

OPTIONS EVALUATION REPORT (OER)



Protection - Busbar Condition

OER 000000001389 revision 4.0

Ellipse project no.: P0008052

TRIM file: [TRIM No]

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

Project category: Prescribed - Asset Renewal Strategies

Approvals

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Date submitted for approval	15 December 2016	

Change history

Revision	Date	Amendment
0	24 June 2016	Initial issue
1	31 October 2016	Update to 2016/17 dollars and SFAIRP/ALARP data
2	17 November 2016	Update to format
3	15 December 2016	Minor amendment – consistent option names

1. Need/opportunity

The assets within this need form a small population of the busbar protection assets base that were inherited from Snowy Hydro, and do not conform to TransGrid's design standards. The relays lack any self-monitoring capabilities resulting in an unknown asset condition between maintenance activities. Manufacturer support for all models has ceased meaning no repair capabilities are available and additionally, spares have been depleted. The assets additionally will have reached the end of their estimated life by 2023.

The use of duplicated protection schemes across all busbars are a continuing requirement of the Australian Energy Regulator (AER) as outlined in the National electricity Rules (NER). These protection schemes are required into the foreseeable future.

2. Related Needs/opportunities

The following Needs address parts of the omitted relays covered by this Need:

- > Need ID 1180 – Wagga 330kV Secondary Systems Renewal
- > Need ID 1186 – Murrumburrah Secondary Systems Renewal
- > Need ID 1191 – Deniliquin Secondary Systems Renewal
- > Need ID 1192 – Lower Tumut Secondary Systems Renewal
- > Need ID 1193 – Broken Hill Secondary Systems Renewal
- > Need ID 1194 – Tenterfield Secondary Systems Renewal
- > Need ID 1196 – Coleambally Secondary Systems Renewal
- > Need ID 1243 – Tamworth 330kV Secondary Systems Renewal
- > Need ID 1244 – Wallerawang 330kV Secondary Systems Renewal
- > Need ID 1246 – Panorama Secondary Systems Renewal
- > Need ID 1247 – Muswellbrook Secondary Systems Renewal
- > Need ID 1252 – Cowra Secondary Systems Renewal
- > Need ID 1253 – Darlington Point Secondary Systems Renewal
- > Need ID 1255 – Ingleburn Secondary Systems Renewal
- > Need ID 1258 – Regentville Secondary Systems Renewal
- > Need ID 1263 – Tuggerah Secondary Systems Renewal
- > Need ID 1266 – Marulan Secondary Systems Renewal
- > Need ID 1267 – Molong Secondary Systems Renewal
- > Need ID 1599 – Liverpool Secondary Systems Renewal

3. Options

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

Base Case

The Base Case for this Need is to run these assets to failure. This approach does not address the increasing failure rates or the risk cost associated with the Need. At \$309k per annum, the risks are significant and foreseen to increase as the probability of failure of the assets will also likely increase. Key drivers for this risk cost are:

- > Consequence assumes black start for assets protecting primary plant at 330kV and above with “N-1” redundancy. The restoration time has been set as 8 hours with an assumed 1,296MW of load interrupted to mixed customers (residential, commercial, and agricultural) to model a number of potential network scenarios based on this consequence.
- > The small population of this asset group is 8 units at 330kV located at various sites connecting Snowy Hydro generation to the transmission network.

Increasing the maintenance for the assets cannot reduce the probability of failure in order to reduce the risk cost.

Option A — Replacement of Individual Assets [[OFR 1389A](#), [OFS 1389A](#)]

This option covers the replacement of assets in a “like for like” manner. This involves removing the panel and replacing it with a new relay panel utilising the same features currently in use. This option doesn’t include any upgrade of systems to maximise the utilisation of available technology.

Operating costs have been estimated at \$1k 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 Installations¹.

The expected total capital cost to replace every asset identified under this need is \$1.17m. This costing is estimated using TransGrid’s “Success” estimating system. This cost has been adjusted to \$585k for analysis in this OER to account for the reduction of 4 assets that will be replaced under Secondary Systems Renewal needs or are utilised on negotiated services. This adjustment has been carried out using the unit costs provided in the Option Feasibility Study (OFS).

Table 1 – Replacement of Individual Assets (\$ thousand)

Item	Unit Cost, Including Labour	Quantity	Total Cost
Busbar 330kV	146	4	584
Total estimated cost			584

The residual risk associated with this option upon completion of the project amounts to \$1.23k per annum (base case risk cost = \$309k). The risk reduction is realised through the reduction in the probability of failure for all assets.

