*	\$0.79m
Environment	\$0.03m	\$0.02m	\$0.01m	*excludes VCR benefits	
Reputation	\$0.15m	\$0.08m	\$0.08m	Benefits in the economic NPV**	\$2.06m
Total Risk benefits	\$2.40m	\$0.33m	\$2.07m	**excludes ENS penalty	
Cost savings and other benefits			\$0.03m		
Total Benefits			\$2.10m		

#### Other Financial Drivers

Incremental opex cost pa (no depreciation)	-\$0.00m	Write-off cost	-\$0.01m
Capital - initial \$m	-\$4.32m	Major Asset Life (Yrs)	15.00 Yrs
Residual Value - initial investment	\$0.29m	Re-investment capital	\$0.00m
Capitalisation period	4.00 Yrs	Start of the re-investment period	0.00 Yrs

## Option B NPV calculation

Project\_Option Name

Panorama Secondary System Renewal - Option B (Commercial)

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

NPV @ standard discount rate	10.00%	-\$0.82m	NPV / Capital (Ratio)	-0.16
NPV @ upper bound rate	13.00%	-\$1.31m	Pay Back Period (Yrs)	0.07 Yrs
NPV @ lower bound rate (WACC)	6.75%	-\$0.02m	IRR%	6.68%

### 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%	\$5.81m	NPV / Capital (Ratio)	1.13
NPV @ upper bound rate	13.00%	\$3.89m	Pay Back Period (Yrs)	2.66 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$8.80m	IRR%	26.67%

### Benefits

Risk cost	As Is	To Be	Benefit	VCR Benefit	\$1.19m
Systems (reliability)	\$1.58m	\$0.31m	\$1.27m	ENS Penalty	\$0.03m
Financial	\$0.61m	\$0.15m	\$0.46m	All other risk benefits	\$0.46m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$1.68m
People (safety)	\$0.02m	\$0.01m	\$0.01m	Benefits in the financial NPV*	\$0.92m
Environment	\$0.03m	\$0.04m	-\$0.01m	*excludes VCR benefits	
Reputation	\$0.15m	\$0.21m	-\$0.05m	Benefits in the economic NPV**	\$2.08m
Total Risk benefits	\$2.40m	\$0.72m	\$1.68m	**excludes ENS penalty	
Cost savings and other benefits			\$0.43m		
Total Benefits			\$2.11m		

### Other Financial Drivers

Incremental opex cost pa (no depreciation)	-\$0.01m	Write-off cost	-\$0.01m
Capital - initial \$m	-\$5.13m	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

Panorama Secondary System Renewal - Option C (Commercial)

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

NPV @ standard discount rate	10.00%	-\$1.10m	NPV / Capital (Ratio)	-0.38
NPV @ upper bound rate	13.00%	-\$1.31m	Pay Back Period (Yrs)	0.04 Yrs
NPV @ lower bound rate (WACC)	6.75%	-\$0.66m	IRR%	4.12%

### 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%	\$1.35m	NPV / Capital (Ratio)	0.47
NPV @ upper bound rate	13.00%	\$0.52m	Pay Back Period (Yrs)	4.54 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$2.82m	IRR%	15.87%

### Benefits

Risk cost	As Is	To Be	Benefit	VCR Benefit	\$0.54m
Systems (reliability)	\$1.58m	\$0.98m	\$0.60m	ENS Penalty	\$0.02m
Financial	\$0.61m	\$0.43m	\$0.19m	All other risk benefits	\$0.35m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$0.91m
People (safety)	\$0.02m	\$0.02m	\$0.00m	Benefits in the financial NPV*	\$0.37m
Environment	\$0.03m	\$0.01m	\$0.02m	*excludes VCR benefits	
Reputation	\$0.15m	\$0.05m	\$0.10m	Benefits in the economic NPV**	\$0.89m
Total Risk benefits	\$2.40m	\$1.48m	\$0.91m	**excludes ENS penalty	
Cost savings and other benefits			-\$0.00m		
Total Benefits			\$0.91m		

### Other Financial Drivers

Incremental opex cost pa (no depreciation)	-\$0.00m	Write-off cost	\$0.00m
Capital - initial \$m	-\$2.88m	Major Asset Life (Yrs)	15.00 Yrs
Residual Value - initial investment	\$0.19m	Re-investment capital	-\$1.98m
Capitalisation period	5.00 Yrs	Start of the re-investment period	2023-24