OPTIONS EVALUATION REPORT (OER)

SNY-NSW constraint - Reactance on TL 2

OER- 000000001713 revision 2.0

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Date submitted for approval	**6th December 2016**	

Change history

Revision	Date	Amendment
0	06/12/2016	Initial issue

1. Need/opportunity

The existing transmission network for Snowy (LTSS/UTSS) to Yass/Canberra cut-set is shown in Figure 1:

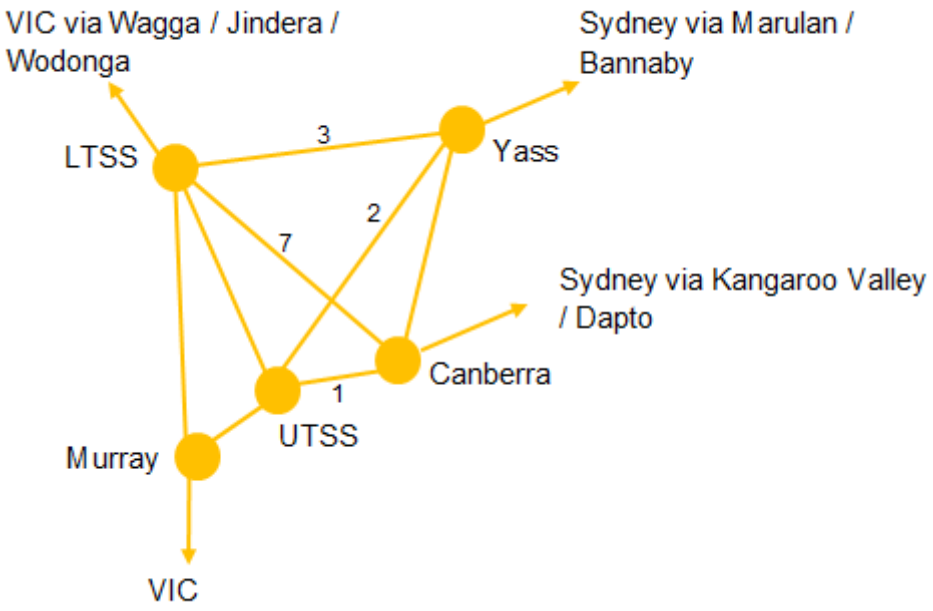

Figure 1 Existing system between Snowy and Yass/Canberra area

As outlined in NOS 1713, transmission line 2 is always the least loaded transmission line for any n-1 contingency due to it being the longest transmission line (i.e. with the largest reactance) in this cut-set. If the reactance for line 2 can be reduced, it could take up more power and relieve the loading on the remaining lines. The current limit of the Snowy to Canberra/Yass cut-set is 2709 MW, as per NOS-1713.

For example, when line 2 reactance is reduced by 2Ω, there is an increase of 26 MW in Snowy to Yass/Canberra cut-set transfer limit.

2. Related needs/opportunities

Nil.

3. Options

3.1 Base case

The cost to the market each year for the “do nothing” option is valued at $1.79 million/year as described below. This cost will be realised as market benefit if option A is implemented.

(a) Market benefit calculation

The market benefit of reducing the impedance by 2 Ω (for example using Smart Wires - multiple units of Power Router 680-1700) on Line 2 can be calculated using the following:

- Improvement in the Snowy – Yass/Canberra cut-set = 26 MW
- Expected use of the cut-set improvement = 16.2%. This is based on the historical Snowy cut-set flows for the 2 year period November 2014 to November 2016. The flow across the cut-set is expected to significantly increase following the retirement of 2000 MW generation at Liddell power station and the 162 MW generation

at Smithfield. It is assumed that this lost generation will be covered by increased import from QNI[1], additional NSW northern/central generation[2] and flow from the south[3], which would be mostly renewable generation in the NSW South West Region.[4,5]

- Average generation cost of thermal generation compared to renewable generation[6] = $25/MWh.

