Revised Regulatory Proposal

Supporting Information: Replace Rural Zone Substation Transformers (RERZT)

Aurora response to the AER's Draft Distribution Determination

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1. Introduction

Aurora provided the AER with its *Regulatory Proposal* on 31 May 2011 in accordance with the provisions of Chapter 6 of the *Rules*. Aurora also set out its answers to the Regulatory Information Notice (RIN) issued by the AER on 21 April 2011 in its response (*RIN Response*) of 31 May 2011.

The AER have reviewed Aurora's *Regulatory Proposal* and *RIN Response* and provided Aurora with the AER's *Draft Distribution Determination*, associated consultant's reports and AER models on 29 November 2011 in accordance with the provisions of Chapter 6 of the *Rules*.

Aurora provides its *Revised Regulatory Proposal* to the AER in response to the AER's *Draft Distribution Determination* in accordance with the provisions of Chapter 6 of the *Rules*. This document provides specific supporting information as an appended attachment to Aurora's *Revised Regulatory Proposal*

2. Replace Rural Zone Substation Transformers (RERZT)

2.1. Summary

In Aurora's Regulatory Proposal, Aurora proposed to replace six of the ageing transformers at Aurora's rural zone substations. The aims of this program were to manage the risk of in-service failure associated with these assets and pro-actively manage the replacement of these assets. Aurora also contends that there are a considerable number of transformers expected to reach their end of life within the next ten years.

The configuration of these substations is such that the failure of one transformer would result in an outage to the whole site and there is currently no oil-containment at these sites.

The AER considers a more prudent approach is to defer the replacement of these assets, ensuring they are appropriately maintained.

Aurora has conducted a review of its zone substation transformer fleet and performed calculations to determine the number of spares required to support the AER's proposed arrangements.

The recommendations arising from this review are:

1 Four spare 22/11 kV, 5 MVA transformers be purchased immediately at an estimated cost of $2m; and

2 Development of an appropriately oil-contained secure site for the storage of the spare transformers at an estimated cost of$160k.

2.2. Background

In Aurora's Regulatory Proposal, Aurora proposed to replace six of the ageing transformers at Aurora's rural zone substations. The aims of this program were to manage the risk of in-service failure associated with these assets and pro-actively manage the replacement of these assets. Aurora also contents there are a considerable number of transformers expected to reach their end of life within the next ten years.

The configuration of these substations is such that the failure of one transformer would result in an outage to the whole site and there is currently no oil-containment at these sites.

The AER considers a more prudent approach is to defer the replacement of these assets, ensuring they are appropriately maintained.

The rural zone substation power transformer fleet can be divided into three types of transformers:

- Small rural transformers (22/11 kV, less than 5 MVA)
- Medium rural transformers (22/11 kV, greater than 5 MVA)
- Tods Corner transformers (6.6/22 kV, 3 MVA)

2.3. Small Rural Transformers (22/11 kV, less than 5 MVA)

There are 14 small rural transformers are located at:

- Gretna;
- New Norfolk;
- Richmond;
- Wayatinah; and
- Westerway.

Section 5 gives the year of manufacture, rating and maximum demand at each substation site.

2.3.1. Medium Rural Transformer (22/11 kV, greater than 5 MVA)

The medium rural transformer is located at Sandy Bay, operating as a step up transformer supplying the University of Tasmania boiler.

This transformer is planned to be decommissioned and removed from the system in 2012-13.

2.3.2. Tods Corner Transformers (6.6/22 kV, 3 MVA)

The system configuration at Tods Corner is unique to Aurora's system, with these being the only transformers of this voltage ratio in the system.

These transformers are planned to be decommissioned and removed from the system in 2012-13.

2.4. Spares Calculation

2.4.1. Methodology

To determine the number of power transformer spares Aurora may consider holding, AusGrid's method of calculating the probability of having a spare when needed (refer Section 3) was applied to Aurora's population of zone substation transformers.

The urban zone substation power transformers were broken into three groups based on voltage and size (refer section 5).

The failure rate of the transformers was taken from ESAA Doc 006 - 1997 *Guidelines for Reliability Assessment Planning*, Appendix 3: Transformers using the figures for 33/11kV transformers. The value used for failure rate was the average of the calculated failure rate for each transformer and not the failure rate for the average age of the transformers.

The provisioning time for a power transformer was taken to be 1 year.

The results are given in Table 1 and the full calculations can be found in Power Transformer Spares Holdings Calculations (reference ❑).

Table 1: Number of spares required for greater than 99.9% probability of having a spare when required

Transformer Type	Number in system	Number of spares required
Small rural (22/11 kV, less than 5 MVA)	14	6
Medium rural (22/11 kV, greater than 5 MVA)	1	1
Tods Corner (6.6/22 kV, 3 MVA)	2	2

Aurora will standardise on a 5 MVA transformer for small rural applications, the number of transformers at each site was adjusted to reflect the number of 5 MVA transformers required to supply the substation maximum demand (winter 2010) at these sites (not allowing for N-1).

