



**EVALUATION OF
DISTRIBUTION LOSS FACTORS**

2022 – 2023

PUBLIC REPORT

ASSET PLANNING & PERFORMANCE

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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 regulator for Distribution Loss Factors (DLFs) for the Endeavour Energy network. This report nominates the DLFs for Endeavour Energy's electrical distribution network for the 2022/23 financial year. It also outlines the methodology, assumptions and base data used for the calculation of the loss factors.

The methodology used in this calculation is based on the requirements set out in Endeavour Energy's publication "Methodology for the Determination of Distribution Loss Factors" dated 30 January 2008 (the Report). 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 DLF submissions since 2008/09.

As required by Section 4.1 of the Report, the proposed DLFs are "forward looking" and use both demand and energy forecast data as provided by Endeavour Energy's Forecasting and Finance Sections for the 2022/23 fiscal year. References in this document to 'last financial year' refer to 2020/21 and references to 'next financial year' refer to 2022/23.

2 Results and Commentary

Network Level ^{1, 3}	2022/23		2021/22		2020/21		Effective Section Loss Factor Change (%)	Cumulative Loss Factor Change (%)
	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	1.0025	1.0025	1.0025	1.0025	1.0026	1.0026	0.00%	0.00%
Transmission Substation	1.0029	1.0069	1.0026	1.0065	1.0025	1.0062	0.03%	0.04%
Sub-transmission Network	1.0049	1.0114	1.0042	1.0104	1.0048	1.0107	0.07%	0.10%
Zone Substation	1.0048	1.0116	1.0046	1.0109	1.0047	1.0116	0.02%	0.07%
HV Distribution Network	1.0045	1.0162	1.0047	1.0157	1.0053	1.0170	-0.02%	0.05%
Distribution Substation	1.0312	1.0493	1.0299	1.0476	1.0286	1.0477	0.13%	0.16%
LV Distribution Network	1.0139	1.0680	1.0153	1.0682	1.0161	1.0687	-0.14%	-0.02%

Table 1 – Generic loss factors

Notes:

1. All loss factors quoted in the above table are given as 1 + the % loss of energy delivered at that level of the network, whether to customers at that level, or to lower levels.
2. In this study section loss factors do not add numerically to give cumulative loss factors because of compounding and network configuration.
3. An allowance for theft losses of 0.5% of total sales has been made.

An examination of the results indicates that the proposed cumulative 2022/23 DLF is consistent with results from previous years. Increases in distribution substation losses are driven by a shift towards larger rated distribution transformers and decreases in LV distribution network losses are driven by a significant increase in residential solar output.

The calculation of the above loss factors is set out in Appendix A. The billed energy data used as the basis of the report is contained in Appendix B.

In addition, and in accordance with the National Electricity Rules, all customers with an average energy consumption of greater than 40 GWh and/or 10 MW demand have had site-specific loss factors calculated. Embedded generators with a peak output of greater than 10 MW have also had loss factors calculated. The results are summarised in the following tables.

There are three new site-specific customers in Endeavour Energy's network: [REDACTED]
[REDACTED]. [REDACTED] has
requalified as a site-specific customer. All site-specific customers in the 2021/22 DLF have retained their site-specificity.

Significant Customers	NMI	2022/23 Loss Factor	2021/22 Loss Factor	2020/21 Loss Factor	Change (%)	Comments on changes
[REDACTED]	4310857952	1.0170	1.0144	1.0149	0.26%	[REDACTED]
[REDACTED]	4310866743	1.0086	1.0083	1.0083	0.02%	
[REDACTED]	4310942441	1.0040	1.0073	1.0049	-0.33%	[REDACTED]
[REDACTED]	4311028276 4311028297 4311246109 4311246110	1.0146	1.0121	1.0136	0.24%	[REDACTED]
[REDACTED]	4311061116 4311061119	1.0064	1.0059	1.0067	0.05%	
[REDACTED]	4311159207	1.0055	1.0050	1.0054	0.05%	
[REDACTED]	4311168207	1.0040	1.0040	1.0044	0.00%	
[REDACTED]	4311204547 4311204594 4311339343 4311339344 4311339345 4311340412	1.0082			N/A	[REDACTED]
[REDACTED]	4311206443 4311173727	1.0040	1.0040	1.0041	0.00%	
[REDACTED]	4311251697 4311297310	1.0011	1.0013	1.0012	-0.01%	
[REDACTED]	4311265997 4311265950	1.0055	1.0059	1.0062	-0.04%	
[REDACTED]	4311271253 4311271260	1.0010	1.0012	1.0012	-0.02%	

