OPTIONS EVALUATION REPORT (OER)

FY24-28 Comms Alarm System Renewals

OER- N2453 revision 0.0

Ellipse project no(s):
TRIM file: [TRIM No]

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

Approvals

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Date submitted for approval	4 November 2021	

Change history

Revision	Date	Amendment
0	04/11/2021	First Issue

Executive summary

Communication's Alarm Systems (CAS) exist at all network sites and monitor the statuses of communications equipment. These systems have traditionally been deployed on a Windows based PC with the use of 3rd party conversion hardware to turn binary inputs to a computer readable format. These systems have relied on an internally developed and maintained software build to facilitate alarms. The hardware and software platforms are not upgradable to Windows 10 and would require renewal to host the new operating system.

The CAS systems have reached end of life with many PCs operating on obsolete versions of Windows, presenting a cybersecurity risks in addition to those related to physical age of the hardware platforms. We have developed a fit-for-purpose solution utilising Intelligent Electric Devices (IEDs) that provide increased reliability, longer technical life and improved visibility of communications equipment to our SCADA Control Room. This solution mitigates risk against operating system obsolescence, lowers our exposure to cybersecurity threats and mitigates overheads associated with bespoke internal development. An IED based solution also brings the CAS into alignment with TransGrid's modern standard design philosophies applicable to both protection and control systems.

There is a need to mitigate our cybersecurity risk profile and address the age of these assets to facilitate the ongoing monitoring and response requirements of our communications equipment.

The assessment of the options considered to address the need appears in Table 1, which includes communications alarm systems evaluated as NPV positive, and reaching end of life by 2027/28. A summary of all options considered are detailed below.

Under the Base Case TransGrid continues to operate and maintain (O&M) the existing computer systems as required. This approach will not address the obsolescence and health of the obsolete and unsupported assets.

Option A involves individual replacements of 107 identified assets across 107 sites within the regulatory period. The remainder of assets are targeted through related needs. The option is based on a direct replacement approach whereby the asset is replaced by a modern IED equivalent. Minor additional system modifications would be deployed under this option.

Table 1 - Evaluated options

Option	Description	Direct capital cost ($m)	Overheads ($m)	Total capital cost[1] ($m)	Weighted NPV (PV, $m)	Rank
Option A – N2453A	Replace with new IED standard	4.55	1.64	6.19	0.48	1

It is the recommendation that Option A – Renewal of Individual Assets, be scoped in detail.

[1] Total capital cost is the sum of the direct capital cost and network and corporate overheads. Total capital cost is used in this OER for all analysis.

1. Need/opportunity

Communication's Alarm Systems (CAS) exist at all network sites and monitor the statuses of communications equipment.

These systems have traditionally been deployed on a Windows based PC with the use of 3rd party conversion hardware to turn binary inputs to a computer readable format. These systems have relied on an internally developed and maintained software build to facilitate alarms. The hardware and software platforms are not upgradable to Windows 10 and would require renewal to host the new operating system.

The CAS systems have reached end of life with many PCs operating on obsolete versions of Windows, presenting a cybersecurity risks in addition to those related to physical age of the hardware platforms. We have developed a fit-for-purpose solution utilising Intelligent Electric Devices (IEDs) that provide increased reliability, longer technical life and improved visibility of communications equipment to our SCADA Control Room. This solution mitigates risk against operating system obsolescence, lowers our exposure to cybersecurity threats and mitigates overheads associated with bespoke internal development. An IED based solution also brings the CAS into alignment with TransGrid's modern standard design philosophies applicable to both protection and control systems.

Furthermore, the current solution limits SCADA visibility to a single alarm for the site indicating that some component of the communications system has failed. This delays response capabilities as it requires an authorised member of the Substation Secure Zone (SSZ) to remotely access the local system to determine the cause of the alarm and initiate appropriate rectification activities.

There is a need to mitigate our cybersecurity risk profile and address the age of these assets to facilitate the ongoing monitoring and response requirements of our communications equipment.

