OPTIONS EVALUATION REPORT (OER)

Making the Grid More Resilience - Taree 132kV Bus Capacity Augmentation

OER 000000001414 revision 7.0

Ellipse project description: P0008180 – Taree 132 kV Bus Capacity Augmentation
TRIM file: [TRIM No]

Project reason: Reliability - To meet connection point reliability requirements
Project category: Prescribed - NCIPAP

Approvals

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Date submitted for approval	28 June 2016	

1. Need/opportunity

Taree 132/66/33 kV Substation on the NSW lower mid-north coast supplies the town of Taree and surrounding areas. At present the maximum demand at the Taree connection points is approximately 72 MW (summer 2016) and is forecast to increase to about 75 MW by winter 2024.

The 132 kV busbar is a double bus arrangement with both busbars connected by bus coupler on either ends. Both bus couplers have two disconnectors, but there is no circuit breaker installed. The disconnectors in the bus couplers are normally closed which results in busbar A and busbar B operating as a solid bus. A trip of either busbar section would trip both busbar A and busbar B and hence result in a total supply interruption to Essential Energy customers who are unsupportable through their network.

2. Related needs/opportunities

> Need DCN-530 Taree Secondary Systems and 33 kV Switchyard Replacement

3. Options

Base case

The Base Case is to continue to operate the network using the status quo Taree 132 kV busbar arrangement, with longer than acceptable restoration times.

This will lead to an annual risk cost of $297,080. The risk cost summary has been included in Attachment 2. The risk cost is predominantly consists of the value of unserved energy.

Cost Calculation

The unserved energy has been calculated using the following data:

> 132 kV terminal equipment failure rate = 0.07 / unit /annum.[1]

> Maximum demand at Taree is 72 MW. Average load is 50 MW, and manual load restoration time is 2 hours[2].

> The value of customer reliability (VCR) for NSW is $38,350/MWh.[3]

Therefore:

> Unserved Energy = (MW at risk) * (failure rate) * (failure duration)

> Unserved Energy = 50 MW * 7% * 2hrs

> Unserved Energy = 7 MWh

The cost of unserved energy (which is included in the above risk cost) has been calculated as follows:

> Cost of Unserved Energy = Unserved Energy * VCR

> Cost of Unserved Energy = 7 MWh * $38,350

> Cost of Unserved Energy = $268,450

1 IPART, *Electricity Transmission Reliability Standards – An Economic Assessment.*

2 Based on travel times to Taree and typical TransGrid restoration times

3 AEMO, *Value of Customer Reliability – Application Guide.*

Option A — 132 kV Bus Coupler Circuit Breaker <OFR-1414A, OFS-1414A>

The reliability of Taree 66 kV and 33 kV supplies can be increased by installing a 132 kV circuit breaker in either of the bus couplers. The disconnectors in the other bus coupler can be left normally open. The new circuit breaker bay would need to include a set of CTs and then the establishment of 2 BBP zones.

The scope of works under this option can be found in OFR-1414A.

The expected capital cost for this option is $0.968 million ± 25% in un-escalated 2016-17 dollars, spread over 3 years. Refer to OFS-1414A for details.

In this case, a bus section trip will not result in any load loss since the remaining bus section will continue to supply load via the respective transformers connected to that bus section[4]. Accordingly, there is no unserved energy cost.

The post-project risk cost of Option A will be $0.02 million (which corresponds to the repair costs associated with the busbar failure) – refer Attachment 2.

Benefit Calculation

The benefit gained from the reduction in unserved energy is therefore:

- Market Benefit = Unserved Energy Improvement * VCR
- Market Benefit = 7 MWh * $38,350
- Market Benefit = $268,450

4. Evaluation

The Base Case[5] and Options A are technically feasible. However, implementing Option A would reduce TransGrid's risk exposure.

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

The full financial and economic evaluations are shown in Attachment 1.

Table 1: Commercial Evaluation of Technically Feasible Options

Option	Description	Total Capex ($m)	Yearly Ongoing Opex ($m)	Yearly Post Project Risk Cost ($m)	Economic NPV ($m)	Rank
Base Case	'Do Nothing' – continue to risk loss of all Taree load on a busbar trip	-	-	0.30	-	2
A	132 kV Bus Coupler Circuit Breaker at Taree Substation	0.968	0.02	0.02	1.08	1

[4] There will not be any overloads on the remaining 60 MVA transformers connected to 33 kV and 66 kV bus bars respectively (since the maximum forecast loads for Taree 33 kV and 66 kV are only about 24 MW and 51 MW respectively). In addition, there would not be any overloads on remaining 132 kV line(s) supplying Taree nor undervoltage issues.

[5] Operating with a split 132 kV busbar to reduce the load at risk in the event of a bus trip is not a desirable option since that could lead to overloading of the Taree transformers under certain system operating conditions and in the event of contingencies – since they could form a low voltage series path with the 132 kV circuits.

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 Attachment 1.

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

Discount Rate (%)	Economic NPV (2018/19 $m)
6.75	1.83
13.00	0.66

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.

Preferred Option

The preferred option is therefore the Option A, as it provides significant benefits, as calculated using TransGrid's NPV Calculation Tool and Risk Tool (refer to Attachment 1).

A summary of the preferred option can be found in Attachment 3.

