

OPTIONS EVALUATION REPORT (OER)



Operational excellence – Installation of two way disconnector to replace line 94M tee connection to Ilford substation

OER- 00000001632 revision 1.0

Ellipse project no(s):

TRIM file: [TRIM No]

Project reason: Reliability - To meet connection point reliability requirements

Project category: Prescribed - NCIPAP

Approvals

Author	Bhavin Sanghavi	Operations Analysis Engineer
Reviewed	Hoang Tong	Operations Analysis Manager
	Jahan Peiris	Network Modelling & Performance Manager
Endorsed	Garrie Chubb	Investment Support Manager
	John Howland	Manager/Portfolio Management
Approved	Andrew Kingsmill	Manager/Power System Analysis
Date submitted for approval	1 December 2016	

Change history

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

1. Need/opportunity

Line 94M connects Mt Piper 132 Substation and Beryl 132 Substation and is teed to supply Endeavour Energy's Ilford 132/66kV Zone Substation.

A fault on any section of line 94M will result in an interruption of supply to Ilford substation. Due to direct tee connection on line 94M, there is no ability to sectionalise 94M at Ilford substation.

The existing arrangement of Ilford Tee on Line 94M Mt Piper 132 – Beryl is shown in Figure 1 below.

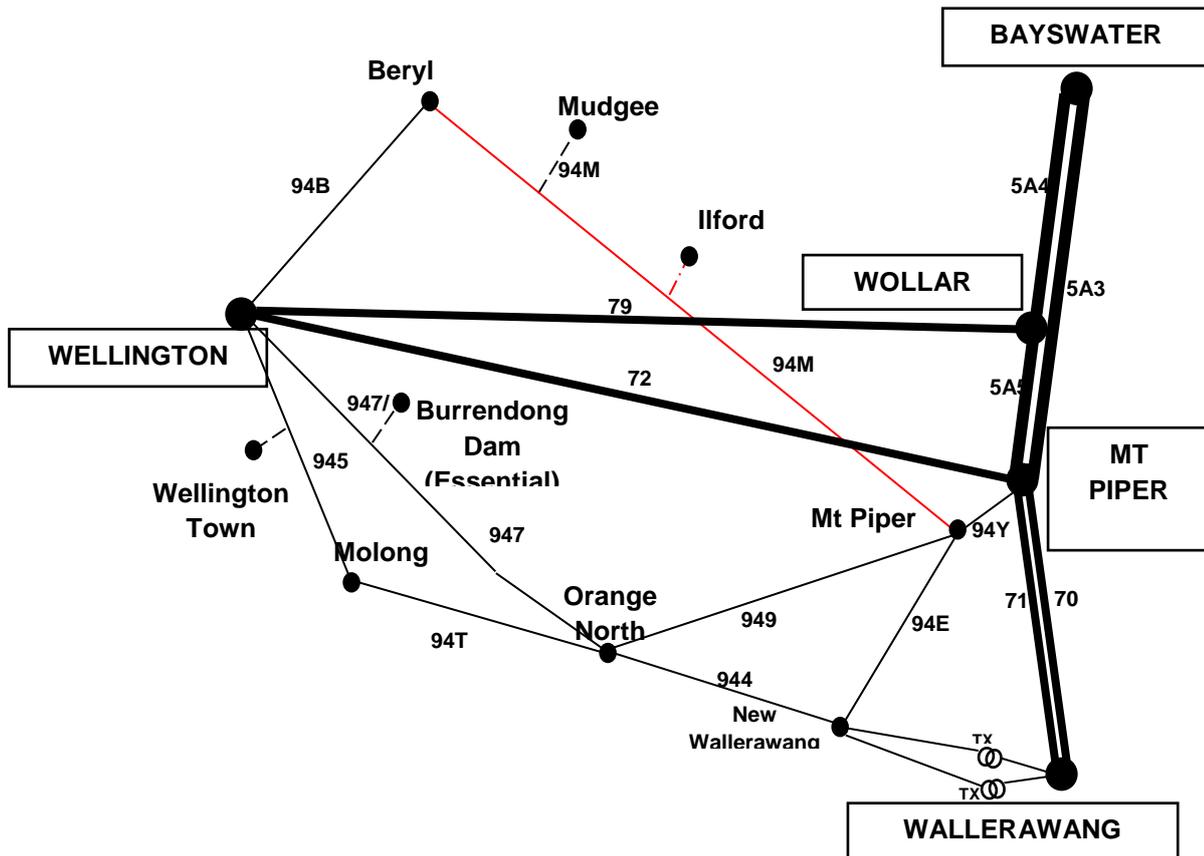


Figure 1 – Existing arrangement of Ilford Tee on Line 94M Mt Piper 132 – Beryl

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 94M, with longer than acceptable restoration times.

This will lead to an annual risk cost of \$0.5 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 95 km long with a failure rate = 3.9 Outages/100km/decade
- > Failure rate of 66 kV terminal equipment = 0.5 Failures/Population/decade
- > Maximum demand from line 94M tee connection to Ilford substation is 42 MW². Average load is 29.43 MW, and manual load restoration time is 24 hours⁴
- > The value of customer reliability (VCR) for NSW is \$38,350/MWh.⁵

Therefore:

- > Unserved Energy = (MW at risk) * (failure rate⁶) * (failure duration)
- > Unserved Energy = 29.4 MW * 0.39 * (95/100) * 0.05 * 24hrs
- > Unserved Energy = 13.07 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 = 13.07 MWh * \$38,350
- > Cost of Unserved Energy = \$501,235

3.2 Option A – Installation of two way disconnecter <OFR-1630A, OFS-1630A>

The reliability of supply to Endeavour Energy's Ilford substation from line 94M tee connection can be increased by installing a two way disconnecter at the tee connection.

