

# OPTIONS EVALUATION REPORT (OER)



Substation Lighting Replacement

OER-000000001455 revision 0.1

**Ellipse project no.:** P0008475

**TRIM file:** [TRIM No]

**Project reason:** Capability – Improved Asset Management

**Project category:** Prescribed – Security/Compliance

## Approvals

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<b>Date submitted for approval</b>	29 November 2016	

## Change history

Revision	Date	Amendment
0	29 June 2016	Initial issue
1	24 October 2016	Update to 2016/17 dollars and SFAIRP/ALARP data
2	29 November 2016	Update to format
3	30 November 2016	Amendment by Author

## 1. Need/opportunity

The benefit of having movement activated lighting [REDACTED]  
In addition, upgrading substation lighting will reduce safety incidents and improve the operational capacity of Closed-circuit Television (CCTV) camera system to achieve clear recording at night. This involves:

- > Installing Movement Activated Lighting system at [REDACTED] substation sites around the perimeter.
- > Upgrading operational lighting in the switchyard at [REDACTED] with modern day equivalents.

[REDACTED] substation sites have been identified for replacement based on the below criteria:

- > The switchyard operational lighting have reached their conditional end of life
- > Number of defects, associated corrective cost and unavailability are high and increasing.
- > Security and safety criticality of these sites are high.

The work will be staggered across the duration of the next regulatory control period, 2018/19-2022/23.

## 2. Related Needs/opportunities

Potential pairing with existing or upcoming projects can deliver cost efficiency. Attachment A.1 contains the list of related Needs.

## 3. Options

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

### Base Case

The description, capital cost and risk cost for the Base Case and preferred option are provided in Table 1.

**Table 1 – Summary of Base Case (\$ million)**

Option	Description	Non-escalated Capital cost	Residual Risk Cost pa
Base Case	Do nothing	-	0.47
A	Install movement activated lighting and upgrade substation lighting at nominated substations	7.70	0.004

### Option A – Install movement activated lighting and upgrade substation lighting at nominated substations [OFS 1455A]

The option involves installing Movement Activated Lighting system and upgrading substation lighting at [REDACTED] substations in the order of priority as per Attachment A.2. For each site the following has been allowed:

- > Install sufficient fast start lighting around the perimeter to achieve the lighting level requirements [REDACTED] for security lighting.
- > Replace switchyard operational lighting at the nominated substation to achieve the required lighting level [REDACTED]

As the design of the security lighting and the operational lighting is closely linked, security lighting upgrades should be carried out with any condition based lighting work at each site. In this case the scope will also include the replacement of lighting throughout the switchyard to achieve the required lighting levels [REDACTED]. This lighting will not be automatically switched.

Following assumptions are considered to identify the risk cost for Option A:

- > Probability of Failure (POF):
  - Probability that movement activated light may fail (to perform their intended tasks) per year is [REDACTED] (pre investment) and [REDACTED]<sup>2</sup> (post investment).
- > Consequences:
  - Personal injury: The likelihood of consequence (LoC) for personal injury has remained [REDACTED] for both pre and post investment based on the rate of unauthorised entry in TransGrid substation sites.
  - Service Interruption: The LoC for service interruption (electricity) has remained 1% for both pre and post investment. This is based on the fact that both a high voltage electrocution/arc and an unauthorised operation of equipment by an intruder will cause a service interruption.
  - Repair cost to TransGrid substation asset: It is considered that damage to TransGrid asset caused by intruder would cost \$20K considering TransGrid unauthorised entry rate of [REDACTED] per annum.

Following cost saving benefits are considered for Net Present Value (NPV) calculation:

- > It considers total \$3k savings for callout cost due to false alarms for [REDACTED] sites per annum based on irregularities statistics related to security from Jan to Dec 2015.

