OPTIONS EVALUATION REPORT (OER)

Wellington No.1 Reactor Renewal

OER 000000001282 revision 2.0

Ellipse project no.: P0005463
TRIM file: [TRIM No]

Project reason: Capability - Improved Asset Management
Project category: Prescribed - Replacement

Approvals

Author	Evan Lamplough	Substations Asset Strategist
Endorsed	Tony Gray	Substations Asset Manager
	Azil Khan	Investment Analysis Manager
Approved	Lance Wee	Manager / Asset Strategy
Date submitted for approval	12 December 2016	

Change history

Revision	Date	Amendment
0	25 June 2016	Initial issue
1	7 October 2016	Updated Capex to 2016/17 dollars, and corresponding NPV values and ALARP methodology. Updated SFAIRP/ALARP table and formatting and wording in Section 3.
2	12 December 2016	Update to format

1. Need/opportunity

Wellington 330kV Substation contains two 330kV 50MVAr shunt reactors, with the No.1 Reactor being connected to the 79 Wollar 330kV transmission line.

The No.1 reactor was installed in 1983 and will be 40 years old by the end of the next regulatory period. A detailed condition assessment has been conducted on the reactor 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 No.1 reactor 330kV Circuit Breaker (CB) will be replaced under the CB renewal program, Need 1337.

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 reactor continue to run to failure. There is a risk cost of $0.40m per annum associated with the reactor which is primarily comprised of reliability, financial and safety risks.

Option A — Replacement of the reactor [OFR 1282A, OFS 1282A]

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

- Procure and install the new reactor with the same ratings.
- Disposal of the existing No.1 Reactor.
- Replacement of the existing bund in order to meet current design standards.

This option has a Capex of $4.07m associated with it and would address the identified risk through installation of a new unit with significantly lower probability of failure.

Option B — Refurbishment of the reactor [OFR 1282B, OFS 1282B]

This option includes the refurbishment of the reactor 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 reactor.
- Replacement of the leaking white phase bushing.
- Bund upgrade works to achieve greater compliance with current design standards.

This option has a Capex of $1.15m associated with it and would address the identified risk by reducing the reactor condition issues through refurbishment. The expected effectiveness of this option is discussed in the following section.

4. Evaluation

4.1 Economic 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
Base Case	Do nothing	-	-	0.44	-	3
A	Reactor replacement	4.07	-	0	2.30	1
B	Reactor refurbishment	1.15	-	0.29	0.59	2

There is a marginal reduction in Opex expected to be achieved by both options due to a reduction in defects. A new reactor installed under Option A will also have a reduced routine maintenance for the new reactor. Both of these reductions are less than $1.00k per annum and are therefore insignificant in the economic evaluation.

The modelling of the effectiveness of the costed refurbishment actions (excluding replacement of the faulty bushing) indicates that the maximum amount of life extension that may be achieved would only be one or two years. This is because the significantly degraded paper insulation, as indicated by high Furan levels, cannot be addressed through refurbishment and confirms that the reactor is approaching the end of its life. Replacement of the faulty bushing provides additional benefit in reducing the overall probability of failure of the reactor. The combined benefit of the refurbishment in Option B has therefore been determined (conservatively – towards higher than expected life extension) to be a maximum of 5 years life extension. The Net Present Value (NPV) analysis has been completed assuming this 5 year life extension is achieved and this has been modelled through a 5 year reduction in the effective age of the reactor throughout the NPV analysis period. The corresponding reduction in probability of failure and risk score has been used to calculate the NPV and post project risk costs. A sensitivity analysis shows that Option B would only have the highest NPV if over 10 years of life extension was achieved, which is not possible.

The 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%
A	Reactor replacement	0.86	5.24
B	Reactor refurbishment	0.19	1.38

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 are summarised in the tables below.

Table 3 – Feasible options ($ thousand)

Option	Description	CAPEX	Expected Life	Annualised CAPEX
Base	Do nothing	N/A	N/A	N/A
A	Reactor replacement	4,070	45 years	90
B	Reactor refurbishment	1,150	5 years	230

Table 4 – Annual risk calculations ($ thousand)

Option	Annual Residual Risk		Annual Risk Savings	
	Safety Risk	Reliability Risk	Safety Risk	Reliability Risk
Base	7,613	10	27	N/A
A	0	0	0	10
B	4,651	7	17	3

Table 5 – Reasonably practicable test ($ thousand)

Option	Network Safety Risk Reduction[1]	Annualised CAPEX	Reasonably practicable[2]?
A	32	90	No
B	11	230	No

4.3 Preferred option

The outcome of the SFAIRP/ALARP evaluation is that neither of the options presented in Table 3 are reasonably practicable and are therefore not required to satisfy the organisation's SFAIRP/ALARP obligations.

Based on the economic evaluation the preferred option is Option A.

Capital and operating expenditure

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

[1] 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

[2] Reasonably practicable is defined as whether the annualised CAPEX is less than the Network Safety Risk Reduction

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 for implementation.