OPTIONS EVALUATION REPORT (OER)

Operational excellence – Installation of two way disconnector to replace line 996 tee connection to Morven substation

OER- 000000001626 revision 1.0

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

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

Approvals

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Date submitted for approval	1 December 2016	

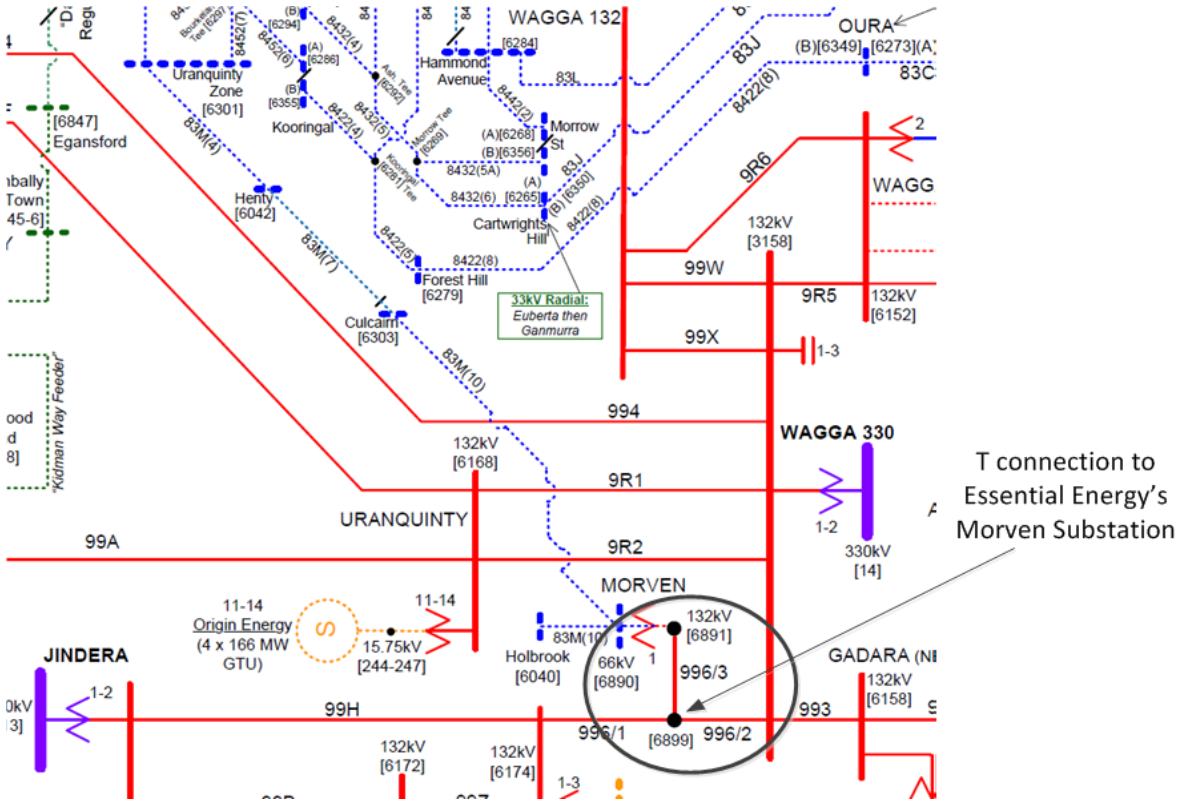
Change history

Revision	Date	Amendment
0	01/12/2016	Initial issue.

1. Need/opportunity

The 996 feeder connects Wagga 330kV substation and ANM 132kV substation and is teed to Essential Energy's Morven 132/66kV substation. Morven substation has an alternate 66kV connection to Wagga 132/66kV substation via line 83M. Line 83M has a normally open point between Essential Energy's Henty and Culcairn substation. Hence, supply to Essential Energy's Culcairn, Morven and Holbrook substations rely upon supply from line 996 tee connection.