## 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 2.

**Table 2 – Commercial evaluation (\$ million)**

Option	Description	Total capex	Annual opex	Annual post project risk cost	Economic NPV @10%	Financial NPV @10%	Rank
Base Case	Do nothing	N/A	N/A	0.473	N/A	N/A	2
A	Install movement activated lighting and upgrade substation lighting at nominated substations	7.70	(0.08)	0.003 <sup>3</sup>	(3.95) <sup>4</sup>	(4.33) <sup>4</sup>	1

<sup>1</sup> Probability of failure of movement activated lighting per year is assumed 100% used in Base Case. No data is available to determine failure rate of movement activated lighting system as this will be the first instance of system in TransGrid network.

<sup>2</sup> Post investment POF is considered based on experience that the defect rate of replaced electrical device is very low.

<sup>3</sup> NPV calculation is available in supporting document in PDGS. Values in bracket resemble negative number.

The commercial evaluation is based on:

- > A 10% discount with sensitivities based on TransGrid's current AER-determined pre-tax real regulatory, WACC of 6.75% (lower bound) and 13% (upper bound).
- > Technical life of movement activated lighting system is assumed to be 15 years.
- > Maintenance cost used for the preferred Option A is 1% of the capital cost.

Sensitivities on economic NPV for the options with changing discount rates are shown in Table 3.

**Table 3 – Discount rate sensitivities (\$ million)**

Option	Description	Economic NPV @13%	Economic NPV @6.75%
A	Install movement activated lighting and upgrade substation lighting at nominated substations	(3.67)	(4.03)

## 4.2 SFAIRP/ALARP evaluation

In the context of the Network Asset Risk Assessment Methodology, the SFAIRP (So Far As Is Reasonably Practicable)/ALARP (As Low As Reasonably Practical) principle is applicable to the following Key Hazardous Events:

- > Contact with electricity
- > Unauthorised access to site

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 in Table 4.

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:

- > Contact with electricity/Unauthorised access to site - 3 times the safety risk cost and 10% of the reliability risk cost

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

**Table 4 – Feasible options (\$ thousand)**

Option	Description	CAPEX	Expected Life	Annualised CAPEX
Base	Do nothing	N/A	N/A	N/A
A	Install movement activated lighting and upgrade substation lighting at nominated substations	7,700	15 years	510

**Table 5 – Annual risk calculations (\$ thousand)**

Option	Annual Residual Risk			Annual Risk Savings		
	Safety Risk	Reliability Risk	Bushfire Risk	Safety Risk	Reliability Risk	Bushfire Risk
Base	195	77	0	N/A	N/A	N/A
A	1	1	0	194	76	0

**Table 6 – Reasonably practicable test (\$ thousand)**

Option	Network Safety Risk Reduction <sup>4</sup>	Annualised CAPEX	Reasonably practicable <sup>5</sup> ?
A	590 <sup>6</sup>	510	Yes

Option A is 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, and is therefore required to satisfy the organisation’s SFAIRP/ALARP obligations.

#### Regulatory Investment Test

The Regulatory Investment Test for Transmission (RIT-T) is not required for this Need.

## 5. Recommendation

It is recommended to progress via Decision Gate 1 (DG1) to detailed scoping for Option A based on SFAIRP/ALARP evaluation.

<sup>4</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>5</sup> Reasonably practicable is defined as whether the annualised CAPEX is less than the Network Safety Risk Reduction

<sup>6</sup> The Network safety Reduction is calculated as 3 x Safety Risk Reduction + 0.1 x Reliability Risk Reduction. SFAIRP/ALARP calculation is available in PDGS.

## Attachment 1 – Prioritisation of substations for Option A

### A.1 Combining current need with existing Needs

Some of the substation rebuild projects include the security treatment like installation of movement activated light as part of their scope of work; however some of these did not. Table 7 shows the substations rebuild projects with related Need.

