OPTIONS EVALUATION REPORT (OER)

Protection - VF Intertrip Condition

OER 000000001371 revision 2.0

Ellipse project no.: P0008010
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	28 June 2016	Initial issue
1	31 October 2016	Update to 2016/17 dollars and SFAIRP/ALARP data
2	14 December 2016	Update to format

1. Need/opportunity

Voice Frequency (VF) Intertrip systems are used throughout the NSW network to aid and accelerate the clearance of faults on transmission lines where high speed clearance is required to maintain the stability of the network. The assets investigated under this Need are aged VF Intertrip systems that have reached the end of their technical life resulting in reduced capabilities to meet accelerated fault clearance performance requirements.

The use of VF Intertrip systems to provide accelerated clearance of faults is a continuing requirement of the Australian Energy Regulator (AER) as outlined in the National Electricity Rules (NER). VF Intertrip systems to meet critical clearance times are required into the foreseeable future.

2. Related Needs/opportunities

The following Needs may benefit from coordination with these works:

- Need ID 1356 – Protection - Reyrolle OHx Condition
- Need ID 1376 – Protection - Alstom Pxxx Condition
- Need ID 1379 – Protection GE Multilin Condition
- Need ID 1380 – Protection - Schweitzer SELxxx Condition
- Need ID 1381 – Protection - Siemens 7xx Condition

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 $17.30m 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 large proportion of this asset group protects 330kV and 500kV voltage levels within the 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 1371A, OFS 1371A]

This option covers the replacement of assets in a “like for like” manner. This involves removing the Intertrips at both ends of a line and replacing them with new units 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 $38k 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[1].

The expected total capital cost to replace all 72 assets identified under this Need is $4.25m. This costing is estimated using TransGrid’s “Success” estimating system. This number has been adjusted to $2.13m due to a reduction of 36 units from those identified in the feasibility request. Numbers have been adjusted using the unit costs provided in the Option Feasibility Study (OFS).

The residual risk associated with this option upon completion of the project amounts to $15.40m per annum (base case risk cost = $17.30m). The risk reduction is realised through the reduction in the probability of failure for replaced assets.

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	0.04	17.30	N/A	N/A	2
A	Replace Individual Assets	2.13	0.04	15.40	5.60	0.68	1

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	Replace Individual Assets	4.07	7.93

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

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 3.

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 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	Replace Individual Assets	2,127	10 years	210

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	19	16,220	9	N/A	N/A	N/A
A	18	14,928	9	1	1,292	1

Table 5 – Reasonably practicable test ($ thousand)

Option	Network Safety Risk Reduction[2]	Annualised CAPEX	Reasonably practicable[3]?
A	132	210	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 3 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.

[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.

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. 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 to proceed with the replacement of all 36 identified assets in the categories described above.

Attachment 1 – Assets for replacement

EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000170974	CC	SYCLT1CM0030601	07 TL CANBERRA VF#1 I/TRIP (P-197)	LT1
000000170975	CC	SYCLT1CM0030602	07 TL CANBERRA VF#2 I/TRIP (P-198)	LT1
000000170952	CC	SYCCA1CM0040403	07 TL LOWER TUMUT VF#1 I/TRIP (P-197)	CA1
000000170953	CC	SYCCA1CM0040404	07 TL LOWER TUMUT VF#2 I/TRIP (P-198)	CA1
000000152918	CC	CMCDPTMA0080001	10 TL AVON VF #1 I/TRIP (P-188)	DPT
000000152919	CC	CMCDPTMA0080002	10 TL AVON VF #2 I/TRIP (P-189)	DPT
000000201397	CC	CMCAVSCM0030203	10 TL DAPTO VF #1 I/TRIP (P-188)	AVS
000000201398	CC	CMCAVSCM0030202	10 TL DAPTO VF #2 I/TRIP (P-189)	AVS
000000152922	CC	CMCDPTMA0050001	11 TL SYDNEY SOUTH VF #1 I/TRIP (P-219)	DPT
000000152951	CC	CMCDPTMA0050002	11 TL SYDNEY SOUTH VF#2 I/TRIP (P-220)	DPT
000000152917	CC	CMCDPTMA0100001	18 TL K'VALLEY VF #1 I/TRIP (P-192)	DPT
000000152947	CC	CMCDPTMA0100002	18 TL K'VALLEY VF #2 I/TRIP (P-193)	DPT
000000028520	CC	NNCLD1CM0050201	33 TL BAYSWATER VF #2 I/TRIP (P-120)	LD1
000000028378	CC	NNCBAYCM0070301	33 TL LIDDELL VF #2 I/TRIP (P-120)	BAY
000000028528	CC	NNCLD1CM0050801	34 TL BAYSWATER VF #2 I/TRIP (P-122)	LD1
000000028380	CC	NNCBAYCM0070401	34 TL LIDDELL VF #2 I/TRIP (P-122)	BAY
000000146649	CC	SYCWDLMA0070001	3C TL CANBERRA VF# 1 I/TRIP (P-413)	WDL
000000146921	CC	SYCWDLMA0070005	3C TL CANBERRA VF# 2 I/TRIP (P-414)	WDL
000000012171	CC	CMCSYSCM0200302	41 TL BEACONSFIELD VF #1 I/TRIP (P-070)	SYS
000000012170	CC	CMCSYSCM0200301	41 TL BEACONSFIELD VF #2 I/TRIP (P-071)	SYS

EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000011773	CC	CMCBFWCM0060502	41 TL SYD SOUTH VF #1 I/TRIP (P-070)	BFW
000000011772	CC	CMCBFWCM0060501	41 TL SYD SOUTH VF #2 I/TRIP (P-071)	BFW
000000028754	CC	NNCNEWCM0040802	81 TL LIDDELL VF#1 I/TRIP (P-030)	NEW
000000028753	CC	NNCNEWCM0040801	81 TL LIDDELL VF#2 I/TRIP (P-031)	NEW
000000028523	CC	NNCLD1CM0050302	81 TL NEWCASTLE VF #1 I/TRIP (P-030)	LD1
000000028522	CC	NNCLD1CM0050301	81 TL NEWCASTLE VF #2 I/TRIP (P-031)	LD1
000000028893	CC	NNCTOMCM0030401	82 TL LIDDELL VF #2 - 64K I/TRIP (P-086)	TOM
000000028527	CC	NNCLD1CM0050602	82 TL TOMAGO VF #2 I/RTRIP (P-086)	LD1
000000028649	CC	NNCMRKCM0030601	83 TL LIDDELL VF #1 I/TRIP (P-)	MRK
000000028647	CC	NNCMRKCM0030301	83 TL LIDDELL VF #2 I/TRIP (P-)	MRK
000000028525	CC	NNCLD1CM0050501	83 TL M'BROOK VF #1 I\TRIP (P-)	LD1
000000028526	CC	NNCLD1CM0050601	83 TL M'BROOK VF #2 I/TRIP (P-)	LD1
000000863231	CC	SYCWDLMA0230003	978 TL COOMA VF# 1 I/TRIP (P-681)	WDL
000000863230	CC	SYCWDLMA0210003	97D TL COOMA VF# 1 I/TRIP (P-679)	WDL
000000146923	CC	SYCWDLMA0140001	97H TL THEODORE VF#1 I/TRIP (P-)	WDL
000000146669	CC	SYCWDLMA0140003	97H TL THEODORE VF#2 I/TRIP (P-)	WDL

Attachment 2 – Commercial evaluation report

Option A NPV calculation

Project_Option Name	Option A - Individual Asset Replacements - Identified Assets

1. Financial Evaluation (excludes VCR benefits)					
NPV @ standard discount rate	10.00%	$0.68m		*NPV / Capital (Ratio)*	*0.32*
NPV @ upper bound rate	13.00%	$0.28m		*Pay Back Period (Yrs)*	*0.16 Yrs*
NPV @ lower bound rate (WACC)	6.75%	$1.32m		*IRR%*	*15.91%*

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%	$5.60m		*NPV / Capital (Ratio)*	*2.63*
NPV @ upper bound rate	13.00%	$4.07m		*Pay Back Period (Yrs)*	*1.12 Yrs*
NPV @ lower bound rate (WACC)	6.75%	$7.93m		*IRR%*	*39.57%*

Benefits					
Risk cost	As Is	To Be	Benefit	*VCR Benefit*	*$1.29m*
Systems (reliability)	*$16.22m*	*$14.93m*	*$1.29m*	*ENS Penalty*	*$0.00m*
Financial	*$1.10m*	*$0.46m*	*$0.64m*	*All other risk benefits*	*$0.65m*
Operational/compliance	*$0.00m*	*$0.00m*	*$0.00m*	Total Risk benefits	$1.94m
People (safety)	*$0.02m*	*$0.02m*	*$0.00m*		
Environment	*$0.01m*	*$0.01m*	*$0.00m*	Benefits in the financial NPV*	$0.65m
Reputation	*$0.00m*	*$0.00m*	*$0.00m*	**excludes VCR benefits*	
Total Risk benefits	$17.35m	$15.41m	$1.94m		
Cost savings and other benefits			$0.00m	Benefits in the economic NPV**	$1.94m
Total Benefits			$1.94m	***excludes ENS penalty*	

Other Financial Drivers			
Incremental opex cost pa (no depreciation)	-$0.04m	Write-off cost	$0.00m
Capital - initial $m	-$2.13m	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