Capital and operating expenditure

The yearly incremental operating expenditure is estimated to be 2% of the upfront capital cost of each option, which equates to $0.02 million, escalated at a rate of 2.9% per annum.[6]

Payback period

Expected payback period for Option A is approximately 3.9 years.

Regulatory Investment Test-Transmission

This Need is not subject to the RIT-T process as it does not exceed the $6 million threshold requirement.

[6] TransGrid Success Database as at May 2016.

5. Recommendation

Based on the economic evaluation above, Option A is the preferred option to address the Need as it reduces TransGrid's risk exposure and yields yearly benefits of $0.3 million (include risk saving $0.28 million and ongoing opex $0.02 million).

It is therefore recommended that a NCIPAP Project be initiated to implement Option A over the 2018-23 period.

Attachment 1 – Financial and Economic Evaluation Reports

Project_Option Name	Taree 132 kV Bus Coupler Circuit Breaker

1. Financial Evaluation (excludes VCR benefits)

NPV @ standard discount rate	10.00%	-$0.97m	*NPV / Capital (Ratio)*	*-1.00*
NPV @ upper bound rate	13.00%	-$0.90m	*Pay Back Period (Yrs)*	*Not measurable*
NPV @ lower bound rate (WACC)	6.75%	-$1.06m	*IRR%*	*-8.18%*

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%	$1.08m	*NPV / Capital (Ratio)*	*1.11*
NPV @ upper bound rate	13.00%	$0.66m	*Pay Back Period (Yrs)*	*3.89 Yrs*
NPV @ lower bound rate (WACC)	6.75%	$1.83m	*IRR%*	*24.15%*

Benefits

Risk cost	As Is	To Be	Benefit
Systems (reliability)	*$0.27m*	*$0.00m*	*$0.27m*
Financial	*$0.00m*	*$0.00m*	*$0.00m*
Operational/compliance	*$0.03m*	*$0.03m*	*$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	$0.30m	$0.03m	$0.27m
Cost savings and other benefits			$0.00m
Total Benefits			$0.27m

VCR Benefit	*$0.27m*
ENS Penalty	*$0.00m*
All other risk benefits	*$0.00m*
Total Risk benefits	$0.27m
Benefits in the financial NPV* *excludes VCR benefits	$0.00m
Benefits in the economic NPV** **excludes ENS penalty	$0.27m

Other Financial Drivers

Incremental opex cost pa (no depreciation)	-$0.02m	Write-off cost	$0.00m
Capital - initial $m	-$0.97m	Major Asset Life (Yrs)	50.00 Yrs
Residual Value - initial investment	$0.45m	Re-investment capital	$0.00m
Capitalisation period	3.00 Yrs	Start of the re-investment period	0.00 Yrs

Attachment 2 – Risk Cost Summaries

Current Option Assessment - Risk Summary

Project Name: Taree 132kV Bus Capacity Augmentation

Option Name: 1414 - Base Case

Option Assessment Name: 1414 - Base Case - Assessment 1

Rev Reset Period: Next (2018-23)

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)
Busbar	1	Busbar	Unplanned Outage - HV (Busbar)	$4.24	Structural Failure	$4.24	7.00%	$0.30	$0.27		$0.03			$0.00
				$4.24		$4.24		$0.30	$0.27		$0.03			$0.00

Total VCR Risk: $0.27 Total ENS Risk:

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Current Option Assessment - Risk Summary

Project Name: Taree 132kV Bus Capacity Augmentation

Option Name: 1414 - Preferred Option

Option Assessment Name: 1414 - Preferred Option - Assessment 1

Rev Reset Period: Next (2018-23)

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)
Busbar	1	Busbar	Unplanned Outage - HV (Busbar)	$0.35	Structural Failure	$0.35	7.00%	$0.02	$0.00		$0.02			
				$0.35		$0.35		$0.02	$0.00		$0.02			

Total VCR Risk: $0.00

Total ENS Risk:

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Attachment 3 – Summary of Preferred Option

Taree 132 kV Bus Circuit Breaker	**The 132 kV busbar is a double bus arrangement with both busbars connected by bus coupler on either ends. Both bus couplers have two disconnectors, but there is no circuit breaker installed. The disconnectors in the bus couplers are normally closed which results with busbar A and busbar B operating as a solid bus. A trip of either busbar section would trip both busbar A and busbar B and hence result in a total supply interruption to Essential Energy customers who are unsupportable through their network. Installing a bus-section breaker will eliminate the risk of supply lost on outage of a single busbar section and yield economic benefits to TransGrid.**
Transmission Circuit / Injection Point	Taree 132 kV Substation
Scope of works	Installing a 132 kV circuit breaker in any of the 132 kV bus couplers, as per OFR-1414A and OFS-1414A.
Reasons to undertake the project	Eliminate loss of supply to customers following an outage of a bus section.
Current value of the limit	0 MW of supply to customers for 2 hours following an outage of a bus section.
Target limit	49 MW of peak demand. No loss of supply to customers following an outage of a bus section.
Capital Cost	The total capital cost is $968,000.
Operating Cost	$16,720 per annum
Market benefits	Market Benefit = 7 MWh x $38,350 Market Benefit = $0.268 million per annum
Pay-back period	Pay-back period = 3.89 Years
Completion date	Over the 2018-23 period