

OPTIONS EVALUATION REPORT (OER)



Substation Noise Non-Compliance Program

OER 000000001454 revision 5.0

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Approvals

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Date submitted for approval	10 November 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	31 October 2016	Amendment
3	1 December 2016	Update to format
5	10 November 2017	Update to project scope

1. Need/opportunity

Need 1454 has been raised to address the mitigation of risks associated with substation operational noise levels that exceed acceptable levels.

In NSW, noise nuisance (or pollution) is regulated through the Protection of the Environment Operations Act 1997 and guidelines for managing industrial noise are set out in the NSW Industrial Noise Policy (INP). For the noise compliance program, the sites being considered as having unacceptable levels of noise have been identified in a detailed risk assessment as potentially exceeding the INP guideline levels by ≥ 5 dB(A) at the nearest receivers.

A desktop review was completed by a consultancy (ERM), in which six sites were identified at higher risk of needing noise mitigation measures. A copy of the summary report is provided in the supporting documentation in PDGS.

Out of the six sites identified as higher risk rating, Dapto substation presently has four transformers however one of the four transformers is an in-service spare and is not required as a permanent installation.

Griffith and Orange substation has moderate/high risk however the substations have newer transformers installed and subject to normal design review including noise design studies.

At Wagga 132/66kV substation two new transformers replace the original three older transformers, Noise design is also provided as part of the replacement project.

Based on the above, it is considered that the originally proposed noise mitigation work at Dapto, Griffith, Orange and Wagga 132 substations should not be required in the RP2 regulatory period.

Noise mitigation measures at Molong and Muswellbrook are to be implemented during the 2019-2023 regulatory period.

2. Related Needs/opportunities

There may be other projects planned for these sites (such as transformer replacements) that will mitigate the need to separately address the potential noise non-compliance issues. Confirmation should be sought that any planned works will adequately address the existing noise amenity issues.

Consideration should also be given to implementing mitigations that will be beneficial for mitigating the risk of future noise amenity issues due to likely residential encroachment.

There are no pre-requisite or dependent Needs.

3. Options

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

A desktop risk assessment identified sites where there is potentially a noise exceedance at nearby receptors of greater than 5dBA above the INP guideline levels. A summary of these Needs can be found in Needs/Opportunities Statement NOS 1454.

Base Case

Under a Base Case of 'do nothing', the associated risk cost from the issues identified in Table 1 is \$3.35m per year.

Table 1 – Base Case risk cost by category (\$ million)

Site	Total Annual Risk Cost	Financial Risk	Environmental Risk	Reputation Risk	Reliability Risk
Molong 132kV Substation	1.33	0.94	0.28	0.08	0.04
Muswellbrook 330kV Substation	2.02	1.67	0.28	0.08	-
TOTAL	3.35	-	-	-	-

Option A — Install Noise Walls [OFR 1454A, OFS 1454A]

This option involves the installation of noise walls at selected sites as per details in Table 2. These sites have been identified as being at high risk of causing noise exceedance at nearby receptors. Initial noise modelling (undertaken as part of the risk assessment) indicates that noise walls as detailed below would reduce noise levels at the nearest receivers.

Table 2 – Recommended noise walls for sites where there are noise exceedances

Site	Predicted Noise Exceedance	Recommended Noise Walls
Molong 132kV Substation	14 dB(A)	Initial modelling showed that 3 sided walls around one of the transformers and also a boundary wall will be required to reduce noise levels. Also, see below for more details in relation to results of a subsequent detailed assessment of the site.
Muswellbrook 330kV Substation	12 dB(A)	Initial modelling shows that 3 sided walls will be required around the two transformers to reduce noise levels.

Further detailed verification of the noise exceedance levels and predicted reduction following installation of the walls, will need to occur during the project scoping phase of the project, except for the Molong site where this has already been completed.

A detailed noise assessment has been undertaken for the Molong site and modelling predicts potential for an exceedance between 0.6 to 3.3 dB at the nearest occupied dwelling, depending on weather conditions. Mitigation in the form of three sided transformer bay walls around transformer 1 or replacement of the transformer will effectively reduce emissions to compliant levels. It is noted the transformer that is the main noise source on the site is 55 years old. Given the age of the transformer, the option of replacing the transformer at this site has also been considered in Option B below.

It is estimated the capital expenditure for this option at Molong and Muswellbrook is \$2.48m ±25%. Details can be found in Section 6 of OFS 1454A.

