

OPTIONS EVALUATION REPORT (OER)



HV Plant Limitations on TL 70 and 71

OER- 00000001703 revision 2.0

Ellipse project no(s):

TRIM file: [TRIM No]

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

Project category: Prescribed - NCIPAP

Approvals

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Date submitted for approval		

Change history

Revision	Date	Amendment
0	November 2016	Initial issue

1. Need/opportunity

According to recent historical performance of the National Electricity Market (NEM), the following constraint significantly affected the market outcomes at times of high load in NSW.

- > N>>N-NIL__S: Avoid overloading Mt Piper to Wallerawang line on trip of the other Mt Piper – Wallerawang line (70 and 71 transmission lines).

The above limit can be improved by addressing HV plant limitations on these lines (circuit breakers, disconnectors, wavetraps) and the secondary CT limitations. All HV plant and secondary ratings need to increase to 1700 MVA. The emergency rating of these transmission lines is currently 1428¹ MVA. The worst limitation currently is 2400A/1371 MVA metering ratios. Increasing these ratios (and other limitations) to a minimum of 1700 MVA will increase the summer day 15 minute rating of the transmission line by about (1700 – 1428 =) 272 MVA.

2. Related needs/opportunities

None.

3. Options

3.1 Base case

The cost to the market each year for the “do nothing” option is valued at \$0.6 million/year and can be calculated using the following:

- > Extra capacity available = 272 MVA
- > Duration NSW demand is greater than 12,000 MW and the constraint may bind² = 1%
- > Average generation cost of thermal generation compared to renewable generation³ = \$25/MWh

Extra renewable (wind/solar) generation capacity made available in NEM = $272 * 0.01 * 24 * 365$ MWh/year

Market impact = $\$ 272 * 0.01 * 24 * 365 * 25$ /year = \$595,680/year

Accordingly, cost to the market each year due to not relieving this limitation can be summarised in the table below.

Circuit	Current Capacity ⁴ (MVA)	Future Capacity (MVA)	Cost to the market for base case (\$/year)
70 Mt Piper – Wellington 330 kV	1428	1700	595,680
71 Mt Piper – Wellington 330 kV	1428	1700	

¹ See OM 304 – Ratings of Main Grid Circuits

² Based on Historical average number of times N>>N-NIL__S was binding for the period from 1 June 2012 to 31 May 2016 – Refer file “nsw-vic-ql-1703.xlsm” in N:\HV System Planning\PUBLIC\NCIPAP\Risk Costs and the NSW demand at the time

³ 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

⁴ This includes terminal equipment and protection limitations. As per Ratings Operating Manuals 304 to 307

3.2 Option A – Replace HV Plant on 70 and 71 Transmission Lines (OSA 1703, OFS 1703A)

The scope of work required for this option is to replace any equipment that does not have a minimum rating of 1700 MVA. See Line Rating Advice for further information. The market impact calculated for the base case will be realised as market benefit if option A is implemented.

The following equipment is required to be replaced and is referenced to Single Line Diagrams WW1-826762_06 and MTP-815876_07, as shown in OFS 1703A.

- > Wallerawang 330kV Substation
 - Replacement of 70 Line disconnectors dBL, dBF, dBA, 1BS and 1BU and attached earth switches dBE, dBQ, dBBE, dBBQ, dBAE, 1BBE and 1BBQ
 - Replacement of 70 Line circuit breakers dBB and 1BB
 - Ratio change on the 70 Line CT dBC indication core
 - Ratio change on the 70 Line CT 1BC Revenue and Check metering cores
 - Installation of quad conductor HV droppers on the 70 Line
 - Replacement of the 71 Line wave traps
 - Replacement of the 71 Line CT dCC
 - Ratio change on the 71 Line CT 1CC indication core, and
 - Installation of quad conductor HV droppers on the 71 Line.
- > Mount Piper 330kV Substation
 - Replacement of the 70 Line wave traps
 - Ratio change on the 70 Line CT dFC indication core
 - Ratio change on the 70 Line CT 2F1C Revenue and Check metering cores
 - Installation of triple conductor HV connections on the 70 Line, including overhead strung bus
 - Installation of quad HV droppers on the 70 Line
 - Replacement of the 71 Line wave traps
 - Ratio change on the 71 Line CT 2G1C Revenue metering core
 - Installation of triple conductor HV connections on the 71 Line, including overhead strung bus, and
 - Installation of quad conductor HV droppers on the 71 Line.

This equates to replacing the following minor plant and equipment:

- > 5 x 330kV disconnectors
- > 7 x 330kV associated earth switches
- > 2 x 330kV circuit breakers
- > 3 x 330kV single phase current transformers, and
- > 6 x 330kV single phase wave traps.