Significant Customers	NMI	2022/23 Loss Factor	2021/22 Loss Factor	2020/21 Loss Factor	Change (%)	Comments on changes
[REDACTED]	4311275493	1.0096	1.0020	1.0027	0.76%	[REDACTED]
[REDACTED]	4311322991 4311322992	1.0062			N/A	[REDACTED]
[REDACTED]	4311371172 4311371951	1.0000			N/A	[REDACTED]
[REDACTED]	NEEE000003	1.0107	1.0101	1.0103	0.06%	
[REDACTED]	NEEE000005	1.0135	1.0137	1.0135	-0.02%	
[REDACTED]	NEEE000006	1.0390	1.0529	1.0497	-1.32%	[REDACTED]
[REDACTED]	NEEE000014	1.0079	1.0110	1.0087	-0.31%	[REDACTED]
[REDACTED]	NEEE000046	1.0036	1.0023	1.0026	0.13%	
[REDACTED]	NEEE000049	1.0155	1.0156	1.0134	0.00%	
[REDACTED]	NEEE000066	1.0279	1.0261	1.0266	0.18%	[REDACTED]
[REDACTED]	NEEE000506	1.0144	1.0144	1.0153	0.00%	
[REDACTED]	NEEE000758 NEEE000759	1.0134	1.0144	1.0148	-0.10%	
[REDACTED]	NEEE000760 NEEE000762 NEEE000764 NEEE000766 NEEE000768	1.0181	1.0065	1.0071	1.15%	[REDACTED]

Significant Customers	NMI	2022/23 Loss Factor	2021/22 Loss Factor	2020/21 Loss Factor	Change (%)	Comments on changes
[REDACTED]	NEEE000881	1.0040	1.0078	1.0032	-0.37%	[REDACTED]
[REDACTED]	NEEE001591	1.0071	1.0108	1.0055	-0.36%	[REDACTED]
[REDACTED]	NEEE001656	1.0036	1.0032	1.0035	0.04%	
[REDACTED]	NEEE001892	1.0130	1.0150	1.0136	-0.20%	[REDACTED]
[REDACTED]	NEEE004639	1.0107			N/A	[REDACTED]
[REDACTED]	NEEE005219	1.0072	1.0071	1.0074	0.01%	
[REDACTED]	NEEEW00001 NEEEW00002	1.0029	1.0028	1.0031	0.01%	
[REDACTED]	NEEEW04150 NEEEW04151 NEEEW04152 NEEEW04153 NEEEW04154	1.0072	1.0066	1.0073	0.06%	
[REDACTED]	NEEEW04511 NEEEW04512 NEEEW04513 NEEEW04514	1.0042	1.0038	1.0024	0.04%	

Table 2 – Location specific loss factors for customers with consumption greater than 40 GWh p.a. and/or a maximum demand greater than 10 MW.

The DLFs for the major embedded generators are as shown below. 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.

Generation >10MW	NMI	2022/23 Loss Factor	2021/22 Loss Factor	2020/21 Loss Factor	Change (%)	Comments on changes
[REDACTED]	NEEE000748	1.0619	1.0512	1.0655	1.0%	[REDACTED]
[REDACTED]	NEEE000749	1.0285	1.0343	1.0257	-0.6%	[REDACTED]
[REDACTED]	NEEE000750	1.0250	1.0376	1.0294	-1.2%	[REDACTED]
[REDACTED]	4310951391	1.0018	1.0001	1.0005	0.2%	[REDACTED]

Table 3 - Location specific loss factors for embedded generators with peak generation greater than 10 MW.

