

OPTIONS EVALUATION REPORT (OER)



Short-Term Rating of Darlington Point Tie Transformers

OER 000000001392 revision 7.0

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 & Performance Engineer
	Bhavin Sanghavi	Operations Analysis Engineer
Reviewed	Jahan Peiris	Network Modelling & Performance Manager
	Hoang Tong	Operations Analysis Manager
Endorsed	Garrie Chubb	Investment Support Manager
	John Howland	Manager/Portfolio Management
Approved	Andrew Kingsmill	Manager/Power System Analysis
Date submitted for approval	8 December 2016	

Change history

Revision	Date	Amendment
0	18/07/2016	Initial issue.
1	28/10/2016	Updated to 2016/17 dollars.

1. NEED/OPPORTUNITY

The rating of a transformer is based on a thermal model that relies on the properties of the unit and on the ambient temperature, prior loading and voltage levels. With a real-time model, more accurate projection of transformer loading limits could be provided for different operating scenarios and the loading capacity of the transformer could be better utilised. Moreover, it can potentially assist in planning of outages for a specific day based on the ambient temperature and load predictions.

The regional interconnector flows can be impacted by the constraint on key tie-transformer ratings. The implementation of dynamic transformer ratings on these key tie transformers would increase the transfer capability of interconnector flows during periods of outage of one of the parallel transformer or during outages in the neighbouring region.

2. RELATED NEEDS/OPPORTUNITIES

Nil.

3. OPTIONS

3.1 Base Case

The base case is to maintain the present ratings on the tie-transformers and potentially constrain the NSW-VIC interconnector flows and renewable generation in the far west area of NSW.

Base Case Risk Cost.

The base case risk is the constraining import from Victoria and renewable generation from far western NSW requiring thermal plant to meet the balance of generation. The higher cost of thermal generation increases the cost to the consumer and results in a negative market benefit.

3.2 Option A – Short-Term Rating of Tie Transformers

This option (which included all tie-transformers in NSW) has been withdrawn as the market benefit of implementing dynamic ratings for these transformers is not sufficient to justify the costs. Only option B for the Darlington point tie-transformers was evaluated.

3.3 Option B – Short-Term Real Time Ratings of Tie Transformers at Darlington Point

This option is to implement dynamic transformer ratings on the Darlington Point 330/220 kV tie-transformers to increase their ratings and therefore increase the transfer capability of interconnector flows during periods of outages.

The scope of works associated with this option includes the following activities for each transformer:

- > Installation of Real-Time monitors
- > Review and refine the transformer thermal model and real time algorithm
- > Implement and commission real time monitoring system in SCADA
- > Share information between SCADA and the Asset Management Centre (AMC).

This option has been assessed for feasibility in OFS-1392B. The estimated un-escalated capital cost of the option is \$0.60M ± 25% in 2016-17 dollars.

Option Benefit

The option benefit can be estimated based on the following:

- > Extra capacity available on average = 100MVA¹
- > Expected use of extra capacity = 1%²
- > Average generation cost of thermal generation compared to renewable generation³ = \$12/MWh

$$\begin{aligned}\text{Option benefit} &= \text{extra capacity available} * \text{expected use of extra capacity} * \text{price difference} \\ &= \$ 100 * 0.01 * 24 * 365 * 12 / \text{year} \\ &= \$0.1051 \text{ million / year}\end{aligned}$$

4. EVALUATION

A single option was identified and is evaluated below against the base case

The economic and financial evaluation of the technically feasible options is set out in Table 1.

Table 1 – Options Comparison

Option	Description	Capex (\$m)	Opex (\$m)	Yearly post project risk cost (\$m)	Economic NPV (\$m)	Rank
Base case	'Do Nothing'	Nil	-	\$0	-	2
B	Implement real-time rating on tie-transformers at Darlington Point	\$0.60 [^]	n/a	-\$0.105 (benefit)	\$0.18	1

[^] Non-escalated cost in 2016/17 dollars.

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% 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	0.36
13.00	0.07

Preferred Option

The preferred option is therefore Option B, as it reduces potential interconnector and renewable generation constraints due to rating limits of the Darlington Point transformers, and yields the most benefits, as calculated using TransGrid's NPV Calculation and Risk tools (refer to Attachment 1).

