

# OPTIONS EVALUATION REPORT (OER)

Marulan No.4 Transformer Renewal

OER 000000001219 revision 4.0



**Ellipse project no.:** P0005431

**TRIM file:** [TRIM No]

**Project reason:** Capability - Improved Asset Management

**Project category:** Prescribed - Asset Renewal Strategies

## Approvals

Author	Robert Li	Substations Asset Strategist
Endorsed	Tony Gray	Substations Asset Manager
	Azil Khan	Manager Investment Analysis
Approved	Lance Wee	Manager, Asset Strategy
Date submitted for approval	12 December 2016	

## Change history

Revision	Date	Amendment
0	29 June 2016	Initial issue
1	29 June 2016	Minor amendment
2	28 October 2016	Updated risk costs, Capex, SFAIRP/ALARP methodology, figures and wording throughout
3	12 December 2016	Update to format
4	12 December 2016	Amendments to fix formatting and Option B hyperlinks

## 1. Need/opportunity

---

Marulan 330/132 kV Substation is equipped with a single 160 MVA transformer which is currently 54 years old and nearing the end of its serviceable life. As per the Health Index (HI) analysis, the remaining life is estimated to be two years at the end of 2018/19- 2022/23 regulatory period.

Marulan transformer will be 61 years old by the end of the next regulatory period. A detailed condition assessment has been conducted on the transformer and has confirmed that it is exhibiting signs that it is approaching the end of its serviceable life and has an increasing probability of failure.

## 2. Related Needs/opportunities

---

Programs for other substation assets are being developed and should be considered when packaging work for delivery. It is expected that the ten 330kV Circuit Breakers (CBs) at Marulan Substation will be replaced under the CB renewal program, Need [1337](#).

Need 1219A has been created to consider transformer refurbishment, including Marulan. This is outlined in detailed in this OER.

## 3. Options

---

All dollar values in this document are expressed in un-escalated 2016/17 dollars.

### Base Case

The Base Case is to do nothing and let the transformer continue to run to failure. There is a risk cost of \$0.47m per annum associated with this option.

### Option A — Replacement of the transformer with a spare transformer [[OFR 1219A](#), [OFS 1219A](#)]

This option considers the replacement of the transformer with a new unit, including the following works:

- > Relocate the spare transformer from its present location to Marulan Substation
- > Disposal of the existing transformer.
- > Re-use existing footing and installed equipment that was previously provided in an earlier aborted project to replace the Marulan transformer.

Option Feasibility Study (OFS) OFS 1219A estimates capital spend of \$1.86m.

The post investment risk cost is \$0.00m. Risk savings from this option is \$0.47m per annum, driven by decrease in the probability of failure due to replacement with a near new spare transformer.

### Option B — Refurbishment of the transformer [[OFR 1354A](#), [OFS 1354A](#)]

This option includes the refurbishment of the transformer onsite with the following works:

- > Oil treatment and circulation to remove moisture in oil and windings.
- > Eliminating oil leaks and removing staining associated with valves, radiators, buchholz relay bleed valve.
- > Repainting of the transformer.

OFS 1354A is for transformer refurbishment program. CAPEX estimate for Marulan No.4 transformer is \$1.21m (shown on page 5 of the OFS).

The post investment risk cost is \$0.29m. Risk savings from this option is \$0.18m per annum, driven by decrease in the probability of failure due to refurbishment work.

## 4. Evaluation

### 4.1 Commercial evaluation

The result of commercial evaluation for each of the technically feasible options is summarised in Table 1.

**Table 1 — Commercial evaluation (\$ million)**

Option	Description	Total capex	Annual opex	Annual post project risk cost	Economic NPV @10%	Rank
<b>Base Case</b>	Do nothing	-	-	0.47	-	3
<b>A</b>	Transformer replacement	1.87	0.01	0.00	3.53	1
<b>B</b>	Transformer refurbishment	1.21	0.00	0.29	0.69	2

The Net Present Value (NPV) analysis is based on a discount rate of 10%, discounted to June 2019. Table 2 provides a sensitivity analysis based on TransGrid's current AER-determined pre-tax real regulatory Weighted Average Cost of Capital (WACC) of 6.75% and an upper bound of 13%.

**Table 2 — Discount rate sensitivities (\$ million)**

Option	Description	Economic NPV @13%	Economic NPV @6.75%
<b>A</b>	Transformer replacement	1.99	6.49
<b>B</b>	Transformer refurbishment	0.22	1.58

### 4.2 SFAIRP/ALARP evaluation

Options to reduce the network safety risk as per the risk treatment hierarchy have been considered in other lifecycle stages of the asset, and it has been determined that no reasonably practicable options exist to reduce the risk further than those capital investment options listed in Table 1.

Evaluation of the proposed options has been completed against the SFAIRP (So Far As Is Reasonably Practicable)/ALARP (As Low As Reasonably Practical) obligation, as required by the Electricity Supply (Safety and Network Management) Regulation 2014 and the Work Health and Safety Act 2011. The Key Hazardous Events and the disproportionality multipliers considered in the evaluation are as follows:

Catastrophic failure of asset/uncontrolled discharge or contact with electricity/ unauthorised access to site - 3 times the safety risk and 10% of the reliability risk (applicable to safety)

Unplanned outage of High Voltage (HV) equipment - 10% of the reliability risk (applicable to safety)

The results of this evaluation is summarised in the tables below.

**Table 3 – Feasible options (\$ thousand)**

Option	Description	CAPEX	Expected Life	Annualised CAPEX
<b>Base</b>	Do nothing	N/A	N/A	N/A
<b>A</b>	Transformer replacement	1,864	45 years	40
<b>B</b>	Transformer refurbishment	1,208	3 years	400

**Table 4 – Annual risk calculations (\$ thousand)**

Option	Annual Residual Risk		Annual Risk Savings	
	Safety Risk	Reliability Risk	Safety Risk	Reliability Risk
<b>Base</b>	7,613	388,332	N/A	N/A
<b>A</b>	0	14	7,613	388,318
<b>B</b>	4,651	237,281	2,962	151,051

**Table 5 – Reasonably practicable test (\$ thousand)**

Option	Network Safety Risk Reduction <sup>1</sup>	Annualised CAPEX	Reasonably practicable <sup>2</sup> ?
<b>A</b>	61,671	41,422	Yes
<b>B</b>	23,991	402,667	No

### 4.3 Preferred option

The outcome of the SFAIRP/ALARP evaluation is that Option A is the preferred option as it is reasonably practicable and provides the greatest network safety risk reduction, and is therefore required to satisfy the organisation's SFAIRP/ALARP obligations.

#### Capital and operating expenditure

There are no other ongoing capital expenditure considerations beyond the initial asset replacement project.

#### Regulatory Investment Test

A Regulatory Investment Test for Transmission (RIT-T) is not required as this is an asset replacement project with no augmentation component.

## 5. Recommendation

It is recommended that Option A be scoped in detail to allow for implementation.

<sup>1</sup> The Network Safety Risk Reduction is calculated as 3 x Safety Risk Reduction + 0.1 x Reliability Risk Reduction. No bushfire risk is applicable for the consequences considered

<sup>2</sup> Reasonably practicable is defined as whether the annualised CAPEX is less than the Network Safety Risk Reduction