¹ Refer SSA Strategy - Renewal and Maintenance - Secondary Systems Site Installations

4. Evaluation

Evaluation of the proposed options has been completed using the ALARP (as low as reasonably practical) 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 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	Run-to-fail	N/A	0	0.31	N/A	N/A	1
A	Replace Individual Assets	0.58	0	0	1.29	0.61	2

The commercial evaluation is based on:

- > Economic life of the assets is assumed 30 years, hence this assessment period has been applied
- > Write-offs have not been estimated
- > Capital cost is not escalated and it does not include capitalised interest

Sensitivities on economic Net Present Value (NPV) for the option 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	Replace Individual Assets	0.81	2.16

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)
- > Unplanned outage of HV equipment - 10% of the reliability risk (applicable to safety).

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

Table 4 – Feasible options (\$ thousand)

Option	Description	CAPEX	Expected Life	Annualised CAPEX
Base	Run-to-fail	N/A	N/A	N/A
A	Replace Individual Assets	584	30 years	20

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	0	119	0	N/A	N/A	N/A
A	0	0	0	0	119	0

Table 6 - Reasonably practicable test (\$ thousand)

Option	Network Safety Risk Reduction ²	Annualised CAPEX	Reasonably practicable ³ ?
A	12	20	No

Option A is not reasonably practicable.

4.3 Preferred option

The outcome of the SFAIRP/ALARP evaluation is that none of the options presented in Table 4 are reasonably practicable, and are therefore not required to satisfy the organisation's SFAIRP/ALARP obligations.

The option to address the condition of the identified assets, Option A – Replacement of Individual Assets is the preferred option for all assets identified.

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 NPV.

Refer to Attachment 1 for details of the assets to be replaced under this need.

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 risk assessment. Option A will also reduce the maintenance costs required to manage a small asset population.

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.

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

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

5. Recommendation

It is recommended to proceed with the replacement of all 4 identified assets.

Attachment 1 – Assets for replacement

Table 7 – Assets for replacement

EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000082619	PT	SYPMURCRWNB1WN2	330KV NO1 SECTION A BUS NO2 PROTECTION	MUR
000000082622	PT	SYPMURCRWSB1WS2	330KV NO2 SECTION A BUS NO2 PROTECTION	MUR
000000082625	PT	SYPMURCRENB1EN2	330KV NO1 SECTION B BUS NO2 PROTECTION	MUR
000000082628	PT	SYPMURCRESB1ES2	330KV NO2 SECTION B BUS NO2 PROTECTION	MUR

Attachment 2 – Commercial evaluation report

Option A NPV calculation

Project_Option Name			Option A - Individual Asset Replacements - All Assets		
1. Financial Evaluation (excludes VCR benefits)					
NPV @ standard discount rate	10.00%	\$0.61m	NPV / Capital (Ratio)	1.04	
NPV @ upper bound rate	13.00%	\$0.33m	Pay Back Period (Yrs)	0.21 Yrs	
NPV @ lower bound rate (WACC)	6.75%	\$1.13m	IRR%	20.88%	
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%	\$1.29m	NPV / Capital (Ratio)	2.20	
NPV @ upper bound rate	13.00%	\$0.81m	Pay Back Period (Yrs)	1.91 Yrs	
NPV @ lower bound rate (WACC)	6.75%	\$2.16m	IRR%	29.32%	
Benefits					
Risk cost	As Is	To Be	Benefit	VCR Benefit	\$0.12m
Systems (reliability)	\$0.12m	\$0.00m	\$0.12m	ENS Penalty	\$0.00m
Financial	\$0.19m	\$0.00m	\$0.19m	All other risk benefits	\$0.19m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$0.31m
People (safety)	\$0.00m	\$0.00m	\$0.00m	Benefits in the financial NPV*	\$0.19m
Environment	\$0.00m	\$0.00m	\$0.00m	*excludes VCR benefits	
Reputation	\$0.00m	\$0.00m	\$0.00m	Benefits in the economic NPV**	\$0.31m
Total Risk benefits	\$0.31m	\$0.00m	\$0.31m	**excludes ENS penalty	
Cost savings and other benefits			\$0.00m		
Total Benefits			\$0.31m		
Other Financial Drivers					
Incremental opex cost pa (no depreciation)			-\$0.00m	Write-off cost	\$0.00m
Capital - initial \$m			-\$0.58m	Major Asset Life (Yrs)	30.00 Yrs
Residual Value - initial investment			\$0.10m	Re-investment capital	\$0.00m
Capitalisation period			5.00 Yrs	Start of the re-investment period	0.00 Yrs