Following the installation of walls as per this option, the risk cost associated with the upgraded sites is \$0.44m per year. A breakdown of the Option A risk cost by category is shown in Table 3.

Table 3 – Option A risk cost by category (\$ million)

Site	Total Annual Risk Cost	Financial Risk	Environmental Risk	Reputation Risk	Reliability Risk
Molong 132kV Substation	0.24	0.16	0.03	0.01	0.04
Muswellbrook 330kV Substation	0.20	0.17	0.03	0.01	-

Site	Total Annual Risk Cost	Financial Risk	Environmental Risk	Reputation Risk	Reliability Risk
TOTAL	0.44	-	-	-	-

The total projected risk reduction as a result of implementing Option A is \$2.91m per year. It can be seen from Table 3 that reductions in the risk costs under the financial, environment and reputation categories are expected, with the implementation of the option reducing the risk of non-compliance and breaches.

Option B — Transformer Replacement at Molong [\[OFR 1454B, OFS 1454B\]](#)

This option involves the replacement of a transformer at Molong. It is noted that the TransGrid transformer that is the main noise source on the site is 55 years old and has a high sound power level (104 Lw) relative to other TransGrid transformers. The average of the known sound power levels for other 132/66kV TransGrid transformers is 85 Lw. The option of replacing the transformer with an alternate that has a lower sound power level has been considered. Further detailed verification of the noise levels at Molong Substation and the predicted levels following the replacement of the transformer will need to occur during the scoping phase of the project.

It is estimated the capital expenditure for this option is \$3.7m ±25%. Details can be found in Section 6 of OFS 1454B.

Following the replacement of the transformer as per this option, the risk cost associated with the upgraded site at Molong is \$0. The total projected risk reduction as a result of implementing Option B at Molong is \$1.33m per year. Reductions in the risk costs under all categories are expected, with the implementation of the option reducing the risk of non-compliance and breaches.

4. Evaluation

Both Option A and B detailed above are considered to be technically feasible¹. The Base Case 'do nothing' is not technically feasible as there is a high likelihood that the option results in a non-compliance with relevant laws.

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 4.

Table 4 – Commercial evaluation (noise non-compliance) (\$ million)

Option	Description	Total capex	Annual opex	Annual post project risk cost	Economic NPV @10%	Rank
Base Case	Do Nothing	N/A	-	0.265	N/A	3
A	Install Noise Walls				-	1

¹ An option is technically feasible if TransGrid reasonably considers that there is a high likelihood that the option, if developed, will provide the relevant service while complying with all relevant laws.

Option	Description	Total capex	Annual opex	Annual post project risk cost	Economic NPV @10%	Rank
	Molong 132kV Substation	0.84	-	0.24	5.96	
	Muswellbrook 330kV Substation	1.64	-	0.20	9.75	
B	Replace Transformer at Molong	3.70	-	0	6.47	2

The commercial evaluation is based on:

- > A 10% discount with sensitivities based on TransGrid's current AER-determined pre-tax real regulatory Weighted Average Cost of Capital (WACC) of 6.75% and 13% for the upper bound
- > An analysis period of 40 years for the asset life for transformer walls and 45 years for the transformer

Details of the Net Present Value (NPV) calculation for Options A and B are provided in PDGS.

Sensitivities on economic Net Present Value (NPV) for the option with changing discount rates are shown in Table 5.

Table 5 – Discount rate sensitivities (\$ million)

Option	Description	Economic NPV @13%	Economic NPV @6.75%
A	Install Noise Walls		
	Molong 132kV Substation	4.09	9.25
	Muswellbrook 330kV Substation	6.74	15.05
B	Replace Transformer at Molong	4.14	10.78

4.2 SFAIRP/ALARP evaluation

Under Option A no network safety or reliability risks were identified for the sites, except at Molong. Further, none of the Key Hazardous Events to which So Far As Is Reasonably Practicable (SFAIRP)/ As Low As Reasonably Practical (ALARP) is applicable, are relevant. As such, the ALARP/SFAIRP principle has only been applied to the options at Molong.