As per clause 4.11.1 of the NER, remote monitoring and control systems are required to be maintained in accordance with the standards and protocols determined and advised by AEMO.

The current deployment of CAS solution does not assist in the rapid response to failures which increases the risk of non-compliance with AEMO's Power Systems Data Communications Standard (PSDCS) which sets the acceptable outage rates for system data.

There are over 147 CAS systems deployed within the network that require rectification.

2. Related needs/opportunities

There are no identified needs that would deliver efficiencies through the coordination of works.

Appendix C lists related Needs that include works covered under this project and have had their associated assets removed.

3. Options

3.1 Base case

The Base Case for this Need is to continue with TransGrid's business as usual operations and maintenance (O&M) for the assets. This approach does not address the deteriorating condition of the computer systems within the network or the risk cost associated with maintaining aging assets. The risk will likely increase due to:

> The probability of failure increasing as assets move further along their failure curves[2].

[2] Refer Network Asset Health Framework

- TransGrid's inability to recover from asset failure in the future due to withdrawn manufacturer support, and depletion of spares availability that would otherwise limit the overall consequence of asset failure.

Key drivers for this risk cost are:

- The majority of assets identified have reached their end of technical life and no manufacturer support as highlighted in previous sections. This therefore increases the likelihood of a hazardous event occurring and decreases TransGrid's ability to mitigate or repair failures.
- Assets have increasing numbers of failure as they progress along their failure curves, increasing the likelihood of a hazardous event occurring.

Increasing maintenance on computer equipment cannot reduce the probability of failure or reduce risk costs. This is because maintenance of computer assets is focused on device inspection and functional performance checks only, the conduct of maintenance at an electronic component level is neither feasible nor practicable.

3.2 Options evaluated

Option A — Replace with new IED standard [NOSA N2453, OFS N2453A]

This option involves targeted replacements of 107 identified assets up to 2027/28. The option is based on a targeted approach whereby the asset is replaced by its modern equivalent utilising an IED. The remainder of CAS systems are captured through related needs.

This option would deliver the greatest benefits to consumers and the network by targeting the probability of failure of targeted assets. This option will provide additional operational benefits such as improved capabilities for remote interrogation.

This option is planned for deployment across the 2023/24-2027/28 regulatory control period. Targeted assets will be in service for approximately 15 years.

3.3 Options considered and not progressed

Table 2 – Options not progressed

Option	Reason for not progressing
Replace with new operating systems	Whilst this option is technically feasible, it does not address the ongoing cybersecurity challenges with a computer system, standard operating system and in-house developed software
Asset Retirement	This can only be achieved by retiring the associated communications assets, which is not technically or economically feasible. The communications network will remain an essential component of the network into the foreseeable future as detailed within TransGrid's 2021 TAPR.
Non-network solutions	It is not technically feasible for non-network solutions to provide the functionality of secondary systems assets for protection, control, communications and metering

4. Evaluation

4.1 Commercial evaluation methodology

The economic assessment undertaken for this project includes three scenarios that reflect a central set assumptions based on current information that is most likely to eventuate (central scenario), a set of assumptions that give rise to a lower bound for net benefits (lower bound scenario), and a set of assumptions that give rise to an upper bound on benefits (higher bound scenario).

Assumptions for each scenario are set out in the table below.

Table 3 – Scenario assumptions

Parameter	Central scenario	Lower bound scenario	Higher bound scenario
Discount rate	4.8%	7.37%	2.23%
Capital cost	100%	125%	75%
Operating expenditure benefit	100%	75%	125%
Risk costs benefit	100%	75%	125%
Other benefit	100%	75%	125%
Scenario weighting	**50%**	**25%**	**25%**

Parameters used in this commercial evaluation:

Table 4 - Commercial evaluation parameters

Parameter	Parameter Description	Value used for this evaluation
Discount year	Year that dollar values are discounted to	2020/21
Base year	The year that dollar value outputs are expressed in real terms	2020/21 dollars
Period of analysis	Number of years included in economic analysis with remaining capital value included as terminal value at the end of the analysis period.	15 years
Safety disproportionality	Multiplier of the safety risk cost included in NPV analysis to demonstrate implementation of obligation to reduce safety to ALARP.	Refer to section 4.3 for details.

