OPTIONS EVALUATION REPORT (OER)

Upgrading Wave Trap for Wagga Line 99X Ratings Augmentation

OER-1426 Revision 1

Ellipse project no(s): P008206
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Project reason: Economic Efficiency - Network developments to achieve market benefits
Project category: Prescribed - NCIPAP

Approvals

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Date submitted for approval	27 October 2016	

1. NEED/OPPORTUNITY

Removing the wave trap limitation on the rating of Line 99X would allow the Wagga 132 kV overload control scheme to operate at a higher overload threshold, increasing the transfer capability during high NSW import from Snowy/Victoria. And also, it reduces the load at risk at Murrumburrah due to reduced need for radial operation of the parallel.

For details, refer to the Need/Opportunity Statement (NOS-1426).

2. RELATED NEEDS/OPPORTUNITIES

Nil.

3. OPTIONS

Base case

The base case is to maintain the present rating on Line 99X and the selectable overload range on the overload control scheme. The base case risk cost is $0.36 million which is predominately made up of value of energy not served. The following assumptions were used in calculating the energy not served:

- Failure rate of line 99W = 0.04 failures/year[1]
- Failure Rate of line 99M = 0.29 failures/year[1]
- Value of customer reliability (VCR) = $38,350/MWh[2]

Period of risk for radial operation = When the combined flow of lines 99W and 99X exceeds 137 MVA. Based on AEMO OPDMS, there have been 1,047 (30 minute) instances where the combined flows on 99W and 99X exceed 137 MVA between July 2009 and February 2016 (6.5 years).

Accordingly, annual average time a risk of radial operation exists = (1,047 x 0.5)/6.5 = 80 hrs/year

The total energy not served as a result of the line limitation is calculated as:

Unserved energy = (Failure Rate of line 99W) * (Failure Rate of 99M) * (Average load at Murrumburrah[3]) * (The time line 99X flow >137 MVA) * (Restoration time from other line 991[4])

= 0.04*(0.29*20)*80*0.5 = 0.04*5.8*80*0.5 = 9.3 MWh/year

Value of unserved energy = Expected unserved energy * VCR = 9.3 * $ 38,350 = $0.36 million/year

Option A — Replace Line 99X wave trap at Wagga 132 kV Substation

This option is to replace the Line 99X wave trap at Wagga 132 kV substation to remove the secondary system limitation on the line rating. The present rating of 137 MVA would be increased to 168 MVA (continuous) and 184 MVA (contingency) and would give Line 99X the same rating as the parallel Line 99W.

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1 Based on historical TransGrid 132 kV line failure rate = 3.9 per 100 km per decade, 99W length = 10 km, 99M length = 72 km – refer to attached file Reliability Analysis – Final Summary.xlsx in PDGS

2 AEMO, Value of Customer Reliability – Application Guide.

3 Based on the Murrumburrah loads from AEMO OPDMS for period 1 June 2015 to 1 June 2016, the average Murrumburrah load = 20 MW

4 Based on typical restoration time of interrupted load using the other line, e.g. line 991 for Murrumburrah – assume 30 minutes using SCADA

This option has been assessed for feasibility in OFS-1426A. The estimated un-escalated capital cost of the option is $0.638 M ± 25% in 2016 -17 AUD.

The increase of rating on Line 99X to 184 MVA (contingency) to match the rating of the parallel Line 99W would eliminate the instances where the combined flow of the two lines are constrained by the lower of the two contingency ratings. The selectable range of the Wagga 132 kV control scheme overload threshold can therefore be increased, allowing for a higher transfer capability.

The option benefits are two folds:

- Increase in reliability of supply to the consumers: the reduction of unserved energy to 0 MWh (no opening of parallel required which will create radial operation of Murrumburrah load), and
- Increase in market benefits: increase of transfer capability from the south of the State, allowing greater market access to lower cost energy, benefiting the consumer.

Increase in reliability to consumers:

The benefits of eliminating the reliability risks during the radial operation of the connected load are described above under the "Base case risk costs". Under this option this risk will be eliminated providing an economic benefit of $0.36 million/year.

Increase in market benefits:

The market benefit is calculated as the additional combined capacity of lines 99W and 99X above 137 MVA multiplied by the energy cost reduction.

Based on TransGrid's historical loadflows S, there have been 1,047 instances where the combined flows on 99W and 99X have exceeded 137 MVA between July 2009 and February 2016. The additional capacity is calculated:

Additional capacity = post-investment capacity[5] – base case capacity[6]
= 184 MW – 0 MW
= 184 MW (max)

Expected additional capacity utilised = 150 MVA[7]

Duration utilising additional capacity = (No. of instances * duration) / span OPDMS snapshot (years)
= (1,047 * 0.5) / (6.5)
= 80 hrs / year

Expected increase in market flow = Expected additional capacity (MW) * additional capacity duration utilised per year * Failure rate of line 99W
= 150 * 80 * 0.04
= 480 MWh/year

Average price difference between Victoria and NSW when NSW is importing = $11/MWh[8]

Total market benefit = (Expected increase in market flow) * (Cost reduction of additional energy to market)
= $480 * 11/year
= $5,280/year

[5] Post-investment, 184 MW transfer is possible even if 99W is not available (since 99X is not overloaded)

[6] Base case transfer capacity is 0 MW since there is no transfer on this 132 kV parallel due to opening of parallel following trip of 99W

[7] Average flows on 99X and 99W from AEMO OPDMS above 137 MW

[8] Based on the NSW and VIC prices in the year from May 2015 to May 2016 when NSW is importing from VIC

Total Benefits

The total post implementation benefits = reliability improvement benefits + market benefits
= $0.36 + $0.005 million/ year
= $0.365 million/year

4. EVALUATION

Commercial 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)	Post project risk cost/Benefit ($m)	NPV ($m)	Rank
Base case	'Do nothing'	Nil	-	$0.36	-	2
A	Replace Line 99X wave traps at Wagga 132 kV substation	$0.638*	$0	-$0.005 (Benefit)	$2.27	1

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

The commercial evaluation is based on:

> A 10% discount rate, 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 Attachment 1.

