

OPTIONS EVALUATION REPORT (OER)

Telecommunications SDH Network Condition

OER 000000001365 revision 3.0



Ellipse project no.: P0007998

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	14 December 2016	

Change history

Revision	Date	Amendment
0	30 June 2016	Initial issue
1	20 October 2016	Update to 2016/17 dollars and SFAIRP/ALARP data
2	14 December 2016	Update to format
3	14 December 2016	Minor amendment to correct typographical errors

1. Need/opportunity

TransGrid need to provide a fast, reliable communications network to operate the high voltage system safely, securely and reliably. The provision of this service forms part of TransGrid's obligations under the National Electricity Rules (NER) as well as enabling systems and initiatives that allow work to be executed efficiently.

The fleet of Synchronous Digital Hierarchy (SDH) multiplexers form a critical part of the communications network. The installed multiplexers will reach their end of life by 2023, and the manufacturer support for all models currently installed ceased as of June 2016. The assets have been identified for replacement to address these issues.

2. Related Needs/opportunities

Nil

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 \$1.72m 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 of failure is forecast to increase as remaining spares are used and TransGrid's ability to monitor and recover from asset failures becomes compromised.
- > The communications network carries data for substations at every voltage level including 330kV and 500kV and a prolonged network failure carries a significant risk of impacting generation, load to customers and market operations.
- > The large population of this asset group at 354 units across the network.

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

TransGrid currently has sufficient spares to manage equipment failures through to 2021, assuming current failure rates remain steady.

Option A — Full System Upgrade [[OFR 1365A](#), [OFS 1365A](#)]

This option covers the replacement of the entire SDH network. This includes the tender and testing of the replacement telecommunications platform, commissioning of all services onto the new system and integration of the Network Management System into the Asset Monitoring centre. This option doesn't include any upgrade of systems to maximise the utilisation of available technology.

The expected total capital cost to implement this option is \$24.14m. This costing is estimated using TransGrid's "Success" estimating system.

Operating costs have not been considered as these assets have no ongoing routine maintenance.

Benefits of increased communications capabilities to remote sites that more modern equipment will provide were identified in the OPGW business case. These benefits have been broadly applied to all 103 sites on TransGrid's network at \$1.69m per annum. The avoided cost of continuing vendor support, likely to increase significantly as the equipment moves further past its End of Life has also been included as a benefit of \$98k per annum, escalated at 10%.

The residual risk associated with this option upon completion of the project amounts to \$441k per annum (base case risk cost = \$1.72m). The risk reduction is realised through the reduction in the probability of failure for all assets.

Option B — Staged Replacement [[OFR 1365B](#), [OFS 1365B](#)]

This option covers the staged replacement of the SDH network, with the 'A' system to be replaced before 2023 and the recovered spared utilised to manage the 'B' system through to 2028. This includes the tender and testing of the replacement telecommunications platform, commissioning of all services onto the new system and integration of the Network Management System into the Asset Monitoring centre. This option doesn't include any upgrade of systems to maximise the utilisation of available technology.

The expected capital costs for the option total \$14.13m. This costing is estimated using TransGrid's "Success" estimating system. A further \$8.85m capital investment would be required over the 10 year life cycle of this option through to 2038.

Operating costs have not been considered as these assets have no ongoing routine maintenance.

Benefits of increased communications capabilities to remote sites that more modern equipment will provide were identified in the OPGW business case. These benefits have been broadly applied to all 103 sites on TransGrid's network at \$1.69m per annum. There is no decrease in the benefits to Option A, only a reduction in availability of those benefits. The avoided cost of continuing vendor support, likely to increase significantly as the equipment moves further past its End of Life has also been included as a benefit of \$98k per annum, escalated at 10%.

The residual risk associated with this option upon completion of the project amounts to \$909k per annum (base case risk cost = \$1.72m). The risk reduction is realised through the reduction in the probability of failure for all assets.

Both Option A and Option B have 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 technically feasible 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
Base case	Run-to-fail	N/A	-	1.72	N/A	N/A	1
A	Full System Upgrade	24.14	-	0.44	(5.01)	(5.85)	3
B	Staged Replacement	14.13	-	0.91	(2.31)	(2.88)	2

The commercial evaluation is based on:

- > Economic life of the assets is assumed 10 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 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%
A	Full System Upgrade	6.79	(1.92)
B	Staged Replacement	(3.80)	0.33

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 in Table 1.

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:

- > 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 3 – Feasible options (\$ thousand)

Option	Description	CAPEX	Expected Life	Annualised CAPEX
Base	Run-to-fail	N/A	N/A	N/A
A	Full System Upgrade	24,140	10 years	2,410
B	Staged Replacement	14,130	10 years	1,410

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
Base	0	520	0	N/A	N/A	N/A
A	0	100	0	0	420	0
B	0	243	0	0	277	0

Table 5 – Reasonably practicable test (\$ thousand)

Option	Network Safety Risk Reduction ¹	Annualised CAPEX	Reasonably practicable ² ?
A	42	2,410	No
B	28	1,410	No

Neither Option A nor Option B is 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 option to address the condition of the identified assets, Option B – Staged Replacement, is the preferred option for the identified Need.

This option has been selected due to its technical viability and reduction in reliability risk. TransGrid is obligated under the National Electricity Rules to maintain a secure and reliable telecommunications system to support the operation and protection of the network, outlined in Clauses 4.3.4 and 4.11.1 below.