The capex figures in this OER do not include any real cost escalation.

4.2 Commercial evaluation results

The commercial evaluation of the technically feasible options is set out in Table 5. Details appear in Appendix A.

Table 5 - Commercial evaluation ($ million)

Option	Capital Cost PV	Central scenario NPV	Lower bound scenario NPV	Higher bound scenario NPV	Weighted NPV	Ranking
Option A	4.91	0.23	-2.31	3.77	0.48	1

4.3 ALARP evaluation

TransGrid manages and mitigates bushfire and safety risk to ensure they are below risk tolerance levels or 'As Low As Reasonably Practicable' ('ALARP'), in accordance with the regulation obligations and TransGrid's business risk

appetite. The need for these assets is not driven by these risks. There is no quantifiable safety risk reduction by addressing the condition of these assets.

4.4 Preferred option

The preferred option to meet the identified need by 2027/28 is Option A. Option A is the most prudent and economically efficient solution to enable TransGrid to continue meeting its regulatory obligations set out in clause 4.11.1, 4.6.1(b)[3] of the NER. This option maximises net economic benefits to all those who produce, consume and transport electricity in the market, and will ensure performance standards applicable to the networks communications systems continue to remain met.

Option A involves an on-site renewal (replacement) of the individually assessed components in an old for new replacement. Efficiencies will be achieved by reusing the existing building, tunnel boards, and the cabling where practicable.

Capital and Operating Expenditure

There is negligible difference in predicted ongoing planned routine operational expenditure between the option and the Base Case.

Resultant corrective maintenance under the base case strategy is anticipated to result in higher expenditure over the upcoming regulatory period. Delivery of proposed works under Option A will reduce the risk of increasing direct defect response costs.

It has been modelled that under corrective maintenance, those components with no manufacturer support and limited spares could incur significant costs associated with design and preparation, and likely augmentation of linking systems required to move to a different design solution. Such costs would not be present in cases where a like-for-like replacement is feasible.

These operating expenditure benefits have been captured in the economic evaluation.

Regulatory Investment Test

The program and estimate allows for the appropriate Regulatory approvals as required.

5. Optimal Timing

The test for optimal timing of the preferred option has been undertaken. The approach taken is to identify the optimal commissioning year for the preferred option where net benefits (including avoided costs and safety disproportionality tests) of the preferred option exceeds the annualised costs of the option. The commencement year is determined based on the required project disbursement to meet the commissioning year based on the OFS.

The results of optimal timing analysis are:

- Optimal commissioning year: 2027/28
- Commissioning year annual benefit: $3.83 million
- Annualised cost: $0.0.59 million

The project is expected to commence in the 2023/24-2027/28 Regulatory Period based on the optimal timing.

[3] As per clause 4.6.1(b) of the NER, AEMO must ensure that there are processes in place, which will allow the determination of fault levels for normal operation of the power system and in anticipation of all credible contingency events and protected events that AEMO considers may affect the configuration of the power system, so that AEMO can identify any busbar which could potentially be exposed to a fault level which exceeds the fault current ratings of the circuit breakers associated with that busbar.

6. Recommendation

It is the recommendation that Option A – Replace with new IED standard be scoped in detail.

The total project cost is $6.19 million including $1.00 million to progress the project from DG1 to DG2.