Table 2: Number of 5 MVA transformers required to supply the substation maximum demand (winter 2010) at each site

Site	Number of 5 MVA transformers required
Gretna	1
New Norfolk	2
Richmond	2
Wayatinah	1
Westerway	1

These revised transformer numbers were entered into the spares calculations and the revised results are given in Table 3 and the full calculations can be found in Revised Power Transformer Spares Holdings Calculations (Small Rural Transformers) (reference 5).

Table 3: Number of spares required for greater than 99.9% probability of having a spare when required (based on revised transformer numbers)

Transformer Type	Number in system	Number of spares required
Small rural (22/11 kV, less than 5 MVA)	7	4

2.4.2. Small Rural Transformers (22/11 kV, less than 5 MVA)

Based on the above analysis, Aurora would be required to hold between four and six spare 5 MVA transformers to ensure that a spare is available when it is needed 99.9 per cent of the time.

It is recommended that Aurora purchase four 22/11 kV 5 MVA transformers immediately to act as spares for these sites. Based on recent transformer purchases, the cost of each spare is estimated at $0.5m

As Aurora does not have a suitable location with oil-containment to store these transformers, it is also recommended that Aurora procure and develop a location for the storage of these transformers. Assuming a transformer storage area is developed as part of the urban zone substation transformer spares purchase, the incremental cost of developing a storage area for these transformers is estimated at $40k per transformer base on recent substation construction costs.

2.4.3. Medium Rural Transformers (22/11 kV, greater than 5 MVA)

This transformer is planned to be decommissioned and removed from the system in 2012/2013, thus there is no requirement for any spares.

2.4.4. Tods Corner Transformers (6.6/22 kV, 3 MVA)

These transformers are planned to be decommissioned and removed from the system in 2012/2013, thus there is no requirement for any spares.

2.5. Operational Expenditure

It is anticipated that there would be a small increase in operational expenditure requirements associated with the management of spare transformers, including silica gel breather inspections, periodic inspections for oil-leaks and oil tests.

2.6. Recommendation

Aurora has conducted a review of its zone substation transformer fleet and performed calculations to determine the number of spares required to support the AER's proposed arrangements.

The following recommendations are made for addressing the spares holding issues associated with the power transformers at Aurora's rural zone substations:

- Four spare 22/11 kV, 5 MVA transformers be purchased immediately at an estimated cost of $2m; and
- Development of an appropriately oil-contained secure site for the storage of the spare transformers at an estimated cost of$160k.

2.7. References

- Power Transformer Spares Holdings Calculations (NW-#276173-V3)
- Revised Power Transformer Spares Holdings Calculations (Small Rural Transformers (NW-#30240816-V1)

3. Spares Availability Calculation

Based on the work presented by AusGrid (formerly Energy Australia) at the Electricity Industry Plant Working Group, the following methodology is used to determine the probability of having a spare of a particular item available when required.

The information used to analyse spares requirements are:

- the reliability of the item;
- the installed population of the item;
- the probability of having a spare item available when required; and
- the provisioning period of the item (i.e. the lead time).

The relationship between these items can be described by:

$$P = \sum_{n=0}^{n=s} \left[\frac{R(-\ln(R))^n}{n!} \right]$$

Where:

P = probability of having a spare of a particular item available when required

S = number of spare parts carried in stock

R = composite reliability (probability of survival); $R=e^{-K\lambda T}$

K = installed population

λ = the failure rate of the item

T = provisioning of the item (lead time in years)

AusGrid's (formerly Energy Australia) policy is to aim for greater than 99.9% probability of having a spare available.

4. Confidentiality

Aurora does not consider any information contained within this document to be confidential.

5. Appendix A - Summary of Aurora Energy Zone Substation Transformers

A.1. Small Rural Transformers

Substation	Number of Transformers	Year of Manufacture	Rating of Transformers (MVA)	N-1 (MVA)	Substation Maximum Demand – Winter 2010 (MVA)
Gretna	2	1971	1	1	0.89
New Norfolk	4	1960	2.5	7.5	9.0
Richmond	2	1960	2.5	2.5	3.8
Wayatinah	4	1950	1	1	0.4
Westerway	2	1962	1	1	0.3

A.2. Medium Rural Transformers

Substation	Number of Transformers	Year of Manufacture	Rating of Transformers (MVA)	N-1 (MVA)	Substation Maximum Demand – Winter 2010 (MVA)
Sandy Bay (Uni Boiler)	1	1967	10/15	0	3

A.3. Tods Corner

Substation	Number of Transformers	Year of Manufacture	Rating of Transformers (MVA)	N-1 (MVA)	Substation Maximum Demand – Winter 2010 (MVA)
Tods Corner	2	1971	3	3	Unknown