OPTIONS EVALUATION REPORT (OER)

Making the Grid More Resilient - Operational Telephone Network (OTN) Capability

OER-1423 Revision 3.0

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Project category: Prescribed - Augmentation

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1. NEED/OPPORTUNITY

TransGrid's operational voices services include mobile telephony, Telstra's PSTN network, and TransGrid's Operational Telephone Network (OTN) and Very High Frequency (VHF) networks. The radio network is primarily required to provide secure and sustained voice communications during a black start and can operate for more than 12 hours.

The existing VHF network was designed in the 1980's to service seven distinct regions, each with their own system control centre. With the introduction of the System Operations requirements, the seven control centres were consolidated into two centres at Wallgrove and Waratah, communicating with the seven regions.

The VHF presently provides the most robust communication channel between the substations, power stations and external control centres during power system emergencies. However, it will be necessary to initiate a program to replace the base stations and repeater sites with new associated batteries and battery chargers as the manufacturer will cease supporting the hardware in 2018.

As referred to in NOS-1423, TransGrid is required to maintain the necessary primary and, where nominated by AEMO, back-up communications facilities to enable AEMO to discharge its market and power system security functions. Experience from the recent blackouts in the Northern territory and South Australia have shown that a robust and reliable Operational Telephone Network (OTN) is essential in enabling rapid restoration of supplies to the network customers.

For details, refer to NOS-1423.

2. RELATED NEEDS/OPPORTUNITIES

Nil

3. OPTIONS

Base case

The base case is to maintain the present VHF network. There is a risk of this system failing after the12 hour mark due to limited battery design capacity at the base stations and repeater sites. Consequently, load restoration will be delayed beyond this time frame.

Base Case Risk Cost

The total risk cost of the base case is calculated to be $3.95m per annum (refer Attachment 2 in NOS 1423), and is predominately made up of the reliability risk caused by extended delays to recovering load from a black start event due to the unavailability of the existing operational voice services beyond the 12 hours mark[1].

The following assumptions were used in the calculation:

- The probability of a black system event is conservatively estimated at 1% (1 in 100 year event)
- The % amount of load not restored at 12 hours mark = 20% of the system load (it is expected that about 80% of the system load will be restored by the 12 hours mark[2])
- Time to restore this remaining load due to unavailability of appropriate telecommunications = 12 hours
- The historical system average demand = 8,577 MW[3]

[1] Design standard for operational telephone network

[2] Based on the historical event restoration times and TransGrid annual black start training simulation experiences

[3] Historical system average demand from AEMC report "*Review of the System Restart Standard*" 25 August 2016 Figure 6.5

- Value of Customer Reliability (VCR) = $38,350/MWh

The total cost of these risks has been calculated in TransGrid's Investment Risk Tool thus:

VCR Risk Cost (Unserved Energy)

$$VCR\ risk\ cost = probability\ of\ black\ start * amount\ of\ load\ not\ restored\ @\ 12\ hours\ mark * average\ historical\ state\ demand * load\ restoration\ scaling\ factor^{4} * remaining\ load\ restoration\ time * VCR^{5}$$

$$\therefore VCR\ risk\ cost = 1\% * 20\% * 8{,}577\ MWh * 0.5 * 12\ hrs * \$38{,}350/MWh$$

$$\boldsymbol{\therefore VCR\ risk\ cost = \$3.95\ million\ per\ annum}$$

The total risk cost is $3.95 million.

Option A – Replace VHF radio base stations and repeater sites

The upgrade and continued operation of TransGrid's existing radio base stations and radio repeater sites would provide a robust communications network within the energy market during black start conditions.

This option has been assessed for feasibility in OFS-1423A. The estimated un-escalated capital cost of the option is $2.42 M ± 25% in 2016-17.

Option Risk Cost

Risk cost for Option A is $1.32 million per annum which is predominantly made of value of unserved energy.

With the availability of VHF radio network it is expected that the remaining load beyond 12 hours mark would be able to be restored in about 4 hours[6].

Using the same assumptions used for the base case, the value of unserved energy can be calculated as follows:

$$VCR\ risk\ cost = probability\ of\ black\ start * amount\ of\ load\ not\ restored\ @\ 12\ hours\ mark * average\ historical\ state\ demand * load\ restoration\ scaling\ factor^{4} * remaining\ load\ restoration\ time * VCR^{7}$$

$$\therefore VCR\ risk\ cost = 1\% * 20\% * 8{,}577\ MWh * 0.5 * 4\ hrs * \$38{,}350/MWh$$

$$\boldsymbol{\therefore VCR\ risk\ cost = \$1.32\ million\ per\ annum}$$

There is a reputational and financial risk cost of $0.01 million (as derived in the Investment risk tool).

The total risk cost is $3.96 million.

Non-network Option

No feasible non-network solutions have been identified to address this Need.

