

OPTIONS EVALUATION REPORT (OER)



Transformers - Reactors Expected Failure

OER- 00000001708 revision 0.0

Ellipse project no(s):

TRIM file: [TRIM No]

Project reason: Capability - Asset Replacement for end of life condition

Project category: Prescribed - Asset Renewal Strategies

Approvals

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Approved	Tony Gray	Acting/Manager/Asset Planning
Date submitted for approval	5 January 2017	

Change history

Revision	Date	Amendment
0	4/1/17	Original Issue

1. Need/opportunity

Across the fleet of oil filled transformers and reactors, failures are expected to occur over the 5 year regulatory period from 2018/19-2022/23. It will be necessary to replace spares following these failures.

Provision of transformer spares is crucial to the operation of the network to minimise impacts on the reliability of supply and to maintain licence conditions. Allowance is hence required to restore spares capability following a transformer failure.

Reactors are required to maintain correct system voltage profiles under all operating conditions and hence replacement is required in the event of a failure. Permanent loss of a reactor will result in an inability to maintain voltages at the levels required by the market operator in all cases.

Allowance is required for this expected expenditure.

2. Related needs/opportunities

Transformer/reactor replacements and refurbishments planned during the regulatory period will affect the likelihood of failure and the requirement to purchase an additional spare. This has been accounted for in the calculation by adjusting the failure rate based on the revised condition at the time of refurbishment or replacement.

Specific related Needs are:

- 1219 – Marulan No. 4 Transformer Replacement
- 548 – Sydney East No. 2 & 3 Transformer Replacement
- 276 – Forbes Transformer Replacements
- 1282 – Wellington No. 1 Reactor Replacement
- 1607 – Armidale No. 2 Reactor Replacement
- 1454 – Molong No. 1 Transformer Replacement
- 1354 – Transformer Refurbishment Program

3. Options

Base case

The predicted failures are expected to occur based on estimated failure rates.

Option A — Provide replacement reactors and transformers following failure.

Purchase replacement transformers and install following failure events.

Transformer and reactor failure curves were developed using past failure data and industry survey data and applied to the transformer/reactor population to estimate the total numbers of failures. A failure curve was applied to each transformer or reactor, which was adjusted for the condition of each transformer's estimated condition using its health index. A work sheet has been prepared as follows:

- A snapshot of the present transformer and reactor populations was prepared.
- The dates of planned replacements and refurbishment projects were used to map changes in effective age across the regulatory period. This was achieved by adjusting the effective age of each unit based on either the installation of a new transformer or from the estimated impact of refurbishment on the current effective age.

- Failure probability year by year was estimated based on failure curves adjusted by the effective age provided in the preceding step.
- For each transformer, the failure probability was summed over the five year period.
- The total failures by voltage/rating were accumulated and cost estimated based on replacement cost by transformer and reactor type groupings.

The total cost represented was totalled.

Standard transformer and reactor replacement costs were used in the above evaluation:

The resulting calculation is in the attached workbook:

[Transformer and Reactor Failures](#)

4. Evaluation

4.1 Commercial evaluation

Option A is the only available option. Following the process outlined above, the following expected cost results:

	MVA	Primary kV	Failures in period	Cost per failure	Total
Transformers	60	132	2.3	\$ 2,448,468	\$ 5,588,739
	375	330	2.6	\$ 5,837,786	\$ 15,364,690
	100	220	0.1	\$ 3,763,786	\$ 215,559
	500	500	0.8	\$ 5,704,916	\$ 4,533,317
					\$ 25,702,305
Reactors	100	132	0.0	\$ 3,357,900	\$ 167,560
	50	330	0.2	\$ 2,805,885	\$ 637,536
	16.667	330S	0.3	\$ 2,659,485	\$ 787,269
	25	220	0.2	\$ 2,497,377	\$ 452,753
					\$ 2,045,118
Total					\$ 27,747,423

4.2 ALARP evaluation

ALARP evaluation is not relevant to this business case as this business case is focussed on response to expected failure and not on prevention.

4.3 Preferred option

Option A is the only available option.

Capital and operating expenditure

There are no operating expenditure trade-offs identified.

Regulatory Investment Test

RIT-T is not relevant to this submission.

5. Recommendation

It is recommended that Option A is implemented.