At Molong, there are relevant network safety risks, due to the age of the transformer. As such, an evaluation of the proposed options at Molong has been completed against SFAIRP/ALARP obligation, as required by the Electricity Supply (Safety and Network Management) Regulation 2014 and the Work Health and Safety Act 2011. Details are provided in PDGS. 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)
- > Unplanned outage of High Voltage (HV) equipment - 10% of the reliability risk (applicable to safety)

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

Table 6 – Feasible options (Molong) (\$ thousand)

Option	Description	CAPEX	Expected Life	Annualised CAPEX
Base	Do nothing	N/A	N/A	N/A
A	Install Noise Walls	840	40 years	21
B	Replace Transformer at Molong	3,700	45 years	82

Table 7 – Annual risk calculations (Molong) (\$ thousand)

Option	Annual Residual Risk			Annual Risk Savings		
	Safety Risk	Reliability Risk	Bushfire Risk	Safety Risk	Reliability Risk	Bushfire Risk
Base	1	40	0	N/A	N/A	N/A
A	1	40	0	0	0	0
B	0	0	0	1	40	0

Table 8 – Reasonably practicable test (Molong) (\$ thousand)

Option	Network Safety Risk Reduction ²	Annualised CAPEX	Reasonably practicable ³ ?
A	0	21	No
B	8	82	No

Options A and B are not reasonably practicable.

4.3 Preferred option

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

The preferred option to mitigate the operational noise risk is Option A – Install Noise Walls for all substations investigated, except in the case of Molong Substation where Option B is preferred. These options have been selected because they are technical viable, reduce financial, environment and reputation risk, and also provide the greatest positive NPV.

Capital and operating expenditure

For Option A – Install Noise Walls, there are no other ongoing capital expenditure considerations beyond the initial installation project, and no significant ongoing operating expenditure considerations.

For Option B – Replace Transformer at Molong, the operational savings associated with decreased defect costs of the new assets has been included and there are no other ongoing capital expenditure considerations beyond the initial installation project.

² The Network Safety Risk Reduction is calculated as 3 x Safety Risk Reduction + 0.1 x Reliability Risk Reduction. No bushfire risk is applicable for the consequences considered

³ Reasonably practicable is defined as whether the annualised CAPEX is less than the Network Safety Risk Reduction

Regulatory Investment Test

No Regulatory Investment Test for Transmission (RIT-T) analysis is required as the works are condition based.

5. Recommendation

From the above commercial and technical evaluation of the available options, it is recommended that detailed scoping be completed for the installation of noise walls as outlined in Option A, however the proposed noise wall for Molong should be removed from this list as the preferred solution is for a full replacement of the transformer. With regard to Molong the recommendation is for a detailed scoping to be completed for the replacement of the transformer.

Further detailed verification of the noise exceedance levels and predicted reduction following installation of noise walls and the transformer replacement will need to occur during the project scoping phase of the project.

Attachment 1 – Commercial evaluation report

Option A NPV calculation – Molong

Project_Option Name		Noisewall Mitigation - Molong 132kV Substation			
1. Financial Evaluation (excludes VCR benefits)					
NPV @ standard discount rate	10.00%	\$5.96m	NPV / Capital (Ratio)	7.09	
NPV @ upper bound rate	13.00%	\$4.09m	Pay Back Period (Yrs)	Not measurable	
NPV @ lower bound rate (WACC)	6.75%	\$9.25m	IRR%	36.97%	
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%	\$5.96m	NPV / Capital (Ratio)	7.09	
NPV @ upper bound rate	13.00%	\$4.09m	Pay Back Period (Yrs)	Not measurable	
NPV @ lower bound rate (WACC)	6.75%	\$9.25m	IRR%	36.97%	
Benefits					
Risk cost	As Is	To Be	Benefit	VCR Benefit	\$0.00m
Systems (reliability)	\$0.04m	\$0.04m	\$0.00m	ENS Penalty	\$0.00m
Financial	\$0.94m	\$0.16m	\$0.78m	All other risk benefits	\$1.09m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$1.09m
People (safety)	\$0.00m	\$0.00m	\$0.00m	Benefits in the financial NPV*	\$1.09m
Environment	\$0.28m	\$0.03m	\$0.25m	*excludes VCR benefits	
Reputation	\$0.08m	\$0.01m	\$0.07m	Benefits in the economic NPV**	\$1.09m
Total Risk benefits	\$1.33m	\$0.24m	\$1.09m	**excludes ENS penalty	
Cost savings and other benefits			\$0.00m		
Total Benefits			\$1.09m		
Other Financial Drivers					
Incremental opex cost pa (no depreciation)			\$0.00m	Write-off cost	\$0.00m
Capital - initial \$m			-\$0.84m	Major Asset Life (Yrs)	40.00 Yrs
Residual Value - initial investment			\$0.32m	Re-investment capital	\$0.00m
Capitalisation period			5.00 Yrs	Start of the re-investment period	0.00 Yrs

