

OPTIONS EVALUATION REPORT (OER)



50V Rack Power Supply Condition

OER 000000001361 revision 2.0

Ellipse project no.: P0007990

TRIM file: [TRIM No]

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

Project category: Prescribed - Replacement

Approvals

Author	Hazem Khamis	Secondary Systems Strategist
Endorsed	Mark Jones	Secondary Systems and Communications Asset Manager
	Azil Khan	Investment Strategy Manager
Approved	Lance Wee	M/Asset Strategy
Date submitted for approval	13 December 2016	

Change history

Revision	Date	Amendment
0	26 June 2016	Initial issue
1	31 October 2016	Update to 2016/17 dollars and SFAIRP/ALARP data
2	13 December 2016	Update to format

1. Need/opportunity

Rack Power Supply (RPS) systems are used throughout the NSW network to provide a continuous supply of power to communications equipment during a loss of primary supply across all voltage levels. The availability of an uninterruptible power supply is crucial particularly during a black event. The assets investigated under this Need are aged RPS systems that have reached the end of their technical life resulting in reduced capabilities to meet backup supply performance requirements.

The use of RPS systems to provide backup power supplies during an outage event are a continuing requirement of the Australian Energy Regulator (AER) as outlined in the National Electricity Rules (NER). Backup power supply systems for the communications network are required into the foreseeable future.

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 \$19.10m 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:

- > Probability of asset failure
- > Consequence assumes loss of load for a site with “N-1” redundancy. The restoration time has been set as 8 hours with an assumed 150MW of load interrupted to mixed customers (residential, commercial, and agricultural) to model a number of potential network scenarios based on this consequence.
- > The total population of this asset group at 213 systems across all voltage levels and sites within the network.
- > The reliance on the communications network to effectively send protection signals from one site to another.

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

Option A — Replace Individual Assets [[OFR 1361A](#), [OFS 1361A](#)]

This option covers the replacement of 130 assets in a “like for like” manner for RPS systems throughout the network.

No operating costs have been estimated 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. It is noted however that maintenance costs would be reduced for RPS systems due to the lack of a need for routine maintenance.

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

The expected total capital cost to replace every asset identified under this Need is \$8.06m. This costing is estimated using TransGrid's "Success" estimating system.

The residual risk associated with this option upon completion of the project amounts to \$10.80m per annum (base case risk cost = \$19.10m). The risk reduction is realised through the reduction in the probability of failure for all assets.

Option A has been identified as the only technically viable option as refurbishment of the systems is not possible.

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	19.10	N/A	N/A	2
A	Replace Individual Assets	8.06	0	10.80	25.70	(2.63)	1

The commercial evaluation is based on:

- > Economic life of the RPS systems is approximately 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	18.87	36.05

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)
- > Conductor drop/structure failure - 6 times the bushfire risk , 6 times the safety risk and 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	8,070	10 years	810

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	75	17,055	2	N/A	N/A	N/A
A	42	9,638	1	33	7,417	1

Table 5 – Reasonably practicable test (\$ thousand)

Option	Network Safety Risk Reduction ²	Annualised CAPEX	Reasonably practicable ³ ?
A	847	810	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.

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, economic Net Present Value (NPV) and reduction in risk.

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

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

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 130 identified assets.

