

OPTIONS EVALUATION REPORT (OER)



Dynamic Line Rating Monitoring

OER 000000001579 revision 4.0

Ellipse project description:

TRIM file: [TRIM No]

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

Project category: Prescribed - NCIPAP

Approvals

Author	Jay Esson	Network Modelling and Performance Engineer
Endorsed	Jahan Peiris	Network Modelling and Performance Manager
	Hoang Tong	Operations Analysis Manager
	Garrie Chubb	Investment Support Manager
Approved	Andrew Kingsmill	Manager/Power System Analysis
Date submitted for approval	14 November 2016	

1. Need/opportunity

TransGrid's present static ratings consider the probabilistic nature of weather and line loading conditions. However, the weather data used as the basis for determining the static ratings do not necessarily refer to the critical constraint spans of a transmission line where conductor sagging is the constraining issue. Real-time localised data can obviate the need for conservative estimates and assumptions and high safety factors introduced into the maximum line loading determination.

Additional transmission lines for the installation of DLR have been identified based on the location of future NSW Connection Opportunities that have been outlined on the TransGrid website and connection enquires that TransGrid has received.

Refer to NOS-1579 for further details, including the list of additional lines that have been identified.

2. Related needs/opportunities

Project DCN526 – Real Time Dynamic Line Rating

3. Options

3.1 Base case

The base case option is to continue using static ratings for transmission lines. The current method assumes conservative estimates and assumptions in order to determine maximum line loadings.

3.2 Option A – Implement Dynamic Line Ratings on extra transmission lines

This option involves the implementation of a Dynamic Line Rating system for the additional lines as outlined in NOS-1579. Details of feasibility study are provided in OFR 1579A and OFS 1579A Rev 1.

Dynamic line ratings are expected to provide benefits in the form of:

- > Allowing maximum power transfer capability of the system (where thermal ratings are the determining factor) to be available for use by market participants (market benefits)
- > De-rating lines in order to protect the assets and the system during adverse conditions
- > Allowing the use of extra line capacity if available, during planned outage conditions, and
- > Reducing the quantity of load shedding required if load shedding is implemented as a way of managing over loading of the lines under contingencies.

The scope of works under this option can be found in OFR-1579A Rev 1. This revision of the OER is being issued to capture the increased scope of works required to achieve favourable DLR ratings (ie, the replacement of some HV plant). See OFS-1579A Rev 1 for detailed description of the works included in this option.

The expected capital cost for this option is \$5.16 million \pm 25% in un-escalated 2016-17 dollars, spread over 3 years. Refer to OFS-1579A Rev 1 for details.

The opex is estimated at 2% of the capital cost (2% * \$5,160,000 = \$103,200).

3.3 Market Benefit Calculation

The benefit of implementation of Dynamic Line Ratings on a given line can be calculated using the following:

- > Extra capacity available on average = 4-20%¹
- > Expected use of extra capacity = 1%²
- > Average generation cost of thermal generation compared to renewable generation³ = \$25/MWh

If line static rating is R,

Increase in capacity due to DLR = 0.04 to 0.2 R

Extra renewable (wind/solar) generation capacity made available in NEM
 = (0.04 to 0.2 R) * 0.01 * 24 * 365 MWh/year

Market benefit = \$ (0.04 to 0.2 R) * 0.01 * 24 * 365 * 25 /year

Using the above assumptions and calculation, the market benefits for all lines is assessed to be \$1.621 million per year.⁴

4. Evaluation

Option A has been assessed to be technically feasible.

The commercial evaluation of the technically feasible options is set out below:

Option	Description	Capex (\$m)	Opex (\$m)	Post project risk cost/benefit (-ve) (\$m)	NPV (\$m)	Rank
Base case	Do nothing	n/a	n/a	n/a	n/a	2
A	Implement DLR on extra transmission lines	5.16	0.1	-1.62	4.40	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 provided in Appendix A.

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

Discount Rate (%)	Economic NPV (2018/19 \$m)
6.75	6.94
13.00	2.79

¹ This is a conservative assumption based on the historical DLRs calculated for lines with DLRs implemented (refer Figure in NOS), and the achievable ratings of terminal equipment

² Based on expected wind farm generation and existing line capacities

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 See supporting document “1579 – Benefit calculations Nov 2016.xlsx” for breakdown of this figure.

