Evaluation of Distribution Loss Factors 2012-2013

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Endeavour Energy

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1 Introduction

The National Electricity Rules require that Distribution Network Service Providers (DNSPs) obtain the approval of the Australian Energy Regulator (AER) as the relevant regulator for Distribution Loss Factors (DLFs) for the DNSP's network. This report nominates the DLFs for Endeavour Energy's electrical distribution network for the 2012/2013 financial year. It also outlines the methodology, assumptions and base data used for the calculation of the loss factors.

Endeavour Energy's methodology for the calculation of distribution loss factors is detailed in a separate document titled "Methodology for the Determination of Distribution Loss Factors" dated 30 January 2008. In compiling the DLFs, and in line with Section 2.1 of the methodology document, "actual load and generation data for the most recently completed financial year will be used, in line with NEM Rules clause 3.6.3 (h)(5)." The AER requires that distribution loss factors should be calculated for site-specific major customers, while loss factors for each tier of the network should be provided to calculate the losses attributable to the remainder of the customers.

The methodology used in this report is identical to that used in the submissions for the 2008/09, 2009/10, 2010/11 and 2011/12 years.

As required by the Rules, the proposed DLFs are "forward looking" and use both demand and energy forecast data as provided by Endeavour Energy's Forecasting Section for the 2011/12 fiscal year.

2 Summary of Results

	2012/2013		2011/2012		2010/2011	
Network Level1, 3	**Effective Section Loss Factor %**	**Cumulative Loss Factor %2**	**Effective Section Loss Factor %**	**Cumulative Loss Factor %2**	**Effective Section Loss Factor %**	**Cumulative Loss Factor %2**
132 kV Network	0.34%	0.34%	0.36%	0.36%	0.32%	0.32%
Transmission Substation	0.42%	0.88%	0.44%	0.92%	0.45%	0.88%
Subtransmission Network	0.53%	1.48%	0.55%	1.49%	0.54%	1.43%
Zone Substation	0.54%	1.57%	0.53%	1.59%	0.48%	1.48%
High Voltage Distribution Network	1.03%	2.74%	0.91%	2.63%	1.40%	3.05%
Distribution Substation	2.88%	6.31%	2.73%	5.85%	2.59%	6.11%
Low Voltage Distribution Network	1.92%	7.70%	2.54%	8.03%	2.56%	8.42%

Table 1 - Generic Loss Factors

Notes:

- All % loss factors quoted in the above table are given as the % of energy delivered at that level of the network, whether to customers at that level, or to lower levels.
- In this study section loss factors do not add numerically to give cumulative loss factors due to the effects of compounding and network configuration.
- An allowance for theft and non-technical losses of 0.5% of total sales has been made.

An examination of both the current (2011/12) and the proposed generic 2012/13 DLFs shows that there is no significant difference between the results. However, there are some small variations in the DLFs across the range. These changes are considered to be the result of improvements in Loss Load Factor (LLF) data, as well as the factoring in of capital works, particularly at the Transmission and Zone Substation level.

In addition, and in accordance with the National Electricity Rules, all customers with a consumption of greater than 40GWh and/or 10MW demand have had site specific Loss Factors calculated. These calculations use data specific to each customer's load profile and assets used to supply them.

Embedded Generators with a peak output of greater than 10MW have also had Loss Factors calculated. The methodology for the calculation of these DLFs is based on the difference in losses in the network between the conditions where the generator is operating and not operating over an annual cycle, relative to the energy sent out by the generator over the same period.

3 Reconciliation of Forecast and Actual Losses

As required by the Rules, a reconciliation of forecast and actual losses has been carried out. This involved taking the complete billing data set for 2010/11 and comparing the losses incurred with those estimated by the calculations carried out in 2009/10. A summary comparison between the actual losses as calculated from the billing data and the losses predicted by calculation is shown in Table 2 below.

Financial Year	Forecast Loss kWh	Actual Loss kWh	Difference kWh	Energy Distributed kWh	Forecast error as % of Energy Distributed
2006/07	1,062,802,864	922,867,190	139,935,674	17,457,605,133	0.80%
2007/08	944,468,857	907,912,261	36,556,596	17,410,946,298	0.21%
2008/09	1,073,392,460	988,987,754	84,404,707	17,363,078,492	0.49%
2009/10	836,833,750	742,886,372	93,947,378	17,514,300,287	0.54%
2010/11	891,864,721	774,135,174	117,729,574	17,431,698,650	0.68%

Table 2 – Reconciliation of Forecast to Actual Losses

Note: The financial year 2010/11 is the last complete set of available billing data.

4 General Comments on Changes to DLFs

General comments driving changes to DLFs are summarised below:

- Care has been taken to ensure that the transmission network has been modelled in the configuration that is most representative of the way in which the system is generally operated in practice.
- Load flow models for the 2012/13 year were executed with the network configured according to current capital program commitments.
- Substantial effort has been put in to returning out-of-service or failed capacitors at Transmission Substations to service and to installing capacitor banks on the 11kV busbar at Zone and Transmission Substations. Consequently, a level of static reactive support has been modelled in the load flow calculations. However, the magnitude of this support is less than the maximum available. Instead, the status of each capacitor has been estimated by considering the time weighted average reactive support at each location.

5 Application of the Methodology

5.1 Treatment of Theft

This study has identified theft as a separate line item and has taken a value of 0.50% of total sales (as recommended by the DLF Working Group) and applied this to the calculations. It has been assumed that all theft occurs at low voltage and the overall theft apportionment is therefore allocated to the low voltage network. Consequently, this equates to 0.95% of low voltage sales.

