NEED/OPPORTUNITY STATEMENT (NOS)

SNY-NSW constraint - Reactance on TL 2

NOS- 000000001713 revision 2.0

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

Project reason: Economic Efficiency - Network developments to achieve market benefits
Project category: Prescribed - NICIPAP

Approvals

Author	Richard Xu	Network Modelling & Performance Engineer
	Jay Esson	Network Modelling & Performance Engineer
Reviewed/Endorsed	Jahan Peiris	Network Modelling & Performance Manager
	Hoang Tong	Operations Analysis Manager
	Anwar Kurukchi	Project Portfolio Sponsorship Manager
	Garrie Chubb	Investment Support Manager
Approved	Andrew Kingsmill	Manager/Power System Analysis
Date submitted for approval	**1/11/2016**	

Change history

Revision	Date	Amendment
0	1/11/2016	Initial issue
1	November 2016	Update market benefit calculation

1. Background

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

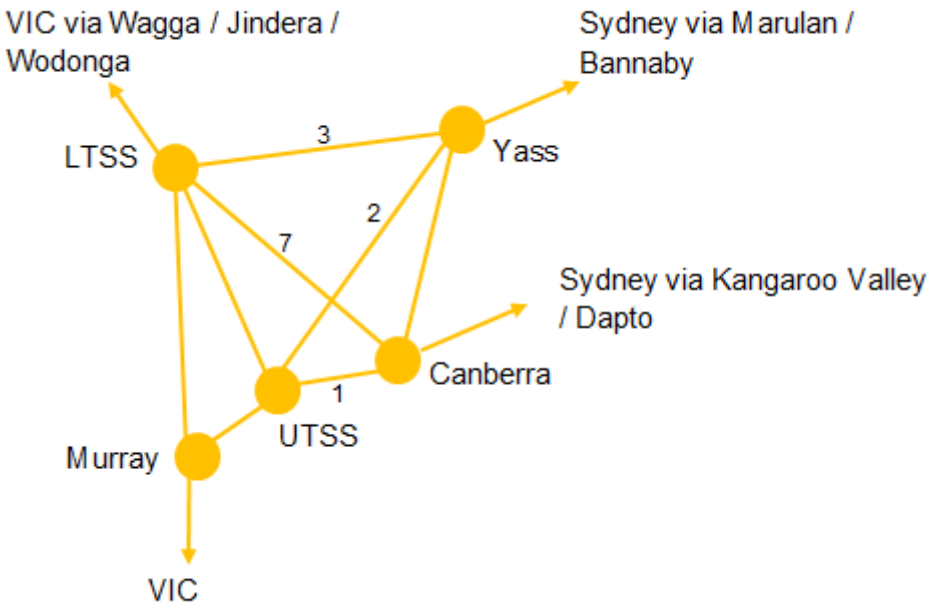

Figure 1 - Existing system between Snowy and Yass/Canberra area

Table 1 shows the distance and line reactance for the transmission lines in Snowy to Yass/Canberra cut-set.

Line No.		Distance (km)	Line reactance (Ω)
3	Lower Tumut – Yass	128.8	41.1
07	Lower Tumut – Canberra	98.8	33.1
01	Upper Tumut – Canberra	99.9	35.3
2	Upper Tumut – Yass	146.6	50.8

Table 1 Line list of Snowy to Yass/Canberra cut-set

Due to the unequal distance of the four lines in Snowy to Yass/Canberra cut-set as well as different power generation at LTSS (Tumut 3 power station with a maximum output of 1800MW) and UTSS (Tumut 1 and 2 power station with a maximum output of 720MW), the line loading under N-1 contingency on these four lines can vary substantially.

Table 2 shows line loadings when Snowy to Yass/Canberra transfer is on its limit (i.e. 2709MW) for different N-1 contingency.

Line loading for existing Line 2 reactance	N system loading	Line 01 out	Line 2 out	Line 3 out	Line 07 out	Cut-set Transfer limit (MW)
Loading on Line 01	64.7%		84.9%	81.5%	100.0%	2709
Loading on Line 2	52.9%	72.8%		76.0%	66.4%	
Loading on Line 3	65.1%	76.9%	81.6%		89.8%	
Loading on Line 07	69.7%	96.3%	80.0%	96.0%		

Table 2 Line loadings when Snowy to Yass/Canberra transfer is on its limit for different N-1 contingencies with existing Line 2 reactance

Column 6 from Table 2 shows the loading on Line 01, 2 and 3 when Line 07 is out of service. For this contingency, Line 01 reaches its contingency rating and therefore the transfer level on the in service three lines (O1, 2 and 3) defines the transfer limit for Snowy to Yass/Canberra cut-set.

Presently the power transfer limit for this cut-set is 2709 MW.

2. Need/opportunity

The loading on this cut-set is only going to increase as the dependence on the Snowy generators to provide quick support to other parts of the NEM will increase as more renewable energy sources are connected to the network. With South Australia requiring increasing generator support from the rest of the NEM, this cut-set will be required to contribute to interconnector transfers. The retirement of other generators in the NEM, such as Liddell (2022) and the Smithfield facility (2017) will also increase the load transfer on this cut-set, as the Snowy generators continue to supply load to the north.