The expected capital cost for this option is \$3.33 million ± 25% (in un-escalated 2016/17 dollars). The project is expected to be completed in an estimated 21 months from the issue of a Request for Project Scoping (RPS).

4. Evaluation

Both the 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 1.

Table 1 — Commercial evaluation (\$ million)

Option	Description	Total capex (\$m)	Annual opex (\$m)	Annual post project risk cost (\$m)	Economic NPV (\$m) @ 10%	Rank
Base case	Do Nothing	0	0	n/a	n/a	2
A	Replace HV Plant on 70 and 71 Transmission Lines	3.33	0.07	-0.6	1.14	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% for 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	2.70
13.00	0.28

Preferred option

The preferred option is Option A – Replace HV Plant on TL 70 and 71 as described in OSA 1703 and assessed in OFS 1703A. This option is preferred since it has a positive economic NPV of \$1.14 million and provides a market benefit of \$0.6 million per year.

A summary of the preferred option can be found in Attachment 2.

Payback period

Expected payback period for Option A is approximately 6.31 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.

5. Recommendation

It is recommended that a NCIPAP project be initiated to implement Option A – Replace HV Plant on TL 70 and 71 in the period 2019-23.

Attachment 1 – Financial and Economic Report

Project_Option Name

Need 1703 - Option A - Replace HV Plant on TL 70 and 71

1. Financial Evaluation (excludes VCR benefits)

NPV @ standard discount rate	10.00%	\$1.14m	NPV / Capital (Ratio)	0.34
NPV @ upper bound rate	13.00%	\$0.28m	Pay Back Period (Yrs)	0.14 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$2.70m	IRR%	14.40%

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%	\$1.14m	NPV / Capital (Ratio)	0.34
NPV @ upper bound rate	13.00%	\$0.28m	Pay Back Period (Yrs)	6.31 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$2.70m	IRR%	14.40%

Benefits

Risk cost	As Is	To Be	Benefit	VCR Benefit	\$0.00m
Systems (reliability)	\$0.00m	\$0.00m	\$0.00m	ENS Penalty	\$0.00m
Financial	\$0.00m	\$0.00m	\$0.00m	All other risk benefits	\$0.00m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$0.00m
People (safety)	\$0.00m	\$0.00m	\$0.00m	Benefits in the financial NPV*	\$0.60m
Environment	\$0.00m	\$0.00m	\$0.00m	*excludes VCR benefits	
Reputation	\$0.00m	\$0.00m	\$0.00m	Benefits in the economic NPV**	\$0.60m
Total Risk benefits	\$0.00m	\$0.00m	\$0.00m	**excludes ENS penalty	
Cost savings and other benefits			\$0.60m		
Total Benefits			\$0.60m		

Other Financial Drivers

Incremental opex cost pa (no depreciation)		-\$0.07m	Write-off cost	\$0.00m
Capital - initial \$m		-\$3.33m	Major Asset Life (Yrs)	40.00 Yrs
Residual Value - initial investment		\$1.00m	Re-investment capital	\$0.00m
Capitalisation period		2.00 Yrs	Start of the re-investment period	0.00 Yrs

Attachment 2 – Summary of Preferred Option

N>>N-NIL__S: Avoid overloading Mt Piper to Wallerawang line on trip of the other Mt Piper – Wallerawang line (70 and 71 transmission lines)

According to recent historical performance of the National Electricity Market (NEM), the following constraint significantly affected the market outcomes at times of high load in NSW.

1. **N>>N-NIL__S: Avoid overloading Mt Piper to Wallerawang line on trip of the other Mt Piper – Wallerawang line (70 and 71 transmission lines)**

The above limit can be improved by addressing HV plant limitations on these lines (circuit breakers, disconnectors, wavetraps) and the secondary CT limitations.

Transmission Circuit / Injection Point	Transmission line 70: Mt Piper – Wallerawang Transmission line 71: Mt Piper - Wallerawang
Scope of works	Replace limiting HV plant on TL 70 and 71 as per OSA-1703 and OFS-1703A.
Reasons to undertake the project	Relieve market limits that cause constraints on the National Electricity Market, increase TL 70/71 capability during outage of the other.
Current value of the limit	Contingency limits on TL 70 and 71 is 1428 MVA
Target limit	Replace any equipment that does not have a minimum rating of 1700 MVA to increase the contingency limits on the TL 70 and 71.
Priority project improvement target	Increase capacity on TL 70 and 71 to 1700 MV
Capital Cost	\$3.33 million
Operating Cost	\$67k per annum
Market benefits	Market Benefit = \$0.6 million per annum
Pay-back period	Pay-back period = 6.31 Years
Completion date	Over the 2018-23 period