¹ Based on TransGrid Operating Manual OM 323, short time overload ratings of Darlington Point transformers.

² Based on expected wind farm generation in the area

³ Constraints apply for NSW import from VIC, therefore the price difference between NSW black coal (\$20) and VIC brown coal (\$8) is used to give \$12/MWh.

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

Capital and Operating Expenditure

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

Regulatory Investment Test

No RIT-T is required for this project as the total cost is less than \$6 million.

5. RECOMMENDATION

Based on the economic evaluation above, Option B is the preferred option to address the Need as it yields yearly benefits of \$ 0.105 million.

It is therefore recommended that a NCIPAP project be initiated for the implementation of dynamic transformer ratings on the Darlington Point tie-transformers over the 2018-23 regulatory period.

Attachment 1 – Financial and Economic Evaluation Report

Project_Option Name

Short-Term Rating of Tie Transformers

1. Financial Evaluation (excludes VCR benefits)

NPV @ standard discount rate	10.00%	\$0.18m	NPV / Capital (Ratio)	0.31
NPV @ upper bound rate	13.00%	\$0.07m	Pay Back Period (Yrs)	0.15 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$0.36m	IRR%	15.32%

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%	\$0.18m	NPV / Capital (Ratio)	0.31
NPV @ upper bound rate	13.00%	\$0.07m	Pay Back Period (Yrs)	5.71 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$0.36m	IRR%	15.32%

Benefits

Risk cost	As Is	To Be	Benefit		
<i>Systems (reliability)</i>	\$0.00m	\$0.00m	\$0.00m	VCR Benefit	\$0.00m
<i>Financial</i>	\$0.00m	\$0.00m	\$0.00m	ENS Penalty	\$0.00m
<i>Operational/compliance</i>	\$0.00m	\$0.00m	\$0.00m	All other risk benefits	\$0.00m
<i>People (safety)</i>	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$0.00m
<i>Environment</i>	\$0.00m	\$0.00m	\$0.00m	Benefits in the financial NPV*	\$0.11m
<i>Reputation</i>	\$0.00m	\$0.00m	\$0.00m	*excludes VCR benefits	
Total Risk benefits	\$0.00m	\$0.00m	\$0.00m	Benefits in the economic NPV**	\$0.11m
Cost savings and other benefits			\$0.11m	**excludes ENS penalty	
Total Benefits			\$0.11m		

Other Financial Drivers

Incremental opex cost pa (no depreciation)	\$0.00m	Write-off cost	\$0.00m
Capital - initial \$m	-\$0.60m	Major Asset Life (Yrs)	15.00 Yrs
Residual Value - initial investment	\$0.04m	Re-investment capital	\$0.00m
Capitalisation period	2.00 Yrs	Start of the re-investment period	2033-34

Attachment 2 – Summary of the Project

Short-Term Rating of Tie Transformers	This project is to implement dynamic transformer ratings on key tie-transformers to increase their ratings and increase the transfer capability of interconnector flows during periods of outages.
Transmission circuit / Injection point	No 3 and No.4 transformers at Darlington Point 330/220 kV Substation
Scope of works	Develop and implement dynamic rating system for Darlington Point 330/220 kV transformers
Reasons to undertake the project	Market benefits by removing potential constraints on regional interconnector flows and renewable generation
Current value of the limit	The current limit is to constrain import from Victoria and cheap renewable generation from far western NSW requiring thermal plant to meet the balance of generation. The higher cost of thermal generation increases the cost to the consumer and results in a negative market benefit.
Target Limit	Expected increase in the current limit by 1% of transformer capacity. Option benefit = extra capacity available * expected use of extra capacity * price difference = \$ 100 * 0.01 * 24 * 365 * 12 /year = \$0.105 million / year
Capital cost	The total capital cost is \$0.60M (non-escalated)
Operating cost	Nil
Market benefits	\$0.105 million / year
Pay-back period	Pay-back period = 5.71 years
Completion date	Within the regulatory period 2018-2023