Estimated market benefit = (MW increase due to SmartWires) * (Expected use of cut-set improvement) * (Average generation cost of thermal generation compared to renewable generation)

= 26 * 0.162 * 24 * 365 * 25 = $0.92 million/year

(b) Value of unserved energy

Following the retirement of Liddell and Smithfield generation, it is expected that NSW will experience supply shortfalls[7]. Lost benefit as a result of "Do nothing" option due to expected unserved energy can be calculated as below:

- Expected time of unserved energy = 0.01%. This is a conservative value assuming that there will be actual lack of reserve conditions in NSW for a period of 1 hour per year at times of peak load following retirement of Liddell and Smithfield generation.
- Lost MW contribution from Snowy – Yass/Canberra cut-set if no action is taken = 26 MW
- The value of customer reliability (VCR) for NSW is $38,350/MWh[8]

Estimated benefit = (Expected time of unserved energy) * (Lost MW contribution due to "Do nothing") * VCR

= (0.01/100) * 24 * 365 * 26 * 38,350 = $0.87 million/year

Accordingly, the "Do nothing" option will result in $(0.92 + 0.87) = 1.79 million cost to the market each year.

3.2 Option A – Installation of Smart Wires on TL 2 [OSA 1713, OFS 1713A]

This option proposed to reduce reactance on TL 2 using Smart Wires (install multiple units of Smart Wires Power Router 680-1700 on Line 2 to achieve a reduction of 2Ω)

The scope of works associated with this option involves:

- Install 30 units of Power Router 680-1700 on Line 2 (10 units/phase)
- Install communication links between Power Router units and control room for remote operation of the units and monitoring purpose
- Modify Line 2 protection system in accordance with the operation status of Power Router units

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1 It was assumed that increase in QNI is about 25% of the historically available headroom

2 It was assumed that new generation in northern and central NSW will cover about 25% of the lost generation due to Liddell and Smithfield retirements – this will be mostly renewables in northern NSW and central NSW

3 Balance of lost generation is assumed to be from southern NSW – this could be mostly new renewables generation in south west NSW and import from new interconnections such as from South Australia

4 According to TAPR 2016 Figure 2.13, NSW is expected to experience a generation deficit following the retirement of Liddell generation (even with maximum existing generation + interconnector flows). Also, AEMO 2015 Electricity Statement of Opportunities (ESOO) report suggests that the unserved energy (USE) level in NSW could exceed the Reliability Standard from 2021 under the high scenario and from 2022 under the medium scenario.

5 Refer to the file 1713_Benefits.xlsx for details of the calculations

6 Based on the NSW Black Coal variable costs of $25 – refer page 61 of Jacobs report "Retail electricity price history and projections.pdf" filed in PDGS supporting documents. Typical bid price for renewable (wind/solar) generation is either $0 or negative. Accordingly, Market impact = $25 - $0 = $25

7 According to TAPR 2016 Figure 2.13, NSW is expected to experience a generation deficit following the retirement of Liddell generation (even with maximum existing generation + interconnector flows). Also, AEMO 2015 Electricity Statement of Opportunities (ESOO) report suggests that the unserved energy (USE) level in NSW could exceed the Reliability Standard from 2021 under the high scenario and from 2022 under the medium scenario.

This option is technically feasible and will achieve a 26 MW increase on the Snowy to Canberra/Yass cut-set (to 2735 MW). The expected capital cost for this option is $5.60 million ± 25% in un-escalated 2016-17 dollars, spread over 3 years. Refer to OFS-1713A for details.

Implementing this option will realise a market benefit of $1.79 million/year.

4. Evaluation

All the options (base case and option A) are technically feasible.

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

The full financial and economic evaluations are shown in Attachment 2.

Table 1 — Commercial Evaluation ($ million)

Option	Description	Total capex ($m)	Annual opex ($m)	Annual post project risk cost ($m)	Economic NPV @ 10% ($m)	Rank
Base case	Do nothing			0.87		2
A	Smart Wire installation on TL 2	5.60	0.11	-0.92 (Benefit)	7.25	1

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% or the lower bound and 13% for the upper bound, is 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	11.14
13.00	4.77

Preferred option

The preferred option is Option A – Installation of Smart Wires on TL 2, as described in OSA 1713 and assessed in OFS 1713A. This option is preferred because:

- It addresses the need to increase the import from Snowy/VIC
- It has a positive economic NPV of $5.93 million, and
- It yields a net benefit of $1.7 million per year (includes VCR risk saving $0.87 million, market benefit $0.92 million and ongoing opex $0.11 million).