**Table 7 – Related Needs**

Need Name	Need No.	Comments
Vales Point 330/132 Substation Rebuild	DCN231	Excludes movement activated lighting
Canberra Substation Rebuild	DCN238	Includes Movement Activated Lighting
Munmorah 330kV Substation Condition	DCN269	Excludes movement activated lighting
Newcastle Substation Condition	DCN74	Excludes movement activated lighting
Orange 132/66Kv Substation Rebuild	DCN208	Includes Movement Activated Lighting
Yanco 132kV Substation Rebuild	DCN138	Excludes movement activated lighting
Forbes Substation Condition	DCN196	Excludes movement activated lighting
Burrinjuck 132/11 Substation Rebuild	DCN128	Excludes movement activated lighting

### A.2 Substation prioritisation

Table 8 lists the substations from highest score to lowest in order to determine the ranking of substations. It also includes the approximate capital cost, pre investment risk cost and post investment risk cost per site. The lighting score is dependent on multiple factors that are listed below.

- > Criticality of the substation
- > Availability of communications network
- > Location of the substation, which considers proximity of the substation to public facilities

Weights are applied on the above factors, with location having the highest weighting, followed by communication and criticality.

Inverell Substation has been prioritised and brought in scope manually since it has achieved HV/Civil/Automation Design and is ready for construction (refer project 6340C006 - Inverell Security Lighting Upgrade).

Armidale substation has achieved High Voltage (HV) Design (refer project 6340C001 - AR1 Security Lighting Upgrade).

**Table 8 – Prioritisation of substations included in Option A**

Substation Name	Priority	Location	Category	Status	Option A	Option B	Option C
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]

## Attachment 2 – Commercial evaluation report

### Option A NPV calculation

Project_Option Name		Substation Lighting Replacement (Option A)			
<b>1. Financial Evaluation</b> (excludes VCR benefits)					
NPV @ standard discount rate	10.00%	-\$4.33m	<i>NPV / Capital (Ratio)</i>	-0.56	
NPV @ upper bound rate	13.00%	-\$4.31m	<i>Pay Back Period (Yrs)</i>	-0.04 Yrs	
NPV @ lower bound rate (WACC)	6.75%	-\$4.21m	<i>IRR%</i>	-3.89%	
<b>2. Economic Evaluation</b> (includes VCR benefits but excludes tax benefits from non-cash transactions, ENS penalty and overall tax cost)					
NPV @ standard discount rate	10.00%	-\$3.95m	<i>NPV / Capital (Ratio)</i>	-0.51	
NPV @ upper bound rate	13.00%	-\$4.03m	<i>Pay Back Period (Yrs)</i>	Not measurable	
NPV @ lower bound rate (WACC)	6.75%	-\$3.67m	<i>IRR%</i>	-2.03%	
<b>Benefits</b>					
Risk cost	As Is	To Be	Benefit	<i>VCR Benefit</i>	\$0.08m
<i>Systems (reliability)</i>	\$0.08m	\$0.00m	\$0.08m	<i>ENS Penalty</i>	\$0.00m
<i>Financial</i>	\$0.20m	\$0.00m	\$0.20m	<i>All other risk benefits</i>	\$0.39m
<i>Operational/compliance</i>	\$0.00m	\$0.00m	\$0.00m	<b>Total Risk benefits</b>	\$0.47m
<i>People (safety)</i>	\$0.20m	\$0.00m	\$0.19m	<b>Benefits in the financial NPV*</b>	\$0.39m
<i>Environment</i>	\$0.00m	\$0.00m	\$0.00m	<i>*excludes VCR benefits</i>	
<i>Reputation</i>	\$0.00m	\$0.00m	\$0.00m	<b>Benefits in the economic NPV**</b>	\$0.47m
<b>Total Risk benefits</b>	\$0.47m	\$0.00m	\$0.47m	<i>**excludes ENS penalty</i>	
<b>Cost savings and other benefits</b>			\$0.00m		
<b>Total Benefits</b>			\$0.47m		
<b>Other Financial Drivers</b>					
Incremental opex cost pa (no depreciation)			-\$0.08m	<i>Write-off cost</i>	\$0.00m
Capital - initial \$m			-\$7.70m	<i>Major Asset Life (Yrs)</i>	15.00 Yrs
Residual Value - initial investment			\$0.51m	<i>Re-investment capital</i>	\$0.00m
Capitalisation period			5.00 Yrs	<i>Start of the re-investment period</i>	0.00 Yrs