Appendix A - Commercial evaluation report

Project Description	FY24-28 Comms Alarm Systems		
Option Description	Option A - Replace with Piecemeal Solution		
Project Summary			
Option Rank	*1*	Investment Assessment Period	*15*
Asset Life	*15*	NPV Year	2020/21
Economic Evaluation			
NPV @ Central Benefit Scenario (PV, $m)	0.23	Annualised CAPEX @ Central Benefit Scenario ($m)	Annualised Capex - Standard (Business Case) 0.59
NPV @ Lower Bound Scenario (PV, $m)	-2.31	Network Safety Risk Reduction ($m)	Network Safety Risk Reduction 0.00
NPV @ Higher Bound Scenario (PV, $m)	3.77	ALARP	ALARP Compliant? No
NPV Weighted (PV, $m)	0.48	Optimal Timing	Optimal timing (Business Case) 2023/24
Cost (Central Scenario)			
Total Capex ($m)	6.19	Cost Capex (PV,$m)	4.91
Terminal Value ($m)	0.00	Terminal Value (PV,$m)	0.00
Risk (Central Scenario)	**Pre**	**Post**	**Benefit**
Reliability (PV,$m)	Reliability Risk (Pre) 0.00	Reliability Risk (Post) 0.00	Pre – Post 0.00
Financial (PV,$m)	Financial Risk (Pre) 0.00	Financial Risk (Post) 0.00	Pre – Post 0.00
Operational/Compliance (PV,$m)	Operational Risk (Pre) 0.00	Operational Risk (Post) 0.00	Pre – Post 0.00
Safety (PV,$m)	Safety Risk (Pre) 0.00	Safety Risk (Post) 0.00	Pre – Post 0.00
Environmental (PV,$m)	Environmental Risk (Pre) 0.00	Environmental Risk (Post) 0.00	Pre – Post 0.00
Reputational ($m)	Reputational Risk (Pre) 0.00	Reputational Risk (Post) 0.00	Pre – Post 0.00
Total Risk (PV,$m)	Total Risk (Pre) 0.00	Total Risk (Post) 0.00	Pre – Post 0.00
OPEX Benefit (PV,$m)			OPEX Benefit 0.00
Other benefit (PV,$m)			Incremental Net Benefit 5.14
Total Benefit (PV,$m)			Business Case Total Benefit 5.14

Appendix B Asset List for targeting

Plant number	Site Name	Site Type	Site Code
CMCBGP	BUGONG GAP RS	Radio Repeater Site	BGP
CMCRAZ	RAZORBACK RS	Radio Repeater Site	RAZ
CMCRRT	ROBERTSON RS	Radio Repeater Site	RRT
COCMCN	MT CANOBOLAS RS	Radio Repeater Site	MCN
COCMLB	MT LAMBIE RS	Radio Repeater Site	MLB
COCMMH	MT MEEHAN RS	Radio Repeater Site	MMH
COCMMQ	MT MACQUARIE RS	Radio Repeater Site	MMQ
COCWLR	WOLLAR RS	Radio Repeater Site	WLR
COCWRS	WELLINGTON RS	Radio Repeater Site	WRS
NNCMAT	MT ARTHUR RS	Radio Repeater Site	MAT
NNCMID	MIDDLE BROTHER RS	Radio Repeater Site	MID
NNCMRW	MERRIWA RS	Radio Repeater Site	MRW
NNCSOM	SOMERSBY RS	Radio Repeater Site	SOM
NNCSUL	MT SUGARLOAF RS	Radio Repeater Site	SUL
NTCBYB	BANYABBA SDH & VHF RS	Radio Repeater Site	BYB
NTCGRD	GIRARD STATE FOREST RS	Radio Repeater Site	GGI
NTCHTG	HALLAM TRIG NEW RS	Radio Repeater Site	HTG
NTCM2A	MT CORAMBA (HUT 2) SDH RS	Radio Repeater Site	M2A