A summary of the preferred option can be found in Attachment 2. Full economic and financial evaluation is included in Attachment 1, and the risk cost summary is included 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.

Payback period

Expected payback period for Option A is approximately about 3.35 years.

Capital and operating expenditure

There is no expected material increase in operating expenditure for the preferred option over and above the 2% expected operating expenditure related to installing additional plant in the network.

Regulatory Investment Test

The RIT-T is not required as the cost of the preferred option is under $6 million. All other network options are considered not economically feasible.

5. Recommendation

It is recommended that a NCIPAP project be initiated to implement Option A – Installation of Smart Wires on TL 2 in the period 2018-23.

Attachment 1 – Financial and Economic Report

Project_Option Name	Need 1713 - Option A - Smartwires on TL 2

1. Financial Evaluation (excludes VCR benefits)

NPV @ standard discount rate	10.00%	$0.52m	*NPV / Capital (Ratio)*	*0.09*
NPV @ upper bound rate	13.00%	-$0.64m	*Pay Back Period (Yrs)*	*0.11 Yrs*
NPV @ lower bound rate (WACC)	6.75%	$2.33m	*IRR%*	*11.20%*

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%	$7.25m	*NPV / Capital (Ratio)*	*1.30*
NPV @ upper bound rate	13.00%	$4.77m	*Pay Back Period (Yrs)*	*3.35 Yrs*
NPV @ lower bound rate (WACC)	6.75%	$11.14m	*IRR%*	*24.06%*

Benefits

Risk cost	As Is	To Be	Benefit
Systems (reliability)	*$0.87m*	*$0.00m*	*$0.87m*
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	$0.87m	$0.00m	$0.87m
Cost savings and other benefits			$0.92m
Total Benefits			$1.79m

VCR Benefit	*$0.87m*
ENS Penalty	*$0.00m*
All other risk benefits	*$0.00m*
Total Risk benefits	$0.87m
Benefits in the financial NPV* *excludes VCR benefits	$0.92m
Benefits in the economic NPV** **excludes ENS penalty	$1.79m

Other Financial Drivers

Incremental opex cost pa (no depreciation)	-$0.11m	Write-off cost	$0.00m
Capital - initial $m	-$5.60m	Major Asset Life (Yrs)	20.00 Yrs
Residual Value - initial investment	$0.00m	Re-investment capital	$0.00m
Capitalisation period	3.00 Yrs	Start of the re-investment period	0.00 Yrs

Attachment 2 – Summary of Preferred Option

NSW-VIC Interconnector Constraint	
Transmission Circuit / Injection Point	2 Upper Tumut – Yass
Scope of works	Installation Smart Wires on TL 2 as per OSA-1713 and OFS-1713A.
Reasons to undertake the project	Evenly spread load across all 4 transmission lines that make up the SNY – NSW cut-set
Current value of the limit	SNY – NSW cut-set capacity = 2709 MW
Target limit	Increase the SNY – NSW cut-set capacity by 26 MW = 2735 MW Market benefit = $2.62 million/year (based on 2Ω reduction of line 2 impedance).
Priority project improvement target	Increase transfer limits on NSW-VIC interconnector to 2735 MW
Capital Cost	$5.6 million
Operating Cost	$112k per annum
Market benefits	Market Benefit = $1.79 million per annum
Pay-back period	Pay-back period = 3.35 Years
Completion date	Over the 2018-23 period

Attachment 3 – Risk Cost Summary of Base Case

Current Option Assessment - Risk Summary

Project Name:

Option Name: 1713 - Base case

Option Assessment Name: 1713 - Base case

Rev Reset Period:

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)	$87.00	Break	$87.00	1.00%	$0.87	$0.87		$0.00			$0.00
				$87.00		$87.00		$0.87	$0.87		$0.00			$0.00

Total VCR Risk: $0.87 **Total ENS Risk:** $0.00

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