# OPTIONS EVALUATION REPORT (OER)

Operational excellence – Installation of two way disconnector to replace line 976 tee connection to Murrumbatemen substation

OER- 000000001627 revision 2.0

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

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

**Approvals**

| | | |
|---|---|---|
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| **Date submitted for approval** | 1 December 2016 | |

**Change history**

| Revision | Date | **Amendment** |
|---|---|---|
| 0 | 01/12/2016 | Initial issue. |
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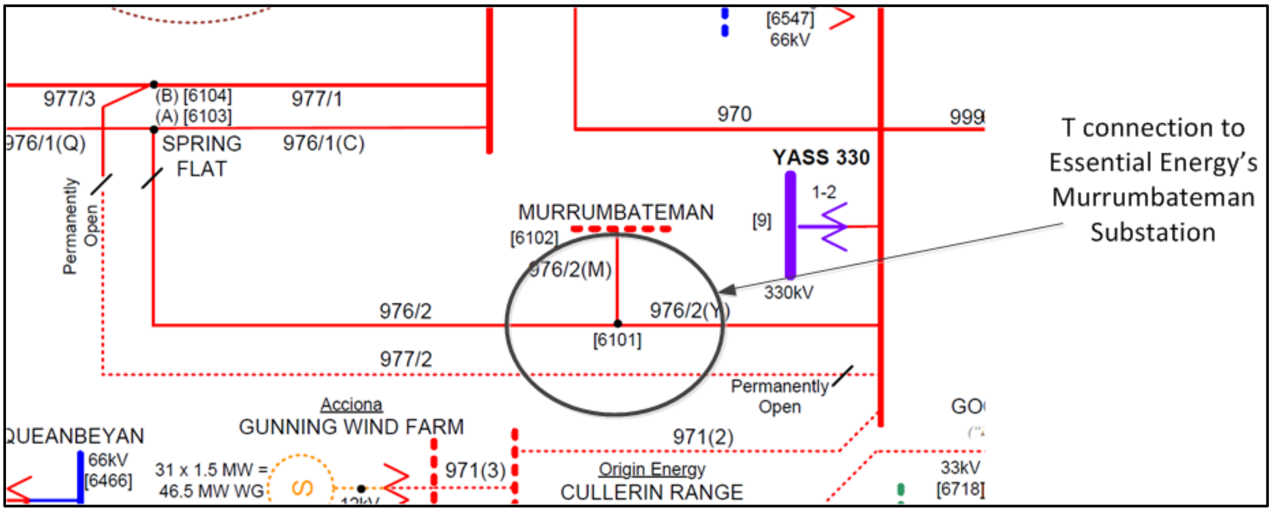
| | | |
| | | |

# 1. Need/opportunity

The 976 feeder connects Yass 330/132/66 kV substation and Canberra 330/132 kV substation and is teed into TransGrid's Queanbeyan 132/66 kV substation and Essential Energy's Murrumbateman substation.

A fault on any section of line 976 will result in an interruption of supply to Murrumbateman substation. Due to direct tee connection on line 976, there is no ability to sectionalise 976 at Murrumbateman substation.




# 2. Related needs/opportunities

None.

# 3. Options

**Base case**

The Base Case is to continue to operate the network using the status quo arrangement of line 976, with longer than acceptable restoration times.

This will lead to an annual risk cost of $0.94 million.  The risk cost predominantly consists of the value of unserved energy. The risk cost summary is included in Attachment 2.

*Cost Calculation*

The unserved energy has been calculated using the following data:

- 132 kV transmission line is 97 km long with a failure rate = 3.9 Outages[1]/100km/decade
- Maximum demand from line 976 tee connection to Murrumbateman substation is 6 MW[2]. Average load is 2.58[3] MW, and manual load restoration time is 24 hours[4]

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

2 TransGrid Annual Planning Report 2016

> 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 = 2.58 MW * 0.39 * (97/100) * 24hrs
> Unserved Energy = 23.42 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 = 23.42 MWh * $38,350
> Cost of Unserved Energy = $898,157

**Option A — Installation of two way disconnector <OFR-1627A, OFS-1627A>**

The reliability of supply to Essential Energy's Murrumbateman substation from line 976 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-1627A.

The expected capital cost for this option is $2.7 million ± 25% in un-escalated 2016-17 dollars, spread over 3 years. Refer to OFS-1627A for details.

In this case, a fault on any section of line 976 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 = 2.58 MW * 0.39 * (97/100) * 0.5hrs
> Unserved Energy = 0.49 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 = 0.49 MWh * $38,350
> Cost of Unserved Energy = $18,792

*Benefit Calculation*

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

> Market Benefit = Unserved Energy Improvement * VCR
> Market Benefit = 22.93 MWh * $38,350
> Market Benefit = $879,365

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3 Based on historical load information for Murrumbateman substation

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

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

## 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 | - | - | 0.94 | - | 2 |
| **A** | Installation of two way disconnector at tee connection | 2.7 | 0.054 | 0.04 | 3.87 | 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 | 6.50 |
| 13.00 | 2.36 |

**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 (refer to Attachment 1) and Risk Tool. Risk cost summaries are included in Attachment 2.