A fault on any section of line 996 (996/1 - ANM to tee connection and 996/2 – Wagga 330kV to tee connection) will result in an interruption of supply to all loads supplied from line 996 tee connection. Due to direct tee connection on line 996, there is no ability to sectionalise 996 at Morven.



2. Related needs/opportunities

None.

3. Options

3.1 Base case

The Base Case is to continue to operate the network using the status quo arrangement of line 996, with longer than acceptable restoration times.

This will lead to an annual risk cost of $1.44 million. The risk cost predominantly consists of the value of unserved energy. The risk cost summary has been included in Attachment 2.

Cost Calculation

The unserved energy has been calculated using the following data:

- 132 kV transmission line is 106 km long with a failure rate = 3.9 Outages[1]/100km/decade
- Maximum demand from line 996 tee connection to Morven substation is 7 MW[2]. Average load is 3.65[3] MW, and manual load restoration time is 24 hours[4]
- The value of customer reliability (VCR) for NSW is $38,350/MWh.[5]

Therefore:

- Unserved Energy = (MW at risk) * (failure rate) * (failure duration)
- Unserved Energy = 3.65 MW * 0.39 * (106/100) * 24hrs
- Unserved Energy = 36.21 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 = 36.21 MWh * $38,350
- Cost of Unserved Energy = $1.39 million

3.2 Option A – Installation of two way disconnector <OFR-1626A, OFS-1626A>

The reliability of supply to Essential Energy's Morven substation from line 996 tee connection can be increased by installing a two-way disconnector at the tee connection.

The scope of works under this option can be found in OFR-1626A.

The expected capital cost for this option is $2.84 million ± 25% in un-escalated 2016-17 dollars, spread over 3 years. Refer to OFS-1626A for details.

In this case, a fault on any section of line 996 will not result in load loss for long duration. It is expected that the load will be able to be restored in 0.5 hours. Accordingly, the unserved energy cost after implementation of two way disconnector is as below.

- Unserved Energy = (MW at risk) * (failure rate) * (failure duration)
- Unserved Energy = 3.65 MW * 0.39 * (106/100) * 0.5hrs
- Unserved Energy = 0.75 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 = 0.75 MWh * $38,350
- Cost of Unserved Energy = $28,933

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

2 TransGrid Annual Planning Report 2016

3 Based on historical load information for Morven substation

4 Based on TransGrid's historical Supervisory Controls and Data Acquisition (SCADA) information.

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

Benefit Calculation

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

> Market Benefit = Unserved Energy Improvement * VCR

> Market Benefit = 35.46 MWh * $38,350

> Market Benefit = $1.36 million

4. Evaluation

The Base Case 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 load supplied from line 996 tee connection if any section of line 996 trips	-	-	1.44	-	2
A	Installation of two way disconnector at tee connection	2.84	0.057	0.05	7.49	1

^ In 2016-17 dollars

 # VCR risk cost component only

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	11.65
13.00	5.10

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 (see Attachment 1).

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 $0.057 million, escalated at a rate of 2.9% per annum.[6]

Payback period

Expected payback period for Option A is approximately 2.13 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.

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 $1.39 million.

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

[6] TransGrid Success Database as at May 2016.

Attachment 1 – Commercial evaluation report

Project_Option Name	Two way disconnector on line 996 tee

1. Financial Evaluation (excludes VCR benefits)				
NPV @ standard discount rate	10.00%	-$2.89m	*NPV / Capital (Ratio)*	*-1.02*
NPV @ upper bound rate	13.00%	-$2.79m	*Pay Back Period (Yrs)*	*Not measurable*
NPV @ lower bound rate (WACC)	6.75%	-$3.00m	*IRR%*	*-6.21%*

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%	$7.49m	*NPV / Capital (Ratio)*	*2.64*
NPV @ upper bound rate	13.00%	$5.10m	*Pay Back Period (Yrs)*	*2.13 Yrs*
NPV @ lower bound rate (WACC)	6.75%	$11.65m	*IRR%*	*32.48%*