Attachment 1 – Assets for replacement

EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000103931	CC	SWCALBCM0000001	50V BATTERY	ALB
000000100887	CC	NTCAR1CM0000002	50V BATTERY	AR1
000000100888	CC	NTCAR1CM0000003	50V BATTERY	AR1
000000091717	CC	NNCBAYCM0000001	BAYSWATER 330 NO1 50V BATTERY & CHARGER	BAY
000000091718	CC	NNCBAYCM0000002	BAYSWATER 330 NO2 50V BATTERY & CHARGER	BAY
000000136888	CC	SYCBBYCR0340101	50V DC RECTIFIER 'A';BATTS	BBY
000000136889	CC	SYCBBYCR0340301	50V DC RECTIFIER 'B';BATTS	BBY
000000599585	CC	NTCBGECM0010801	EATON 50V DC MODULAR POWER SYS	BGE
000000599586	CC	NTCBGECM0010802	EATON 50V DC MODULAR POWER SYS	BGE
000000729158	CC	NTCBGNM0010801	EATON 50V DC MODULAR POWER SYS	BGN
000000729159	CC	NTCBGNM0010802	EATON 50V DC MODULAR POWER SYS	BGN
000000011740	CC	CMCBGPCM0000001	BUGONG GAP NO1 50V BATTERY & CHARGER	BGP
000000063580	CC	CMCBGPCM0000002	BUGONG GAP NO2 50V BATTERY & CHARGER	BGP
000000122960	CC	NTCBOACM0000801	50V DC MODULAR POWER SYSTEM	BOA
000000132314	CC	NTCBOACM0000803	50V DC MODULAR POWER SYSTEM	BOA
000000101563	CC	NTCBOSCM0020501	"A" 50V DC MODULAR POWER SYSTEM	BOS
000000101562	CC	NTCBOSCM0020402	"B" 50V DC MODULAR POWER SYSTEM	BOS
000000108359	CC	SWCBRACM0030101	50V MODULAR POWER SYSTEM "A"	BRA
000000108362	CC	SWCBRACM0030301	50V MODULAR POWER SYSTEM "B"	BRA
000000133997	CC	NTCBYBCM0000605	50V DC MODULAR POWER SYSTEM	BYB
000000141787	CC	NTCBYBCM0000604	50V DC MODULAR POWER SYSTEM	BYB
000000157121	CC	SWCCLYCM0020705	50V POWER SYSTEM	CLY

EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
00000093125	CC	SYCCMSCM0040101	50V MODULAR POWER SYSTEM	CMS
000000150337	CC	COCCNRCM0020401	50V MODULAR POWER SYSTEM "A"	CNR
000000784179	CC	SYCCOACM0010801	50V DC BATTERY CHARGER 'A'	COA
000000784183	CC	SYCCOACM0011001	50V DC BATTERY CHARGER 'B'	COA
000000084997	CC	NTCCOFCM0000005	"A" COFFS HARB 330 50V DC MOD POWER SYS	COF
000000084998	CC	NTCCOFCM0000006	"B" COFFS HARB 330 50V DC MOD POWER SYS	COF
000000108386	CC	SWCCRWCM0020201	50V MODULAR POWER SYSTEM "A"	CRW
000000108388	CC	SWCCRWCM0020101	50V MODULAR POWER SYSTEM "B"	CRW
000000111119	CC	COCCW2CM0040503	BATTERIES 50V	CW2
000000111120	CC	COCCW2CM0040601	BATTERIES 50V	CW2
000000092303	CC	SYCCWFCM0010701	50V DC 'A' MODULAR POWER SYSTEM	CWF
000000092304	CC	SYCCWFCM0020701	50V DC 'B' MODULAR POWER SYSTEM	CWF
000000720246	CC	SWCDN2CM0020100	No1 50V DC BATTERY & CHARGER RACK	DN2
000000150382	CC	NNCELDCM0000001	ELDERSLIE RS 50V BATTERY	ELD
000000150383	CC	NNCELDCM0000002	ELDERSLIE RS 50V CHARGER	ELD
000000225073	CC	SYCELSCR0020101	50V MODULAR POWER SYSTEM "A"	ELS
000000225075	CC	SYCELSCR0020201	50V MODULAR POWER SYSTEM "B"	ELS
000000113273	CC	NNCER0CM0000008	50V DC BATTERY CHARGER No.1	ER0
000000113274	CC	NNCER0CM0000009	50V DC BATTERY CHARGER No.2	ER0
000000121844	CC	COCFB2CM0020202	50V BATTERY CHARGER	FB2
000000064385	CC	SWCFNYCM0050101	FINLEY 132 50V BATTERY & CHARGER	FNY
000000626394	CC	SWCGADCM0020701	EMERSON 50V DC MODULAR POWER SYS	GAD
000000626395	CC	SWCGADCM0020702	EMERSON 50V DC RECTIFIERS	GAD
000000150019	CC	CMCGFDCM0010101	50V MODULAR POWER SYSTEM "A"	GFD
000000644712	CC	NTCGN2CM0020302	EATON 50V DC MODULAR POWER SYS 'A'	GN2

EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000644711	CC	NTCGN2CM0020501	EATON 50V DC MODULAR POWER SYS 'B'	GN2
000000830234	CC	NTCGRDCM0020601	50V DC MODULAR POWER SYSTEM	GRD
000000863234	CC	SWCGRFCM0000201	EATON 50V DC MOD PWR SYS - A	GRF
000000863235	CC	SWCGRFCM0000202	EATON 50V DC MOD PWR SYS - B	GRF
000000130705	CC	SYCGTHCM0010301	Battery/Rectifier:50V:'A':EMERSON	GTH
000000217407	CC	SYCGULCM0020401	50V MODULAR POWER SYSTEM "A"	GUL
000000217409	CC	SYCGULCM0020301	50V MODULAR POWER SYSTEM "B"	GUL
000000358633	CC	SYCGURCM0011200	50V A BTY CHARGER & BTY RACK	GUR
000000358638	CC	SYCGURCM0011400	50V B BTY CHARGER & BTY RACK	GUR
000000101514	CC	SYCHHRCM0010601	50V DC 'A' MODULAR POWER SYSTEM	HHR
000000101515	CC	SYCHHRCM0010701	50V DC 'B' MODULAR POWER SYSTEM	HHR
000000108449	CC	SYCHKHCM0020401	50V MODULAR POWER SYSTEM "A"	HKH
000000108452	CC	SYCHKHCM0020201	50V MODULAR POWER SYSTEM "B"	HKH
000000454832	CC	CMCHLDCM0030100	50V A BATTERIES RACK	HLD
000000454837	CC	CMCHLDCM0030300	50V B BATTERIES RACK	HLD
000000830211	CC	NTCHTGCM0020601	50V DC MODULAR POWER SYSTEM	HTG
000000104180	CC	SWCJDACM0000001	50V BATTERY	JDA
000000104181	CC	SWCJDACM0000002	50V BATTERY	JDA
000000073465	CC	NTCKLKCM0000003	KOOLKHAN 132 50V DC MODULAR POWER SYSTEM	KLK
000000121572	CC	NTCKLKCM0000004	KOOLKHAN 132 50V DC MODULAR POWER SYSTEM	KLK
000000122501	CC	NTCLSMCM0000007	"A" LISMORE 330 50V DC MOD POWER SYSTEM	LSM
000000122502	CC	NTCLSMCM0000008	"B" LISMORE 330 50V DC MOD POWER SYSTEM	LSM
000000084537	CC	SYCLT1CMBAT2A	Battery/Rectifier:50V:'A':Eaton:117421	LT1
000000084538	CC	SYCLT1CMBAT2B	Battery/Rectifier:50V:'B':Eaton:117421	LT1
000000150677	CC	NTCM2ACM0010701	50V MODULAR POWER SYSTEM "A"	M2A

EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000150792	CC	NTCM2ACM0020801	50V MODULAR POWER SYSTEM "B"	M2A
000000094139	CC	CMCMACCM0040101	50V DC MODULAR POWER SYSTEM "A"	MAC
000000094140	CC	CMCMACCM0040401	50V DC MODULAR POWER SYSTEM "B"	MAC
000000102854	CC	NNCMATCM0030101	50V MODULAR POWER SYSTEM "A"	MAT
000000102898	CC	NNCMATCM0030104	50V MODULAR POWER SYSTEM "B"	MAT
000000150205	CC	SYCMBHCM0010102	50V BATTERIES "A"	MBH
000000150204	CC	SYCMBHCM0010101	50V MODULAR POWER SYSTEM "A"	MBH
000000150914	CC	NNCMBRCM0010601	50V MODULAR POWER SYSTEM "A"	MBR
000000019800	CC	COCMCNCM0000003	MT CANOBOLAS 50V BATTERY & CHARGER	MCN
000000108487	CC	COCMDLCM0020401	50V MODULAR POWER SYSTEM "A"	MDL
000000108519	CC	COCMDLCM0020201	50V MODULAR POWER SYSTEM "B"	MDL
000000150553	CC	NNCMDSCM0010601	50V MODULAR POWER SYSTEM "A"	MDS
000000150962	CC	NNCMGTTCM0010601	50V MODULAR POWER SYSTEM "A"	MGT
000000211017	CC	SYCMGYCM0020601	50V MODULAR POWER SYSTEM "A"	MGY
000000211018	CC	SYCMGYCM0020701	50V MODULAR POWER SYSTEM "B"	MGY
000000150981	CC	NNCMIDMA0000601	50V MODULAR POWER SYSTEM "A"	MID
000000170495	CC	NNCMIDMA0000701	50V MODULAR POWER SYSTEM "B"	MID
000000019814	CC	COCMLBCM0020302	MT LAMBIE 50V CHARGERS - A	MLB
000000131317	CC	COCMLBCM0020102	MT LAMBIE 50V CHARGERS - B	MLB
000000093019	CC	COCMMHCM0020401	50V MODULAR POWER SYSTEM "A"	MMH
000000093005	CC	COCMMHCM0020201	50V MODULAR POWER SYSTEM "B"	MMH
000000830282	CC	NTCMMKCM0020601	50V DC MODULAR POWER SYSTEM	MMK

EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000108552	CC	COCMMQCM0020402	50V MODULAR POWER SYSTEM "A" CHARGERS	MMQ
000000108536	CC	COCMMQCM0020202	50V MODULAR POWER SYSTEM "B" CHARGERS	MMQ
000000096737	CC	NNCMN1CM0000108	50V DC BATTERY CHARGER	MN1
000000096738	CC	NNCMN1CM0000109	50V DC BATTERY CHARGER	MN1
000000169456	CC	COCMNLCM0040101	50V MODULAR POWER SYSTEM "A"	MNL
000000169458	CC	COCMNLCM0040301	50V MODULAR POWER SYSTEM "b"	MNL
000000130616	CC	SYCMNYCM0010301	EMERSON 50V A BATTERY CHARGER	MNY
000000137510	CC	COCMOLCM0010102	50V MODULAR POWER SYSTEM "A"	MOL
000000137508	CC	COCMOLCM0010302	50V MODULAR POWER SYSTEM "B"	MOL
000000135949	CC	SYCMP2CM0020101	50V MODULAR POWER SYSTEM "A"	MP2
000000135963	CC	SYCMP2CM0020201	50V MODULAR POWER SYSTEM "B"	MP2
000000644740	CC	NTCMRECBAT0101	EATON 50V DC MODULAR POWER SYS 'A'	MRE
000000644746	CC	NTCMRECBAT0302	EATON 50V DC MODULAR POWER SYS 'B'	MRE
000000101147	CC	NNCMRWCM0020401	50V DC MODULAR POWER SYSTEM	MRW
000000101165	CC	NNCMRWCM0020201	50V DC MODULAR POWER SYSTEM	MRW
000000105285	CC	SYCMMSGCM0010201	50V DC 'A' MODULAR POWER SYSTEM	MSG
000000063380	CC	SYCMMSGCM0010301	50V DC 'B' MODULAR POWER SYSTEM	MSG
000000130525	CC	SYCMURCM0040801	Battery/Rectifier:50V:'A':Eaton:118908	MUR
000000130526	CC	SYCMURCM0041001	Battery/Rectifier:50V:'B':Eaton:118908	MUR
000000083311	CC	NTCNAMCRB141401	NAMBUCCA 132 50V A BATT & CHARGER	NAM
000000644718	CC	NTCNB2CM0040201	EATON 50V DC MODULAR POWER SYS 'A'	NB2
000000644724	CC	NTCNB2CM0040402	EATON 50V DC MODULAR POWER SYS 'B'	NB2
000000106687	CC	COCORCCM0000003	50VDC BATTERY CHARGER	ORC

EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000151103	CC	NTCPANCM0001301	50V BATTERIES "A"	PAN
000000151106	CC	NTCPANCM0001302	50V BATTERIES "B"	PAN
000000169753	CC	COCPKSCM0000101	50V MODULAR POWER SYS "A"	PKS
000000169717	CC	COCPKSCM0000103	50V MODULAR POWER SYS "B"	PKS
000000098324	CC	NNCPMQCR0000002	50V DC BATTERY CHARGER	PMQ
000000100999	CC	SYCQBYCM0040101	50V DC MODULAR POWER SYSTEM	QBY
000000092209	CC	NTCRALCM0020401	50V DC MODULAR POWER SYSTEM	RAL
000000092210	CC	NTCRALCM0020601	50V DC MODULAR POWER SYSTEM	RAL
000000137285	CC	CMCRAZCM0000005	RAZORBACK NO1 50V BATTERY & CHARGER	RAZ
000000137286	CC	CMCRAZCM0000006	RAZORBACK NO2 50V BATTERY & CHARGER	RAZ
000000169031	CC	NNCREDCM0010601	50V MODULAR POWER SYSTEM "A"	RED
000000102775	CC	CMCRGVCM0030701	50V DC MODULAR POWER SYSTEM	RGV
000000102776	CC	CMCRGVCM0030901	50V DC MODULAR POWER SYSTEM	RGV

Attachment 2 – Commercial evaluation report

Option A NPV calculation

Project_Option Name	Need ID 1360 - 50V RPS Condition - Option A Replace selected a
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1. Financial Evaluation (excludes VCR benefits)				
NPV @ standard discount rate	10.00%	-\$2.63m	NPV / Capital (Ratio)	-0.33
NPV @ upper bound rate	13.00%	-\$2.98m	Pay Back Period (Yrs)	0.02 Yrs
NPV @ lower bound rate (WACC)	6.75%	-\$1.98m	IRR%	1.67%

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%	\$25.68m	NPV / Capital (Ratio)	3.19
NPV @ upper bound rate	13.00%	\$18.87m	Pay Back Period (Yrs)	Not measurable
NPV @ lower bound rate (WACC)	6.75%	\$36.05m	IRR%	43.22%

Benefits					
Risk cost	As Is	To Be	Benefit	VCR Benefit	\$7.42m
Systems (reliability)	\$17.06m	\$9.64m	\$7.42m	ENS Penalty	\$0.00m
Financial	\$2.02m	\$1.14m	\$0.88m	All other risk benefits	\$0.91m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$8.33m
People (safety)	\$0.08m	\$0.04m	\$0.03m	Benefits in the financial NPV*	\$0.91m
Environment	\$0.00m	\$0.00m	\$0.00m	*excludes VCR benefits	
Reputation	\$0.00m	\$0.00m	\$0.00m	Benefits in the economic NPV**	\$8.33m
Total Risk benefits	\$19.15m	\$10.82m	\$8.33m	**excludes ENS penalty	
Cost savings and other benefits			\$0.00m		
Total Benefits			\$8.33m		
Other Financial Drivers					
Incremental opex cost pa (no depreciation)			\$0.00m	Write-off cost	\$0.00m
Capital - initial \$m			-\$8.06m	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	2028-29