The scope of works under this option can be found in OFR-1632A.

The expected capital cost for this option is \$2.81 million ± 25% in un-escalated 2016-17 dollars, spread over 3 years. Refer to OFS-1632A for details.

In this case, a fault on any section of line 94M 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 disconnecter is as below.

- > Unserved Energy = (MW at risk) * (failure rate) * (failure duration)
- > Unserved Energy = 29.4 MW * 0.39 * (95/100) * 0.05 * 0.5hrs
- > Unserved Energy = 0.27 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 = 0.27 MWh * \$38,350

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

² TransGrid Annual Planning Report 2016

³ Average load = 70% of maximum forecast load

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

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

⁶ Endeavour Energy has advised that auto-changeover is available on 66kV and it is assumed that the failure rate for the 66 kV terminal equipment applies.

- > Cost of Unserved Energy = \$10,355

Benefit Calculation

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

- > Market Benefit = Unserved Energy Improvement * VCR
- > Market Benefit = 12.8 MWh * \$38,350
- > Market Benefit = \$490,880

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	-	-	0.5	-	2
A	Installation of two way disconnector at tee connection	2.81	0.056	0.01	0.64	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 .

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

Discount Rate (%)	Economic NPV (2018/19 \$m)
6.75	1.98
13.00	-0.11

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 improves TransGrid's risk exposure and provides significant benefits, as calculated using TransGrid's NPV Calculation Tool and Risk Tool (refer to Attachment 1).

A summary for 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 \$0.056 million, escalated at a rate of 2.9% per annum.⁷

Payback period

Expected payback period for Option A is 6.53 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 \$0.49 million.

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

⁷ TransGrid Success Database as at May 2016.

Attachment 1 – Commercial Evaluation Report

Project_Option Name

Two way disconnecter on line 94M tee

1. Financial Evaluation (excludes VCR benefits)

NPV @ standard discount rate	10.00%	-\$3.10m	NPV / Capital (Ratio)	-1.10
NPV @ upper bound rate	13.00%	-\$2.95m	Pay Back Period (Yrs)	Not measurable
NPV @ lower bound rate (WACC)	6.75%	-\$3.29m	IRR%	-8.20%

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%	\$0.64m	NPV / Capital (Ratio)	0.23
NPV @ upper bound rate	13.00%	-\$0.11m	Pay Back Period (Yrs)	6.53 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$1.98m	IRR%	12.48%

Benefits

Risk cost	As Is	To Be	Benefit	VCR Benefit	
Systems (reliability)	\$0.50m	\$0.01m	\$0.49m	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	\$0.49m
People (safety)	\$0.00m	\$0.00m	\$0.00m	Benefits in the financial NPV*	\$0.00m
Environment	\$0.00m	\$0.00m	\$0.00m	*excludes VCR benefits	
Reputation	\$0.00m	\$0.00m	\$0.00m	Benefits in the economic NPV**	\$0.49m
Total Risk benefits	\$0.50m	\$0.01m	\$0.49m	**excludes ENS penalty	
Cost savings and other benefits			\$0.00m		
Total Benefits			\$0.49m		

Other Financial Drivers

Incremental opex cost pa (no depreciation)	-\$0.06m	Write-off cost	\$0.00m
Capital - initial \$m	-\$2.81m	Major Asset Life (Yrs)	50.00 Yrs
Residual Value - initial investment	\$1.29m	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: Ilford 132kV TL 94M 3-way Disconnectors

Option Name: 1632 - Base Case

Option Assessment Name: 1632 - 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)	\$25.82	Break	\$25.82	1.95%	\$0.50	\$0.50		\$0.00			\$0.00
				\$25.82		\$25.82		\$0.50	\$0.50		\$0.00			\$0.00

Total VCR Risk: \$0.50

Total ENS Risk: \$0.00

Current Option Assessment - Risk Summary



Project Name: Ilford 132kV TL 94M 3-way Disconnectors

Option Name: 1632 - Preferred Option A

Option Assessment Name: 1632 - 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)	\$0.60	Break	\$0.60	1.95%	\$0.01	\$0.01		\$0.00			\$0.00
				\$0.60		\$0.60		\$0.01	\$0.01		\$0.00			\$0.00

Total VCR Risk: \$0.01

Total ENS Risk: \$0.00



Attachment 3 – Summary of Preferred Option

Installation of two way disconnector on line 94M tee connection to Ilford substation

Line 94M connects Mt Piper 132 Substation and Beryl 132 Substation and is teed to supply Endeavour Energy's Ilford 132/66kV Zone Substation.

A fault on any section of line 94M will result in an interruption of supply to Ilford substation. Due to direct tee connection on line 94M, there is no ability to sectionalise 94M at Ilford substation.

Transmission Circuit / Injection Point	Line 94M tee supply to Endeavour Energy's Ilford 132/66kV substation
Scope of works	Installing a two way isolator at line 94M tee connection to Ilford substation, as per OFR-1632A and OFS-1632A.
Reasons to undertake the project	Reduce duration of supply interruption to customers following any fault on line 94M 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 94M
Target limit	Full restoration of supply to customers (42 MW peak load) within 0.5 hours following a trip of any section of line 94M
Capital Cost	The total capital cost is \$2.81 million.
Operating Cost	\$56,000 per annum
Market benefits	Market Benefit = 12.8 MWh * \$38,350 Market Benefit = \$490,880
Pay-back period	Pay-back period = 6.53 years
Completion date	Over the 2018-23 period