Preferred Option

The preferred option is therefore Option A, as it significantly improves TransGrid's risk exposure, and yields the most benefits, as calculated using TransGrid's NPV Calculation Tool and Risk Tool (refer Appendix A).

Capital and operating expenditure

There is insignificant capital and operating expenditure trade-offs associated with the preferred option in comparison to the base case.

Regulatory Investment Test

The RIT-T is not required as this project is less than \$6m.

5. Recommendation

It is recommended that Option A – Additional Dynamic Line Rating Systems – be developed into a NCIPAP project for the regulatory period 2018-23.

Appendix A – Financial and Economic Evaluation Reports

Project_Option Name

Implement Dynamic Line Ratings on extra transmission lines

1. Financial Evaluation (excludes VCR benefits)

NPV @ standard discount rate	10.00%	\$4.40m	NPV / Capital (Ratio)	0.85
NPV @ upper bound rate	13.00%	\$2.79m	Pay Back Period (Yrs)	0.24 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$6.94m	IRR%	23.56%

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%	\$4.40m	NPV / Capital (Ratio)	0.85
NPV @ upper bound rate	13.00%	\$2.79m	Pay Back Period (Yrs)	3.41 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$6.94m	IRR%	23.56%

Benefits

Risk cost	As Is	To Be	Benefit		
Systems (reliability)	\$0.00m	\$0.00m	\$0.00m	VCR Benefit	\$0.00m
Financial	\$0.00m	\$0.00m	\$0.00m	ENS Penalty	\$0.00m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	All other risk benefits	\$0.00m
People (safety)	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$0.00m
Environment	\$0.00m	\$0.00m	\$0.00m	Benefits in the financial NPV*	\$1.62m
Reputation	\$0.00m	\$0.00m	\$0.00m	*excludes VCR benefits	
Total Risk benefits	\$0.00m	\$0.00m	\$0.00m	Benefits in the economic NPV**	\$1.62m
Cost savings and other benefits			\$1.62m	**excludes ENS penalty	
Total Benefits			\$1.62m		

Other Financial Drivers

Incremental opex cost pa (no depreciation)	-\$0.10m	Write-off cost	\$0.00m
Capital - initial \$m	-\$5.16m	Major Asset Life (Yrs)	15.00 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

Appendix B – Summary of Preferred Option

Additional Dynamic Line Rating	TransGrid's present static ratings consider the probabilistic nature of weather and line loading conditions. However, the weather data used as the basis for determining the static ratings do not necessarily refer to the critical constraint spans of a transmission line where conductor sagging is the constraining issue. Real-time localised data can obviate the need for conservative estimates and assumptions and high safety factors introduced into the maximum line loading determination.
Transmission Circuit / Injection Point	X5/1, X5/3, X2, 63, 99K, 99D, 99T, 99J, 94K, 94U, 94H, 72, 79, 945, 94B, 947, 9U4
Scope of works	Dynamic Line Rating system for the additional lines
Reasons to undertake the project	<ul style="list-style-type: none"> • Allowing maximum power transfer capability of the system (where thermal ratings are the determining factor) to be available for use by market participants (market benefits). • De-rating lines in order to protect the assets and the system during adverse conditions • Allowing the use of extra line capacity if available, during planned outage conditions • Reducing the quantity of load shedding required if load shedding is implemented as a way of managing over loading of the lines under contingencies
Current value of the limit	Market benefits not realised, protection of assets.
Target limit	Expected increase in the current limit by 1%, at favourable weather times, and protection of assets during unfavourable weather events. Benefit = \$1.621 million per annum
Priority project improvement target	Allow maximum power transfer, de-rate lines in order to protect assets, better utilisation of lines during outage, reduce load shedding.
Capital Cost	The total capital cost is \$5.16 million.
Operating Cost	\$0.1 million/year
Market benefits	\$1.62 million/year
Pay-back period	3.41 years
Completion date	Regulatory period 2018 - 2023