The applied sensitivities on the discount rate give the following economic NPVs:

Discount Rate (%)	Economic NPV (2018/19 $m)
6.75	3.41
13.00	1.62

Preferred Option

The preferred option is Option A, as it improves TransGrid's risk exposure, and yields the most benefits, as calculated using TransGrid's NPV Calculation Tool (refer to Attachment 1) and Risk Tool. The base case risk cost summary is included in Attachment 2.

A summary of the preferred option can be found in Attachment 3.

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

There is no capital and operating expenditure trade-offs associated with this option.

Regulatory Investment Test

Option A would not require RIT-T as the total cost is less than $6 million.

Risk Cost Benefits

Option A would realise a net benefit of $0.365 million per annum. This includes risk saving $0.36 million and market benefits $0.005 million.

Net Present Value

The NPV of option A is $2.27 million based on a standard discount rate of 10%.

The pay-back period is 1.75 years.

5. Recommendation

Based on the economic evaluation above, Option A is the preferred option to address the Need as it reduces TransGrid's risk exposure and yields yearly benefits of $ 0.365 million.

It is therefore recommended that a NCIPAP project be initiated for the replacement of line 99X wave trap at Wagga 132 kV substation over the 2018-23 regulatory periods.

Attachment 1 – Financial and Economic Evaluation Reports

Project_Option Name	Line 99X Rating Upgrade

1. Financial Evaluation (excludes VCR benefits)

NPV @ standard discount rate	10.00%	-$0.48m	*NPV / Capital (Ratio)*	*-0.75*
NPV @ upper bound rate	13.00%	-$0.47m	*Pay Back Period (Yrs)*	*Not measurable*
NPV @ lower bound rate (WACC)	6.75%	-$0.47m	*IRR%*	*-1.68%*

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%	$2.27m	*NPV / Capital (Ratio)*	*3.56*
NPV @ upper bound rate	13.00%	$1.62m	*Pay Back Period (Yrs)*	*1.75 Yrs*
NPV @ lower bound rate (WACC)	6.75%	$3.41m	*IRR%*	*52.62%*

Benefits

Risk cost	As Is	To Be	Benefit
Systems (reliability)	*$0.36m*	*$0.00m*	*$0.36m*
Financial	*$0.00m*	*$0.00m*	*$0.00m*
Operational/compliance	*$0.00m*	*$0.00m*	*$0.00m*
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	$0.36m	$0.00m	$0.36m
Cost savings and other benefits			$0.01m
Total Benefits			$0.37m

VCR Benefit	*$0.36m*
ENS Penalty	*$0.00m*
All other risk benefits	*$0.00m*
Total Risk benefits	$0.36m
Benefits in the financial NPV*	$0.01m
**excludes VCR benefits*	
Benefits in the economic NPV**	$0.37m
***excludes ENS penalty*	

Other Financial Drivers

Incremental opex cost pa (no depreciation)	$0.00m	Write-off cost	$0.00m
Capital - initial $m	-$0.64m	Major Asset Life (Yrs)	50.00 Yrs
Residual Value - initial investment	$0.29m	Re-investment capital	$0.00m
Capitalisation period	3.00 Yrs	Start of the re-investment period	2024-25

Attachment 2 – Base Case Risk Cost Summary

Current Option Assessment - Risk Summary

Project Name: Wagga132kV TL99X Rating Upgrade

Option Name: 1426 - Base case

Option Assessment Name: 1426 - Base case - Assessment 1

Rev Reset Period: Next (2018-23)

Major Component	No.	Minor Component	Sel. Hazardous Event	LoC x CoF ($M)	Failure Mechanism	NoxLoC xCoF ($M)	PoF (Yr 1)	Total Risk ($M)	Risk ($M) (Rel)	Risk ($M) (Op)	Risk ($M) (Fin)	Risk ($M) (Peo)	Risk ($M) (Env)	Risk ($M) (Rep)
Conductor	1	Conductor (inc Joints)	Unplanned Outage - HV (Conductor)	$31.20	Break	$31.20	1.16%	$0.36	$0.36					$0.01
				$31.20		$31.20		$0.36	$0.36					$0.01

Total VCR Risk: $0.36 Total ENS Risk:

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Attachment 3 – Project Summary

Project	Upgrading Wave Trap for Wagga Line 99X Ratings Augmentation
Transmission Circuit / Injection Point	Line 99X/Wagga 132
Scope of works	Replace line 99X wave trap at Wagga 132
Reasons to undertake the project	To improve supply reliability and market benefits
Current value of the limit	137 MVA (due to wave trap at Wagga 132 on line 99X)
Target limit	184 MVA (due to wave trap at Wagga 132 on line 99W)
Capital Cost	The total capital cost is $0.638 millions
Operating Cost	$0
Market benefits	Market benefit = Value of unserved energy + increased transfer benefit Market benefit = [$0.36 + $0.005] per annum = $0.365 million/year The NPV benefit = $2.27 million, using 10% WACC
Pay-back period	Pay-back period = 1.75 years
Completion date	Over the 2018-23 period