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

**Capital and operating expenditure**

The capital cost for this option is estimated at $2.7 million, spread over 3 years.

The yearly incremental operating expenditure is estimated to be 2% of the upfront capital cost of each option, which equates to $0.054 million, escalated at a rate of 2.9% per annum.[6]

**Payback period**

Expected payback period for Option A is approximately about 3.22 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 $0.84 million (includes risk saving $0.9 million and ongoing opex $0.054 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 976 tee |

**1. Financial Evaluation** (excludes VCR benefits)

| | | | | |
|---|---|---|---|---|
| NPV @ standard discount rate | 10.00% | -$2.85m | *NPV / Capital (Ratio)* | *-1.05* |
| NPV @ upper bound rate | 13.00% | -$2.74m | *Pay Back Period (Yrs)* | *Not measurable* |
| NPV @ lower bound rate (WACC) | 6.75% | -$2.98m | *IRR%* | *-6.79%* |

**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% | $3.87m | *NPV / Capital (Ratio)* | *1.42* |
| NPV @ upper bound rate | 13.00% | $2.36m | *Pay Back Period (Yrs)* | *3.22 Yrs* |
| NPV @ lower bound rate (WACC) | 6.75% | $6.50m | *IRR%* | *23.15%* |

**Benefits**

| Risk cost | As Is | To Be | Benefit |
|---|---|---|---|
| *Systems (reliability)* | *$0.90m* | *$0.02m* | *$0.88m* |
| *Financial* | *$0.02m* | *$0.02m* | *$0.00m* |
| *Operational/compliance* | *$0.00m* | *$0.00m* | *$0.00m* |
| *People (safety)* | *$0.00m* | *$0.00m* | *$0.00m* |
| *Environment* | *$0.00m* | *$0.00m* | *$0.00m* |
| *Reputation* | *$0.02m* | *$0.00m* | *$0.02m* |
| Total Risk benefits | $0.94m | $0.04m | $0.90m |
| Cost savings and other benefits | | | $0.00m |
| Total Benefits | | | $0.90m |

| | |
|---|---|
| *VCR Benefit* | *$0.88m* |
| *ENS Penalty* | *$0.00m* |
| *All other risk benefits* | *$0.02m* |
| Total Risk benefits | $0.90m |
| Benefits in the financial NPV*<br>**excludes VCR benefits* | $0.02m |
| Benefits in the economic NPV**<br>***excludes ENS penalty* | $0.90m |

**Other Financial Drivers**

| | | | |
|---|---|---|---|
| Incremental opex cost pa (no depreciation) | -$0.05m | Write-off cost | $0.00m |
| Capital - initial $m | -$2.72m | Major Asset Life (Yrs) | 50.00 Yrs |
| Residual Value - initial investment | $1.25m | 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

TransGrid

Project Name: Murrumbatemen 132kV TL 976 - 2 3-way D

Option Name: 1627 - Base Case

Option Assessment Name: 1627 - 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) | $2.42 | Break | $2.42 | 39.00% | $0.94 | $0.91 | | $0.02 | | | $0.02 |
| | | | | $2.42 | | $2.42 | | $0.94 | $0.91 | | $0.02 | | | $0.02 |

Total VCR Risk: $0.90 Total ENS Risk: $0.00

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# Current Option Assessment - Risk Summary

Project Name: Murrumbatemen 132kV TL 976 - 2 3-way D

Option Name: 1627 - Preferred Option A

Option Assessment Name: 1627 - 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) | $0.11 | Break | $0.11 | 39.00% | $0.04 | $0.02 | | $0.02 | | | $0.00 |
| | | | | $0.11 | | $0.11 | | $0.04 | $0.02 | | $0.02 | | | $0.00 |

Total VCR Risk: $0.02 Total ENS Risk: $0.00

## Attachment 3 – Summary of Preferred Option

| **Installation of two way disconnector on line 976 tee connection to Morven substation** | **The 976 feeder connects Yass 330/132/66 kV substation and Canberra 330/132 kV substation and is teed into TransGrid's Queanbeyan 132/66 kV substation and Essential Energy's Murrumbateman substation. A fault on any section of line 976 will result in an interruption of supply to all loads supplied from line 976 tee connection. Due to direct tee connection on line 976, there is no ability to sectionalise 976 at Murrumbateman.** |
|---|---|
| Transmission Circuit / Injection Point | Line 976 tee supply to Essential Energy's Murrumbateman 132/22kV substation |
| Scope of works | Installing a two way isolator at line 976 tee connection to Murrumbateman substation, as per OFR-1627A and OFS-1627A. |
| Reasons to undertake the project | Reduce duration of supply interruption to customers following any fault on line 976 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 976 |
| Target limit | Full restoration of supply to customers (6 MW peak load) within 0.5 hours following a trip of any section of line 976 |
| Capital Cost | The total capital cost is $2.7 million. |
| Operating Cost | $54,000 per annum |
| Market benefits | Market Benefit = 22.93 MWh x $38,350<br>Market Benefit = $0.88 million / year |
| Pay-back period | Pay-back period = 3.87 Years |
| Completion date | Over the 2018-23 period |