[4] A factor if 0.5 is used assuming gradual restoration of load

[5] TransGrid's Investment Risk Tool bases the Value of Customer Reliability (VCR) on figures published by AEMO in its *Value of Customer Reliability Review - Final Report*, September 2014. In this case we use the mixed residential/industrial figure of $38,350/MWh.

[6] Based on the historical event restoration times and TransGrid annual black start training simulation experiences

[7] TransGrid's Investment Risk Tool bases the Value of Customer Reliability (VCR) on figures published by AEMO in its *Value of Customer Reliability Review - Final Report*, September 2014. In this case we use the mixed residential/industrial figure of $38,350/MWh.

4. EVALUATION

A single option was identified and is evaluated below against the base case.

The economic evaluation of the technically feasible options is set out in Table 1.

Table 1 – Options Comparison

Option	Description	Capex ($m)^#	Opex ($m)	Yearly post project risk cost ($m)	Financial NPV ($m)	Economic NPV ($m)	Rank
Base case	'Do nothing'	Nil	-	$3.96	-	-	2
A	Replace VHF radio base stations and repeater sites	$2.42*	$0.05	$1.32	(2.32)	14.21	1

^ In 2016-17 dollars
 # Expenditure in 2018-19 period
**Non-escalated cost*

The commercial evaluation is based on:

- a 10% discount with sensitivities based on TransGrid's current AER-determined pre-tax real regulatory WACC of 6.75% for the lower bound and 13% for the upper bound provided in Appendix A.
- The applied sensitivities on the discount rate give the following economic NPVs:

Discount Rate (%)	Economic NPV ($m)
6.75	18.83
13.00	11.15

ALARP Evaluation

An ALARP assessment is triggered by the following hazard with the associated disproportionate factor:

- Unplanned outage of high voltage equipment – 3 times the safety risk reduction and taking 10% of the reliability risk reduction as applicable to safety.

However, as this will only produce 30% of the benefit derived in the commercial evaluation, a full ALARP evaluation will not produce an alternative preferred solution.

Capital and operating expenditure

The annual maintenance cost is $0.05 million calculated at 2% of Capital cost, escalated at a rate of 2.9%.

Regulatory Investment Test

No RIT-T is required for this project as the total cost is less than $6 million.

Risk Cost Benefits

The preferred option would realise a risk cost benefit of $2.64 million per annum.

Risk Cost Benefit Sensitivity

The risk cost benefit is realised for a wide range of system restart likelihoods and VCRs. There is therefore a high likelihood that the option would realise a positive net benefit during its asset life.

Net Present Value

The NPV of this option is $14.21m based on a standard discount rate of 10%.

The pay-back period is less than 1 year.

5. Recommendation

Based on the economic evaluation above, it is recommended that a project be initiated to replace the existing VHF network as per Option A by June 2023.

Appendix A – Financial and Economic Evaluation Reports

Project_Option Name	Operation Telephone Network (OTN) Capability

1. Financial Evaluation (excludes VCR benefits)

NPV @ standard discount rate	10.00%	-$2.32m	*NPV / Capital (Ratio)*	*-0.96*
NPV @ upper bound rate	13.00%	-$2.16m	*Pay Back Period (Yrs)*	*Not measurable*
NPV @ lower bound rate (WACC)	6.75%	-$2.53m	*IRR%*	*Not measurable*

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%	$14.21m	*NPV / Capital (Ratio)*	*5.87*
NPV @ upper bound rate	13.00%	$11.15m	*Pay Back Period (Yrs)*	*Not measurable*
NPV @ lower bound rate (WACC)	6.75%	$18.83m	*IRR%*	*94.20%*

Benefits

Risk cost	As Is	To Be	Benefit
Systems (reliability)	*$3.95m*	*$1.32m*	*$2.63m*
Financial	*$0.00m*	*$0.00m*	*$0.00m*
Operational/compliance	*$0.01m*	*$0.00m*	*$0.01m*
People (safety)	*$0.00m*	*$0.00m*	*$0.00m*
Environment	*$0.00m*	*$0.00m*	*$0.00m*
Reputation	*$0.00m*	*$0.00m*	*$0.00m*
Total Risk benefits	$3.96m	$1.32m	$2.64m
Cost savings and other benefits			$0.00m
Total Benefits			$2.64m

VCR Benefit	*$2.63m*
ENS Penalty	*$0.00m*
All other risk benefits	*$0.01m*
Total Risk benefits	$2.64m
Benefits in the financial NPV*	$0.01m
**excludes VCR benefits*	
Benefits in the economic NPV**	$2.64m
***excludes ENS penalty*	

Other Financial Drivers

Incremental opex cost pa (no depreciation)	-$0.05m	Write-off cost	$0.00m
Capital - initial $m	-$2.42m	Major Asset Life (Yrs)	15.00 Yrs
Residual Value - initial investment	$0.00m	Re-investment capital	$0.00m
Capitalisation period	2.00 Yrs	Start of the re-investment period	2038-39