Benefits					
Risk cost	As Is	To Be	Benefit	*VCR Benefit*	*$1.36m*
Systems (reliability)	*$1.40m*	*$0.03m*	*$1.37m*	*ENS Penalty*	*$0.00m*
Financial	*$0.02m*	*$0.02m*	*$0.00m*	*All other risk benefits*	*$0.03m*
Operational/compliance	*$0.00m*	*$0.00m*	*$0.00m*	Total Risk benefits	$1.39m
People (safety)	*$0.00m*	*$0.00m*	*$0.00m*		
Environment	*$0.00m*	*$0.00m*	*$0.00m*	Benefits in the financial NPV*	$0.03m
Reputation	*$0.02m*	*$0.00m*	*$0.02m*	**excludes VCR benefits*	
Total Risk benefits	$1.44m	$0.05m	$1.39m		
Cost savings and other benefits			$0.00m	Benefits in the economic NPV**	$1.39m
Total Benefits			$1.39m	***excludes ENS penalty*	

Other Financial Drivers			
Incremental opex cost pa (no depreciation)	-$0.06m	Write-off cost	$0.00m
Capital - initial $m	-$2.84m	Major Asset Life (Yrs)	50.00 Yrs
Residual Value - initial investment	$1.31m	Re-investment capital	$0.00m
Capitalisation period	3.00 Yrs	Start of the re-investment period	2033-34

Attachment 2 – Risk Cost Summaries

Current Option Assessment - Risk Summary

Project Name: Morvern 132kV TL 996 3-way Disconnectors

Option Name: 1626 - Base Case

Option Assessment Name: 1626 - 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)
Conductor	1	Conductor (inc Joints)	Unplanned Outage - HV (Conductor)	$3.47	Break	$3.47	41.34%	$1.44	$1.40		$0.02			$0.02
				$3.47		$3.47		$1.44	$1.40		$0.02			$0.02

Total VCR Risk: $1.39 Total ENS Risk: $0.00

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Current Option Assessment - Risk Summary

Project Name: Morvern 132kV TL 996 3-way Disconnectors

Option Name: 1626 - Preferred Option A

Option Assessment Name: 1626 - Preferred Option A - 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)
Conductor	1	Conductor (inc Joints)	Unplanned Outage - HV (Conductor)	$0.13	Break	$0.13	41.34%	$0.05	$0.03		$0.02			$0.00
				$0.13		$0.13		$0.05	$0.03		$0.02			$0.00

Total VCR Risk: $0.03

Total ENS Risk: $0.00

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Attachment 3 – Summary of Preferred Option

Installation of two way disconnector on line 996 tee connection to Morven substation	**The 996 feeder connects Wagga 330kV substation and ANM 132kV substation and is teed to Essential Energy's Morven 132/66kV substation. A fault on any section of line 996 (996/1 - ANM to tee connection and 996/2 – Wagga 330kV to tee connection) will result in an interruption of supply to all loads supplied from line 996 tee connection. Due to direct tee connection on line 996, there is no ability to sectionalise 996 at Morven.**
Transmission Circuit / Injection Point	Line 996 tee supply to Essential Energy's Morven 132/66kV substation
Scope of works	Installing a two way isolator at line 996 tee connection to Morven substation, as per OFR-1626A and OFS-1626A.
Reasons to undertake the project	Reduce duration of supply interruption to customers following any fault on line 996 which result in the line being tripped.
Current value of the limit	0 MW of supply to customers for 24 hours following a fault and subsequent trip of line 996
Target limit	Full restoration of supply to customers (7 MW peak load) within 0.5 hours following a trip of any section of line 996
Capital Cost	The total capital cost is $2.84 million.
Operating Cost	$57,000 per annum
Market benefits	Market Benefit = 35.46 MWh x $38,350 Market Benefit = $1.36 million per annum
Pay-back period	Pay-back period = 2.13 Years
Completion date	Over the 2018-23 period