Clause 4.3.4 (c) - Each Network Service Provider must arrange and maintain, in accordance with the standards described in clause 4.3.4(e), controls, monitoring and secure communication systems to facilitate a manually initiated, rotational load shedding and restoration process which may be necessary if there is, in AEMO's opinion, a prolonged major supply shortage or extreme power system disruption.

Clause 4.11.1 - Remote control and monitoring devices

(a) All remote control, operational metering and monitoring devices and local circuits as described in schedules 5.2, 5.3 and 5.3a, must be installed and maintained in accordance with the standards and protocols determined and advised by AEMO (for use in the control centres) for each:

(1) scheduled generating unit and semi-scheduled generating unit connected to the transmission or distribution network; and

(2) substation connected to the network.

(c) The control and monitoring devices must include provision for indication of active power and reactive power output, provision for signalling the status and any associated alarm condition relevant to achieving adequate control of the transmission network, and provision for indication of generating plant active and reactive output

Option B returns a positive economic NPV for investment rate of return closer to the current Weighted Average Cost of Capital (WACC), demonstrating that there is a value to customers for delivering this option. This option will also reasonably meet TransGrid's regulatory obligations as the Base Case Run-to-fail will not adequately address the deteriorating condition of the assets.

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. These have been captured as benefits for delivering the project.

¹ The Network Safety Risk Reduction is calculated as 6 x Bushfire Risk Reduction + 3 x Safety Risk Reduction + 0.1 x Reliability Risk Reduction

² Reasonably practicable is defined as whether the annualised CAPEX is less than the Network Safety Risk Reduction

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 B Staged Replacement proceed to detailed scoping.

Attachment 1 – Commercial evaluation report

Option A NPV calculation

Project_Option Name			Option A - Full System Upgrade		
1. Financial Evaluation (excludes VCR benefits)					
NPV @ standard discount rate	10.00%	-\$5.85m	NPV / Capital (Ratio)	-0.24	
NPV @ upper bound rate	13.00%	-\$7.44m	Pay Back Period (Yrs)	0.04 Yrs	
NPV @ lower bound rate (WACC)	6.75%	-\$3.05m	IRR%	4.40%	
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%	-\$5.01m	NPV / Capital (Ratio)	-0.21	
NPV @ upper bound rate	13.00%	-\$6.79m	Pay Back Period (Yrs)	7.10 Yrs	
NPV @ lower bound rate (WACC)	6.75%	-\$1.92m	IRR%	5.30%	
Benefits					
Risk cost	As Is	To Be	Benefit	VCR Benefit	\$0.22m
Systems (reliability)	\$0.52m	\$0.10m	\$0.42m	ENS Penalty	\$0.00m
Financial	\$1.20m	\$0.34m	\$0.86m	All other risk benefits	\$1.06m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$1.28m
People (safety)	\$0.00m	\$0.00m	\$0.00m		
Environment	\$0.00m	\$0.00m	\$0.00m	Benefits in the financial NPV*	\$2.86m
Reputation	\$0.00m	\$0.00m	\$0.00m	*excludes VCR benefits	
Total Risk benefits	\$1.72m	\$0.44m	\$1.28m		
Cost savings and other benefits			\$1.80m	Benefits in the economic NPV**	\$3.08m
Total Benefits			\$3.08m	**excludes ENS penalty	
Other Financial Drivers					
Incremental opex cost pa (no depreciation)			\$0.00m	Write-off cost	\$0.00m
Capital - initial \$m			-\$24.14m	Major Asset Life (Yrs)	10.00 Yrs
Residual Value - initial investment			\$0.00m	Re-investment capital	\$0.00m
Capitalisation period			5.00 Yrs	Start of the re-investment period	0.00 Yrs

Option B NPV calculation

Project_Option Name			Option B - Staged Replacement		
1. Financial Evaluation (excludes VCR benefits)					
NPV @ standard discount rate	10.00%	-\$2.88m	NPV / Capital (Ratio)	-0.20	
NPV @ upper bound rate	13.00%	-\$4.24m	Pay Back Period (Yrs)	0.06 Yrs	
NPV @ lower bound rate (WACC)	6.75%	-\$0.44m	IRR%	6.31%	
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%	-\$2.31m	NPV / Capital (Ratio)	-0.16	
NPV @ upper bound rate	13.00%	-\$3.80m	Pay Back Period (Yrs)	7.74 Yrs	
NPV @ lower bound rate (WACC)	6.75%	\$0.33m	IRR%	7.08%	
Benefits					
Risk cost	As Is	To Be	Benefit	VCR Benefit	\$0.15m
Systems (reliability)	\$0.52m	\$0.24m	\$0.28m	ENS Penalty	\$0.00m
Financial	\$1.20m	\$0.67m	\$0.54m	All other risk benefits	\$0.66m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$0.81m
People (safety)	\$0.00m	\$0.00m	\$0.00m	Benefits in the financial NPV*	\$2.46m
Environment	\$0.00m	\$0.00m	\$0.00m	*excludes VCR benefits	
Reputation	\$0.00m	\$0.00m	\$0.00m	Benefits in the economic NPV**	\$2.61m
Total Risk benefits	\$1.72m	\$0.91m	\$0.81m	**excludes ENS penalty	
Cost savings and other benefits			\$1.80m		
Total Benefits			\$2.61m		
Other Financial Drivers					
Incremental opex cost pa (no depreciation)			\$0.00m	Write-off cost	\$0.00m
Capital - initial \$m			-\$14.13m	Major Asset Life (Yrs)	10.00 Yrs
Residual Value - initial investment			\$0.00m	Re-investment capital	-\$8.85m
Capitalisation period			5.00 Yrs	Start of the re-investment period	2023-24