5.2 Site Specific DLFs

Site specific DLFs for embedded generators >10MW have also been calculated. These are located at Tallawarra Power Station, Marubeni (formerly Sithe Guildford) and Appin and Tower Collieries. Tower has again recorded a negative DLF this year due to the levels of generation into the Nepean network. At times of light load on the network, the generator is providing load into a remote network in the Campbelltown area via relatively lossy 66kV connections to that load centre and therefore the network losses in that area are increased over the situation when the generator is not in service.

Tallawarra Power Station has also recorded a negative DLF again this year due to an increase in the generation output which has resulted in higher levels of generation into the Springhill, Mount Terry and Shoalhaven transmission systems. At times of light load on the network, the generator is providing load into the remote network in the southern areas via Dapto BSP, therefore the network losses are increased over the situation when the generator is not in service as supply would have been provided from Dapto BSP.

The Marubeni Generator at Guildford has recorded a negative DLF this year. This appears to be due to the observed increase in energy that is being transferred into the upstream network from the Guildford TS connection point.

Location specific loss factors were calculated for a total of 23 significant customer connection points. The factors were calculated using the same methodology as the general loss calculations; using forecast load data for the 2012/13 year to determine the 15 minute average line losses using a load flow calculation.

Note that location specific loss factors were not calculated for Autocast and Forge, Sydney Water (East Prospect) and Clarence Colliery as in previous years, as their consumption did not meet the requirement of >40GWh energy and/or 10MW demand in the 2009/10 year.

In most cases the major customers shared upstream network assets with other general Endeavour Energy Network customers. As noted previously, the energy losses for these shared assets were calculated and allocated to the loads in proportion to the energy delivered to each load by each asset through a linear estimate of the load flow solution at each metering interval. The location specific loss factors were then calculated using the total energy losses attributable to a particular load divided by the energy delivered to that load. These quantities were then subtracted from the overall network pool, which was used to calculate the general Loss Factors.

5.3 132kV Lines

Endeavour Energy's 132kV network supplies transmission substations, 132/11kV zone substations and 132kV customers. Forecast load data from the 2009/10 year were used to determine the 15 minute average line losses using a load flow calculation. This data was normalised to account for both the forecast 2012/13 peak demand and the forecast energy consumption from the network.

The 132kV line losses were then accrued from the load flow calculations conducted for each 15 minute metering interval. In the case of site specific 132kV customers, the 132kV line losses attributable to that customer were calculated from a linear estimation of the load flow solution, at each time interval.

5.4 Transmission Substations

Transformer series losses were calculated by applying the forecast 2012/13 load data to the network load flow model. The transformer losses were then accrued from those obtained in each 15 minute metering interval.

Actual shunt losses were used for 54% of transmission substations. The average shunt losses for the known transformers, as a percentage of rating, were applied to the remainder.

5.5 Subtransmission Lines

The subtransmission line series losses were also calculated by applying the forecast 2012/13 load data to the network load flow model. The line series losses were then accrued from those obtained at this level of the network in each 15 minute metering interval.

5.6 Zone Substations

As in the case of transmission substations, the transformer series losses were calculated by applying the forecast 2012/13 load data to the network load flow model. The transformer losses were then accrued from the losses in each metering interval.

Actual shunt losses were used for 65% of zone substations. The average shunt losses for the known transformers, as a percentage of rating, were applied to the remainder.

5.7 Medium Voltage Lines (11kV, 22kV)

The medium voltage peak distribution line losses for the whole distribution network were modelled by applying the forecast 2012/13 peak demands to the DINIS load flow model for each of the Zone Substation networks. The losses for each Zone Substation network were then calculated using the 2010/11 LLF for that zone substation, applied to the peak line losses of feeders supplied from the particular substation.

In cases where a site specific customer was supplied by a medium voltage distribution feeder, the losses attributable to the general tariff customers were first determined by calculating the LLF, while excluding the site specific customer from the load flow model. The calculation was then repeated using the site specific customer's own LLF and a load flow model which excluded the general tariff customers.

5.8 Distribution Substations

Losses incurred within distribution substations were assessed by using an average load and generic transformer characteristics due to the large number (>29,000) of distribution transformers in the Endeavour Energy network. The numbers of each size of transformer were determined from Endeavour Energy's Asset Database (Ellipse) as at 31 December 2011.

Transformers of 100kVA or greater are generally fitted with Maximum Demand Indicators (MDIs) and so maximum loadings can be monitored. The latest MDI reading for each individual transformer was used to determine an average utilisation for each transformer category, or rating. For those transformers with no corresponding MDI data, a lower utilisation of 50% was assumed.

Transformer full load loss values ranged from 1.5% of rating for the smallest transformers down to 0.9% for the largest. Shunt losses ranged from 0.5% of rating for smaller units down to 0.25% for the larger ones. A LLF ranging from 0.21 to 0.23 has also been used for the distribution transformers as this is representative of the average LLF for the whole of the Endeavour Energy network.

5.9 Low Voltage Lines

Due to the lack of load information and modelling data it is not possible to model LV network losses directly. Instead, losses were assessed using an assessment of energy purchases less energy sales, theft and other losses.

To determine LV network losses, total losses were first calculated by subtracting energy purchases from energy sales. All other calculated network losses, including theft, were then subtracted from total losses to give the LV network losses.