

# OPTIONS EVALUATION REPORT (OER)

Deniliquin Secondary Systems Renewal

OER 000000001191 revision 4.0



**Ellipse project no.:** P0005261

**TRIM file:** [TRIM No]

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

**Project category:** Prescribed - Replacement

## Approvals

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Approved	Lance Wee	M/Asset Strategy
Date submitted for approval	24 November 2016	

## Change history

Revision	Date	Amendment
0	29 June 2016	Initial issue
1	26 October 2016	Update to 2016/17 dollars and SFAIRP/ALARP data
2	11 November 2016	Update to format
3	15 November 2016	Minor amendment
4	24 November 2016	Added OSR reference

## 1. Need/opportunity

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Deniliquin 132/66kV Substation comprises 2×132kV feeders, 2×132/66kV transformers and 5×66kV feeders. The site was established in 1970, and the secondary systems assets have install dates between 1971 (electro-mechanical type with 40 years average nominal asset life) and 2010 (microprocessor with 15 years average nominal asset life).

A bulk of 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

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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 1380 – Schweitzer SELxxx Condition
- > Need ID 1376 – Replacement of Alstom Pxxx Protection Relays
- > Need ID 1356 – Replacement of OHx Protection Relays
- > Need ID 621 – Replacement of DB Series Protection Relays
- > Need ID 1383 – Replacement of GE FV2 Protection Relays
- > Need ID 1387 – Replacement of Capacitor Protection Relays
- > Need ID 610 – Replacement of EDM I MK3 Energy Meters

## 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, and component deterioration of the secondary systems or the risk cost associated with the Need. The risk cost associated with all secondary systems at Deniliquin 132/66kV Substation of \$3.35m 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:

- > All the relays protecting assets at this site have either reached or will reach their end of life by 2023, 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 — Complete Replacement with SSBs [OFR 1191A, OFS 1191A]**

Option A is to carry out the complete upgrade and renewal of secondary systems at Deniliquin by using modular Secondary Systems Building (SSBs) and installing new cable throughout the Substation. 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 \$10.4m. 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 involves complete replacement of the existing secondary systems.

Operating costs have been estimated at \$38k per annum for this option based on current maintenance schedule.

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.

The residual risk associated with this option upon completion of the project amounts to \$88k per annum (base case risk cost = \$3.35). 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 — Complete In-Situ Replacement [OFR 1191B, OFS 1191B]**

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

The expected capital costs for the option total \$4.4m. 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 \$4k 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.

The residual risk associated with this option upon completion of the project amounts to \$742k per annum (base case risk cost = \$3.35m). 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 1191C, OFS 1191C]**

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 \$2.84m. This costing is estimated using TransGrid's "Success" estimating system. A further \$532k capital investment would be required over the 15 year life cycle of this option through to 2038 in order to replace other assets as their reach their end of life.

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

The residual risk associated with this option upon completion of the project amounts to \$1.94m per annum (base case risk cost = \$3.35m). 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.

## 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	0.004	3.35	N/A	N/A	4
<b>A</b>	Complete Replacement with SSBs	10.4	0.004	0.088	9.57	(0.20)	2
<b>B</b>	Complete In-Situ Replacement	4.45	0.004	0.742	10.62	0.95	1
<b>C</b>	Strategic Asset Replacement	2.84	0.004	1.94	3.83	(2.05)	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 \$1.6k for Options A and B only as 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 three 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>	Complete Replacement with SSBs	6.24	15.0

<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>	Complete In-Situ Replacement	7.62	15.4
<b>C</b>	Strategic Asset Replacement	2.40	6.29

## 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 - 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>	Complete Replacement with SSBs	10.44	15 years	700
<b>B</b>	Complete In-Situ Replacement	4,450	15 years	300
<b>C</b>	Strategic Asset Replacement	2,840	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>	954	1,939	2	N/A	N/A	N/A
<b>A</b>	0	53	1	954	1,887	0
<b>B</b>	636	71	0	318	1,868	1
<b>C</b>	954	563	2.00k	0	1,376	0

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

Option	Network Safety Risk Reduction <sup>2</sup>	Annualised CAPEX	Reasonably practicable <sup>3</sup> ?
A	3,054	700	Yes
B	1,150	300	Yes
C	136	190	No

Both Options A and B are reasonably practicable.

Option C is not reasonably practicable.

### 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 (approximately 3 times more than option B), and is therefore required to satisfy the organisation's SFAIRP/ALARP obligations.

Although commercially less attractive than option B, this option also returns positive Net Present Value (NPV).

The preferred option to address the condition of the secondary systems is Option A – Complete Replacement with SSBs.