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 the last financial year and comparing the losses incurred with those estimated by the calculations carried out previously for that year. A summary comparison between the actual losses as calculated from the billing data and the losses predicted by calculation at the macro level is shown in Table 4 below. A reconciliation using the proposed DLFs for the relevant year are shown in Table 5.

Details of this calculation for the 2020/21 financial year are contained in Appendix B.

Financial Year	Forecast Loss	Actual Loss	Difference	Energy Distributed	Forecast error as % of Energy Distributed
	kWh	kWh	kWh	kWh	
2011/12	845,522,227	831,903,329	13,648,898	16,393,244,332	0.08%
2012/13	740,442,654	620,376,827	120,065,827	16,073,479,557	0.75%
2013/14	662,109,404	644,181,958	17,927,446	15,636,951,097	0.11%
2014/15	620,376,428	672,024,439	-51,648,011	16,127,500,731	-0.32%
2015/16	644,002,105	693,554,014	-49,551,909	16,645,596,945	-0.30%
2016/17	672,024,439	673,002,628	-978,189	16,739,660,930	-0.01%
2017/18	693,554,014	784,053,584	-90,499,570	16,639,359,421	-0.54%
2018/19	673,002,628	783,907,002	-110,904,374	16,758,896,351	-0.66%
2019/20 ¹	715,801,176	750,188,080	-34,386,904	16,511,359,434	-0.21%
2020/21	783,907,002	735,934,929	47,972,073	16,716,870,093	0.29%

Table 4 - Reconciliation of forecast to actual losses at macro level

Notes:

- Note that the DLF 2021/22 reported reconciliation for the 2019/20 financial year had an error. The error was corrected and the above reconciliation figure is accurate.

Financial Year	Forecast Loss	Actual Loss	Difference	Energy Distributed	Forecast error as % of Energy Distributed
	kWh	kWh	kWh	kWh	
2016/17	811,986,066	673,002,628	138,983,438	16,739,660,930	0.83%
2017/18	786,334,666	784,053,584	2,281,082	16,639,359,421	0.01%
2018/19	783,544,563	783,907,002	-362,439	16,758,896,351	0.00%
2019/20	765,491,446	750,188,080	15,303,366	16,511,359,434	0.09%
2020/21	853,091,551	735,934,929	117,156,622	16,716,870,093	0.70%

Table 5 - Reconciliation of forecast to actual losses using DLF for that year

Note that the 2020/21 financial year is the last complete set of available billing data.

4 Overall Methodology

This submission presents loss factors that can be applied to customers' metered energy to recover upstream network losses. In general, loss factors have been calculated for each hierarchical level (or tier) of Endeavour Energy's network to apply across the entire Endeavour Energy franchise area.

Energy loss in the supply network falls into two categories. The first is series losses which are dependent on the load being supplied, and the second is shunt losses which are independent of the load and are confined to the transformers on the network. Both series losses and shunt losses have been determined and included in this study.

For site-specific (SS) or general tariff customers (TC) connected to zone substations, or higher voltage levels, the loss factor calculations have been achieved by calculating the losses attributable to the customer within each hierarchical tier of the network using 15-minute metering data. From the resulting series of load flow solutions, the DLF for the site-specific or tariff customers can then be determined from the sum of the series and shunt network losses attributable to that customer, divided by the energy consumed by that customer.

The series losses are calculated by incorporating the 15-minute metering data from the previous financial year into the load flow routine. This metering data is scaled such that the peak demand matches the forward-looking forecast demand for the relevant customer. However, in previous years, energy consumption has been in decline at a faster rate than demand at most locations. Therefore, scaling the metering data by the peak demand alone does not produce network loads representative of the coming year. Hence, the forecast metering data is also normalised in order to obtain a load flow energy consumption that matches the forecast energy demand.

