OPTIONS EVALUATION REPORT (OER)

KCR - ER0 33kV Tertiary Reactor Renewal

OER 000000001367 revision 3.0

Ellipse project no.: P0008002
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Project reason: Capability - Asset Replacement for end of life condition
Project category: Prescribed - Replacement

Approvals

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Date submitted for approval	12 December 2016	

Change history

Revision	Date	Amendment
0	21 June 2016	Initial issue
1	22 June 2016	Reapproved without change
2	20 October 2016	Updated Capex to 2016/17 dollars and ALARP methodology
3	12 December 2016	Update to format

1. Need/opportunity

The 33kV air cored reactors at Kemps Creek and Eraring Substations have experienced advanced aging and failures of this type of reactors have been experienced recently. Analysis of the options to mitigate the risks associated with the potential for failure of the Kemps Creek No.2 reactor and the Eraring No.2 reactor should be undertaken.

2. Related Needs/opportunities

Programs for other substation assets are being developed and these should be considered when packaging work for delivery.

3. Options

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

Base Case

The Base Case is a run to failure strategy for the reactors without the procurement of spares in advance to limit any impact of failure. Following a failure, procurement of a spare reactor would commence in order to restore the reactive power functionality to the network.

This option has a risk cost of $0.80m per annum, which is dominantly comprised of the reliability consequence.

Option A — Procurement of a spare air cored reactor [OFR 1367A, OFS 1367A]

The Option Feasibility Study (OFS) for this option includes the procurement of one spare air cored reactor to provide for the replacement of one reactor coil after its failure (one phase the 6 single phases at Kemps Creek and Eraring Substations). There is no change in Opex as a result of this option as the reactors are essentially maintenance free, however residual risks still exist as the spare reactor purchased would cater for one failure but not additional subsequent failures which are likely to occur.

Option B — Replacement of two three phase sets of air cored reactors [OFR 1367B, OFS 1367B]

This option includes the procurement, installation and commissioning of a replacement set of three phase air cored reactors for both the Eraring No.2 reactor and the Kemps Creek No.2 reactor. The cost given in the OFS provides the cost for one replacement, but it can be doubled to provide the cost of replacing all three phases at both sites, and this has been evaluated in this OER. The residual risk cost is significantly lower in this option due to the replacement of the aged reactors with new units which have significantly reduced probability of failure.

There is no change in Opex as a result of this option as the reactors are essentially maintenance free.

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
Base Case	Do nothing and run-to-failure	-	-	0.80	-	3
A	Procure 1 spare reactor	0.24	-	0.5	2.70	2
B	Replacement of Kemps Creek reactors	0.75	-	0	7.05	1
	Replacement of Eraring reactors	0.75	-	0	0.26	

The economic evaluation is based on a discount rate of 10% discounted to June 2019. The asset life of the new reactors is 45 years and the Net Present Value (NPV) analysis has been completed over a 30 year timeframe, including the investment period and the residual values of the reactors have been included in the final year cash flow. The capex spend has been distributed within the regulatory period according to the OFS. The risk savings associated with the investment have utilised the air cored reactor probability of failure modelling over the NPV period. The increase in risk saving over time is calculated using the difference in probabilities of failure between the existing units and new units as they both age.

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	Procure 1 spare reactor	1.78	4.51
B	Replacement of all Kemps Creek reactors	4.67	11.52
	Replacement of all Eraring reactors	0.01	0.77

4.2 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	Procure 1 Spare Reactor	240	45	5
B	Replacement of all Kemps Creek reactors	750	45	17
	Replacement of all Eraring reactors	750	45	17

Table 4 – Annual risk calculations ($ thousand)

Option	Annual Residual Risk			Annual Risk Savings		
	Safety Risk	Reliability Risk	Bushfire Risk	Safety Risk	Reliability Risk	Bushfire Risk
Base	1	658	N/A	N/A	N/A	N/A
A	0	439	N/A	1	219	N/A
B	0	0	N/A	1	654	N/A
	0	0	N/A	1	4	N/A

Table 5 – Reasonably practicable test ($ thousand)

Option	Network Safety Risk Reduction[1]	Annualised CAPEX	Reasonably practicable[2]?
A	23	5	Yes
B	66	17	Yes
	1	17	No

Both Option A and the Kemps Creek reactors under Option B are reasonably practicable.

4.3 Preferred option

The outcome of the SFAIRP/ALARP evaluation is that Option B for Kemps Creek reactors 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. Option B for Eraring is not reasonably practicable. It should also be noted that the vast majority of the network safety risk reduction under Option A is due to Kemps Creek, and so if Option B is implemented it will provide the greatest overall reduction in network safety risk.

The preferred option from the Economic NPV is also Option B.

[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

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 Project Approval Documents be prepared to implement option B for the replacement of both the Kemps Creek No.2 reactor and the Eraring No.2 reactor (both sets of three phase 33kV air cored reactors) with a total Capex of $1.50m.