#### Capital and operating expenditure

There is negligible difference in predicted ongoing operational expenditure between all identified options and the Base Case. Deploying the Complete Replacement with SSBs 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 Replacement with SSBs 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			Deniliquin Secondary System Renewal - Option A (Commercial)		
1. Financial Evaluation (excludes VCR benefits)					
NPV @ standard discount rate	10.00%	-\$0.20m	NPV / Capital (Ratio)	-0.02	
NPV @ upper bound rate	13.00%	-\$1.21m	Pay Back Period (Yrs)	0.10 Yrs	
NPV @ lower bound rate (WACC)	6.75%	\$1.60m	IRR%	9.54%	
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%	\$9.57m	NPV / Capital (Ratio)	0.92	
NPV @ upper bound rate	13.00%	\$6.24m	Pay Back Period (Yrs)	3.20 Yrs	
NPV @ lower bound rate (WACC)	6.75%	\$15.00m	IRR%	27.92%	
Benefits					
Risk cost	As Is	To Be	Benefit	VCR Benefit	\$1.88m
Systems (reliability)	\$1.94m	\$0.05m	\$1.89m	ENS Penalty	\$0.00m
Financial	\$0.46m	\$0.03m	\$0.42m	All other risk benefits	\$1.38m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$3.26m
People (safety)	\$0.95m	\$0.00m	\$0.95m		
Environment	\$0.00m	\$0.00m	\$0.00m	Benefits in the financial NPV*	\$1.42m
Reputation	\$0.00m	\$0.00m	\$0.00m	*excludes VCR benefits	
Total Risk benefits	\$3.35m	\$0.09m	\$3.26m		
Cost savings and other benefits			\$0.03m	Benefits in the economic NPV**	\$3.30m
Total Benefits			\$3.30m	**excludes ENS penalty	
Other Financial Drivers					
Incremental opex cost pa (no depreciation)			-\$0.04m	Write-off cost	-\$0.00m
Capital - initial \$m			-\$10.44m	Major Asset Life (Yrs)	15.00 Yrs
Residual Value - initial investment			\$0.00m	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

Deniliquin Secondary System Renewal - Option B (Commercial)

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

NPV @ standard discount rate	10.00%	\$0.95m	NPV / Capital (Ratio)	0.21
NPV @ upper bound rate	13.00%	\$0.24m	Pay Back Period (Yrs)	0.14 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$2.17m	IRR%	14.44%

### 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%	\$10.62m	NPV / Capital (Ratio)	2.39
NPV @ upper bound rate	13.00%	\$7.62m	Pay Back Period (Yrs)	1.69 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$15.42m	IRR%	47.68%

### Benefits

Risk cost	As Is	To Be	Benefit	VCR Benefit	\$1.86m
Systems (reliability)	\$1.94m	\$0.07m	\$1.87m	ENS Penalty	\$0.00m
Financial	\$0.46m	\$0.03m	\$0.42m	All other risk benefits	\$0.75m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$2.61m
People (safety)	\$0.95m	\$0.64m	\$0.32m	Benefits in the financial NPV*	\$0.78m
Environment	\$0.00m	\$0.00m	\$0.00m	*excludes VCR benefits	
Reputation	\$0.00m	\$0.00m	-\$0.00m	Benefits in the economic NPV**	\$2.64m
Total Risk benefits	\$3.35m	\$0.74m	\$2.61m	**excludes ENS penalty	
Cost savings and other benefits			\$0.03m		
Total Benefits			\$2.64m		

### Other Financial Drivers

Incremental opex cost pa (no depreciation)	-\$0.00m	Write-off cost	-\$0.00m
Capital - initial \$m	-\$4.45m	Major Asset Life (Yrs)	15.00 Yrs
Residual Value - initial investment	\$0.30m	Re-investment capital	\$0.00m
Capitalisation period	4.00 Yrs	Start of the re-investment period	0.00 Yrs



## Option C NPV calculation

Project_Option Name			Deniliquin Secondary System Renewal - Option C (Commercial)		
1. Financial Evaluation (excludes VCR benefits)					
NPV @ standard discount rate	10.00%	-\$2.05m	NPV / Capital (Ratio)	-0.72	
NPV @ upper bound rate	13.00%	-\$1.86m	Pay Back Period (Yrs)	-0.14 Yrs	
NPV @ lower bound rate (WACC)	6.75%	-\$2.28m	IRR%	-14.34%	
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%	\$3.83m	NPV / Capital (Ratio)	1.35	
NPV @ upper bound rate	13.00%	\$2.40m	Pay Back Period (Yrs)	2.40 Yrs	
NPV @ lower bound rate (WACC)	6.75%	\$6.29m	IRR%	26.53%	
Benefits					
Risk cost	As Is	To Be	Benefit	VCR Benefit	\$1.37m
Systems (reliability)	\$1.94m	\$0.56m	\$1.38m	ENS Penalty	\$0.00m
Financial	\$0.46m	\$0.42m	\$0.03m	All other risk benefits	\$0.04m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$1.41m
People (safety)	\$0.95m	\$0.95m	\$0.00m	Benefits in the financial NPV*	\$0.04m
Environment	\$0.00m	\$0.00m	\$0.00m	*excludes VCR benefits	
Reputation	\$0.00m	\$0.00m	-\$0.00m	Benefits in the economic NPV**	\$1.41m
Total Risk benefits	\$3.35m	\$1.94m	\$1.41m	**excludes ENS penalty	
Cost savings and other benefits			\$0.00m		
Total Benefits			\$1.41m		
Other Financial Drivers					
Incremental opex cost pa (no depreciation)			-\$0.00m	Write-off cost	\$0.00m
Capital - initial \$m			-\$2.84m	Major Asset Life (Yrs)	15.00 Yrs
Residual Value - initial investment			\$0.00m	Re-investment capital	-\$0.53m
Capitalisation period			6.00 Yrs	Start of the re-investment period	2024-25