Option A NPV calculation – Muswellbrook

Project_ Option Name

Noisewall Mitigation - Muswellbrook 330kV Substation

1. Financial Evaluation (excludes VCR benefits)

NPV @ standard discount rate	10.00%	\$9.75m	NPV / Capital (Ratio)	5.92
NPV @ upper bound rate	13.00%	\$6.74m	Pay Back Period (Yrs)	Not measurable
NPV @ lower bound rate (WACC)	6.75%	\$15.05m	IRR%	45.09%

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%	\$9.75m	NPV / Capital (Ratio)	5.92
NPV @ upper bound rate	13.00%	\$6.74m	Pay Back Period (Yrs)	Not measurable
NPV @ lower bound rate (WACC)	6.75%	\$15.05m	IRR%	45.09%

Benefits

Risk cost	As Is	To Be	Benefit	VCR Benefit	
<i>Systems (reliability)</i>	\$0.00m	\$0.00m	\$0.00m	ENS Penalty	\$0.00m
<i>Financial</i>	\$1.66m	\$0.16m	\$1.50m	All other risk benefits	\$1.82m
<i>Operational/compliance</i>	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$1.82m
<i>People (safety)</i>	\$0.00m	\$0.00m	\$0.00m	Benefits in the financial NPV*	\$1.82m
<i>Environment</i>	\$0.28m	\$0.03m	\$0.25m	*excludes VCR benefits	
<i>Reputation</i>	\$0.08m	\$0.01m	\$0.07m	Benefits in the economic NPV**	\$1.82m
Total Risk benefits	\$2.02m	\$0.20m	\$1.82m	**excludes ENS penalty	
Cost savings and other benefits			\$0.00m		
Total Benefits			\$1.82m		

Other Financial Drivers

Incremental opex cost pa (no depreciation)	-\$0.03m	Write-off cost	\$0.00m
Capital - initial \$m	-\$1.65m	Major Asset Life (Yrs)	40.00 Yrs
Residual Value - initial investment	\$0.62m	Re-investment capital	\$0.00m
Capitalisation period	5.00 Yrs	Start of the re-investment period	0.00 Yrs

Option B NPV calculation – Molong

Project_Option Name		1454 Molong Transformer - Option A Replacement			
1. Financial Evaluation (excludes VCR benefits)					
NPV @ standard discount rate	10.00%	\$5.99m	NPV / Capital (Ratio)	1.62	
NPV @ upper bound rate	13.00%	\$3.81m	Pay Back Period (Yrs)	0.34 Yrs	
NPV @ lower bound rate (WACC)	6.75%	\$10.00m	IRR%	33.83%	
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%	\$6.47m	NPV / Capital (Ratio)	1.75	
NPV @ upper bound rate	13.00%	\$4.14m	Pay Back Period (Yrs)	2.74 Yrs	
NPV @ lower bound rate (WACC)	6.75%	\$10.78m	IRR%	35.14%	
Benefits					
Risk cost	As Is	To Be	Benefit	VCR Benefit	\$1.25m
Systems (reliability)	\$1.25m	\$0.00m	\$1.25m	ENS Penalty	\$0.00m
Financial	\$0.07m	\$0.00m	\$0.07m	All other risk benefits	\$0.08m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$1.33m
People (safety)	\$0.01m	\$0.00m	\$0.01m	Benefits in the financial NPV*	\$0.08m
Environment	\$0.00m	\$0.00m	\$0.00m	*excludes VCR benefits	
Reputation	\$0.00m	\$0.00m	\$0.00m	Benefits in the economic NPV**	\$1.33m
Total Risk benefits	\$1.33m	\$0.00m	\$1.33m	**excludes ENS penalty	
Cost savings and other benefits			\$0.00m		
Total Benefits			\$1.33m		
Other Financial Drivers					
Incremental opex cost pa (no depreciation)			\$0.00m	Write-off cost	\$0.00m
Capital - initial \$m			-\$3.70m	Major Asset Life (Yrs)	45.00 Yrs
Residual Value - initial investment			\$1.64m	Re-investment capital	\$0.00m
Capitalisation period			5.00 Yrs	Start of the re-investment period	0.00 Yrs