An assessment undertaken for NOS-1528[1] concluded that after the retirement of Liddell power station, existing NSW generation with full interconnector support from other states will not be able to meet NSW demand. Upgrading the connection to Snowy will increase the ability to continue to supply NSW demand.

2.1 Benefits of Reducing Line 2 Reactance

As outlined from Table 1 and 2, Line 2 is always the least loaded transmission line for the N-1 contingencies 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.

[1] http://thewire/projects/prew/000000001528/Shared%20Documents/Milestone%20Documents/NS-000000001528%20Rev%200%20-%20Reinforcement%20of%20Southern%20Network.pdf

Table 3 shows Line loading when Line 2 reactance is reduced by 2Ω.

Line loading for 2Ω reduction in Line 2 reactance	N system loading	Line 01 out	Line 2 out	Line 3 out	Line 07 out	Cut-set Transfer limit (MW)
Loading on Line 01	64.7%		85.8%	81.3%	100.0%	2735
Loading on Line 2	55.1%	75.5%		78.8%	69.0%	
Loading on Line 3	65.2%	76.9%	82.5%		90.0%	
Loading on Line 07	69.9%	96.4%	80.7%	96.2%		

Table 3 Line loadings when Snowy to Yass/Canberra transfer is on its limit for different N-1 contingencies with 2Ω reduction in Line 2 reactance

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

2.2 Impact of Unserved Energy Due to Generation Retirements

The retirement of Liddell power station and Smithfield generation will result in greater reliance on interconnector flows to supply NSW load. Reducing the reactance on Line 2 will reduce the potential unserved energy caused by the generation retirements by 26 MW. As can be seen from the table below, taken from the TransGrid Transmission Annual Planning Report 2016, from 2022/23 when Liddell is expected to retire, the maximum demand will be greater than the total generation less reserve and the nominal maximum interconnector flow. This will result in unserved energy in NSW. This need provides an opportunity to reduce the potential unserved energy by increasing interconnector flows by 26 MW.

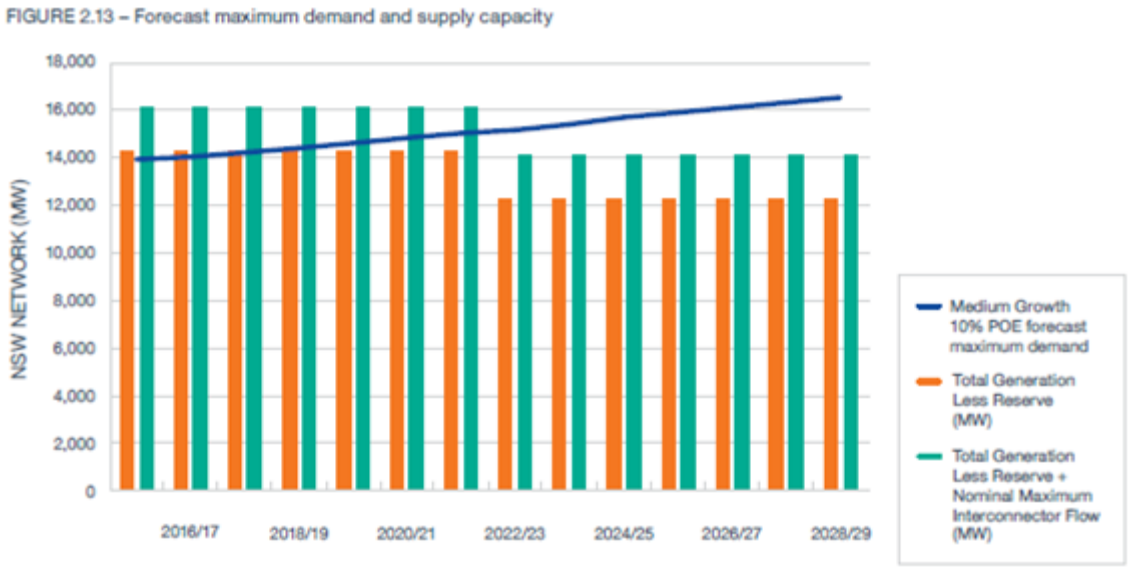

Figure 2 - Forecast maximum demand and supply capacity (page 18, T-APR 2016)

3. Related needs/opportunities

Nil.

4. Recommendation

It is recommended to investigate the options to reduce the impedance of line 2 so that the Snowy to Yass/Canberra cut-set flow can be increased. This project is to be included in TransGrid NCIPAP for the regulatory period 2018 – 2023.

Attachment 1 – Benefit calculation

(a) Market benefits

- 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 162 MW of Smithfield generation. It can be assumed that this lost generation will be covered by increased import from QNI[2], additional NSW northern/central generation[3] and flow from south[4] which would be mostly renewable generation in NSW South West Region[5,6]
- Average generation cost of thermal generation compared to renewable generation[7] = $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[8]. 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[9]

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.

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

[3] 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

[4] 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

[5] 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.

[6] Refer to the file 1713_Benefits.xlsx for details of the calculations

[7] 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

[8] 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.

Attachment 2 – Risk Cost Summary

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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