Plant number	Site Name	Site Type	Site Code
NTCMMK	MT MACKENZIE NEW RS	Radio Repeater Site	MMK
NTCMSR	MT SOMA RS	Radio Repeater Site	MSR
NTCPAN	PARROTS NEST SDH & VHF RS	Radio Repeater Site	PAN
NTCRLP	ROCHES LOOP RS	Radio Repeater Site	RLP
NTCSKC	SIMPKINS CREEK RS	Radio Repeater Site	SKC
SWCBRA	MT BURRA RS	Radio Repeater Site	BRA
SWCCRW	CURRAWARNA RS	Radio Repeater Site	CRW
SWCSQH	SQUARE HEAD RS	Radio Repeater Site	SQH
SYCHHR	HAMMONDS HILL RS	Radio Repeater Site	HHR
SYCHKH	HAWK HILL RS	Radio Repeater Site	HKH
SYCLDA	LERIDA RS	Radio Repeater Site	LDA
SYCMSG	MT SPRING RS	Radio Repeater Site	MSG
SYCSNB	SNUBBA RS	Radio Repeater Site	SNB
CMDSWC	METROPOLITAN REGIONAL CENTRE	Regional Centre	SWC
NNDNEC	NEWCASTLE REGIONAL CENTRE	Regional Centre	NEC
SYDYSC	YASS REGIONAL CENTRE	Regional Centre	YSC
CMDAVS	AVON SUBSTATION	Substation	AVS
CMDBFN	BEACONSFIELD NORTH SUBSTATION	Substation	BFN
CMDBFS	BEACONSFIELD SOUTH SUBSTATION	Substation	BFS
CMDDPT	DAPTO SUBSTATION	Substation	DPT
CMDHLD	HOLROYD SUBSTATION	Substation	HLD
CMDKVS	KANGAROO VALLEY SUBSTATION	Substation	KVS

Plant number	Site Name	Site Type	Site Code
CMDMAC	MACARTHUR SUBSTATION	Substation	MAC
CMDRWR	ROOKWOOD SUBSTATION	Substation	RWR
CMDSYN	SYDNEY NORTH SUBSTATION	Substation	SYN
CMDSYS	SYDNEY SOUTH SUBSTATION	Substation	SYS
CMDSYW	SYDNEY WEST SUBSTATION	Substation	SYW
CMDVYD	VINEYARD SUBSTATION	Substation	VYD
CODBER	BERYL SUBSTATION	Substation	BER
CODMNL	MANILDRA SUBSTATION	Substation	MNL
CODMOL	MOLONG SUBSTATION	Substation	MOL
CODMPP	MT PIPER 132 SUBSTATION	Substation	MPP
CODMTP	MT PIPER 500/330 SUBSTATION	Substation	MTP
CODONO	ORANGE NORTH SUBSTATION	Substation	ONO
CODORG	ORANGE SUBSTATION	Substation	ORG
CODPKS	PARKES SUBSTATION	Substation	PKS
CODWOL	WOLLAR SUBSTATION	Substation	WOL
CODWWS	WALLERAWANG 132 SUBSTATION	Substation	WWS
NNDBAY	BAYSWATER SUBSTATION	Substation	BAY
NNDER0	ERARING SUBSTATION	Substation	ER0
NNDLD1	LIDDELL SUBSTATION	Substation	LD1
NNDMN1	MUNMORAH SUBSTATION	Substation	MN1
NNDMRK	MUSWELLBROOK SUBSTATION	Substation	MRK
NNDNEW	NEWCASTLE SUBSTATION	Substation	NEW
NNDPMQ	PORT MACQUARIE SUBSTATION	Substation	PMQ
NNDTGH	TUGGERAH SUBSTATION	Substation	TGH
NNDTRE	TAREE SUBSTATION	Substation	TRE
NNDWRH	WARATAH WEST SUBSTATION	Substation	WRH

Plant number	Site Name	Site Type	Site Code
NTDBOS	BOAMBEE SOUTH SUBSTATION	Substation	BOS
NTDDMQ	DUMARESQ SUBSTATION	Substation	DMQ
NTDKLK	KOOLKHAN SUBSTATION	Substation	KLK
NTDLSM	LISMORE SUBSTATION	Substation	LSM
NTDMRE	MOREE SUBSTATION	Substation	MRE
NTDMVL	MACKSVILLE SUBSTATION	Substation	MVL
NTDRAL	RALEIGH SUBSTATION	Substation	RAL
NTDTA1	TAMWORTH 330 SUBSTATION	Substation	TA1
NTDTMW	TAMWORTH 132 SUBSTATION	Substation	TMW
NTDTTF	TENTERFIELD SUBSTATION	Substation	TTF
SWDALB	ALBURY SUBSTATION	Substation	ALB
SWDANM	ANM SUBSTATION	Substation	ANM
SWDBKH	BROKEN HILL SUBSTATION	Substation	BKH
SWDBRG	BURONGA SUBSTATION	Substation	BRG
SWDCLY	COLEAMBALLY SUBSTATION	Substation	CLY
SWDDN2	DENILIQUIN SUBSTATION	Substation	DN2
SWDDNT	DARLINGTON POINT SUBSTATION	Substation	DNT
SWDDPK	DEER PARK SUBSTATION	Substation	DPK
SWDGAD	GADARA SUBSTATION	Substation	GAD
SWDGRF	GRIFFITH SUBSTATION	Substation	GRF
SWDHU2	HUME SUBSTATION	Substation	HU2
SWDJDA	JINDERA SUBSTATION	Substation	JDA
SWDTU2	TUMUT SUBSTATION	Substation	TU2
SWDWG1	WAGGA 330 SUBSTATION	Substation	WG1
SWDWG2	WAGGA 132 SUBSTATION	Substation	WG2
SWDWGN	WAGGA NORTH SUBSTATION	Substation	WGN

Plant number	Site Name	Site Type	Site Code
SWDYA2	YANCO SUBSTATION	Substation	YA2
SYDBBY	BANNABY SUBSTATION	Substation	BBY
SYDBUK	BURRINJUCK SUBSTATION	Substation	BUK
SYDCA1	CANBERRA SUBSTATION	Substation	CA1
SYDCOA	COOMA SUBSTATION	Substation	COA
SYDGTH	GUTHEGA SUBSTATION	Substation	GTH
SYDMNY	MUNYANG SUBSTATION	Substation	MNY
SYDMRN	MARULAN SUBSTATION	Substation	MRN
SYDMUR	MURRAY SUBSTATION	Substation	MUR
SYDQBY	QUEANBEYAN SUBSTATION	Substation	QBY
SYDSDL	STOCKDILL SUBSTATION	Substation	SDL
SYDUT1	UPPER TUMUT SUBSTATION	Substation	UT1
SYDWDL	WILLIAMSDALE SUBSTATION	Substation	WDL

Appendix C Related Needs with Assets Removed

The following Needs contain assets that would otherwise be covered under this proposed program of work. These assets have been captured and justified within the relevant Option Evaluation Report for each Need below.

Need ID	Need Description
N2437	FY24-28 COF Secondary Systems Renewal
N2436	FY24-28 INV Secondary Systems Renewal
N2435	FY24-28 NB2 Secondary Systems Renewal
N2433	FY24-28 TOM Secondary Systems Renewal
N2432	FY24-28 GN2 Secondary Systems Renewal
N2431	FY24-28 NAM Secondary Systems Renewal
N2430	FY24-28 FB2 Secondary Systems Renewal
N2429	FY24-28 VP1 Secondary Systems Renewal
N2428	FY24-28 CW2 Secondary Systems Renewal
N2427	FY24-28 RGV Secondary Systems Renewal
N2426	FY24-28 WW1 Secondary Systems Renewal
N2419	FY24-28 PMA Secondary Systems Renewal
N2411	FY24-28 WL1 Secondary Systems Renewal
N2410	FY24-28 FNY Secondary Systems Renewal
N2409	FY24-28 KS2 Secondary Systems Renewal
N2408	FY24-28 AR1 Secondary Systems Renewal
N2407	FY24-28 BRD Secondary Systems Renewal
N2406	FY24-28 GNS Secondary Systems Renewal
N2405	FY24-28 LT1 Secondary Systems Renewal
N2212	FY24-28 SE1 Secondary Systems Renewal
N2211	FY24-28 YSN Secondary Systems Renewal