For each metering interval, one load flow solution is obtained to determine the total network losses and the accumulated network losses within each hierarchical tier. During the financial year, there are 35,040 (or 35,136 for leap years) 15-minute metering data points. Therefore, the loss factor LF for TC or SS customer K is given by:

$$LF = \frac{\sum_{N=1}^{35040} Losses(K)_{Series} + \sum_{N=1}^{35040} Losses(K)_{Shunt}}{\sum_{N=1}^{35040} Energy(K)}$$

where:

N	= the 15-minute metering interval
LF	= the loss factor for the customer
$Losses(K)_{Series}$	= the total series losses attributable to the customer
$Losses(K)_{Shunt}$	= the total shunt losses attributable to the customer
$Energy(K)$	= the energy consumed by the customer during the interval N .

The proportion of the series network losses which are attributable to the customer is calculated through linear estimation of the load flow solution at each of the 15-minute time intervals.

Similarly, the proportion of the shunt network losses which are attributable to each customer is calculated in accordance with the relative load placed on that transformer by the customer. Within substations, transformer no-load losses have been calculated from manufacturer's data where available as:

$$\text{Shunt Energy losses (kWh)} = \text{shunt losses (kW)} \times 8760 \text{ hours}$$

For example, if one transformer supplied both a 20 GWh pa of network load and a 10 GWh pa customer with a location specific loss factor, the transformer shunt losses would be allocated 2/3 to the network “pool” and 1/3 to the 10 GWh customer.

For customers supplied from 11/22 kV distribution feeders, the additional distribution series losses are calculated using a LLF for each zone substation. In this case, the distribution series losses are defined as:

$$\text{Series Energy Losses (kWh)} = \text{peak losses (kW)} \times 8760 \text{ hours} \times \text{LLF}$$

The peak distribution losses were modelled in the DIgSILENT PowerFactory load flow package using location specific demand forecasts for the DLF study year. The LLF is the ratio between the instantaneous losses incurred at peak load and the average instantaneous losses over a year. It is based on the square of the load and can be expressed as follows:

$$LLF = \frac{1}{i} * \sum_{n=1}^i \frac{P_n^2}{\hat{P}^2}$$

where:

i	the number of 15-minute load recordings in the last financial year
P_n	the 15-minute average load in the n^{th} period.
\hat{P}	the highest 15-minute average load in the year

In accordance with the National Electricity Rules, site-specific loss factors have been calculated for those customers whose maximum demand exceeds 10 MW, and/or whose consumption is greater than 40 GWh per annum. The calculations use data specific to each customer’s load profile and the assets used to supply them. The losses and energy allocated to the significant customers are then removed from the generic pool. The remaining losses and energy are used to determine the general network loss factors by calculating the pool of losses incurred within a level of the network and dividing them by the total energy delivered by that level.

It should be noted that the overall network DLFs take account of the effect of all other embedded generation on the network. Metering data for each of these sites has been included in the previous load flow calculations.

Embedded generators which have a peak generation greater than 10 MW have also been allocated a site-specific DLF. As stated previously, the methodology centres on the difference in network losses between the conditions where the generator operating and not operating over an annual cycle. The loss factor for generator G is then equal to:

$$LF_G = \frac{\sum_{N=1}^{35040} (L_{GEN_OUT} - L_{GEN_IN})}{\sum_{N=1}^{35040} E_G}$$

where:	LF_G	= the loss factor for the generator
	L_{GEN_IN}	= the total network losses when the generator is modelled in service, in accordance with the generation profile for the last financial year
	L_{GEN_OUT}	= the total network losses when the generator output is set to zero during the metering interval N .
	E_G	= the energy sent out by the generator during the metering interval N

In summary, the calculation methodologies are presented in the table below. Additional detail on the calculations for each of the tiers of the network is presented in sections 5 to 11 of this submission.

Table 6 - Summary of Network Loss Allocation Methodologies

Network Element	Voltage Level	Series Loss	Transformer	
			Series Loss	Shunt Loss
Transmission Network	132 kV	Summation of 15-minute load flow solutions using normalised metering data where available (or SCADA data or PQ meter data)		
Transmission Substation	132/66/33 kV		Summation of 15-minute load flow solutions using normalised metering data where available (or SCADA data or PQ meter data), in conjunction with manufacturer's data.	Use of manufacturer's data (fixed losses for each type of transformer)
Sub Transmission Network	66 kV, 33 kV	Summation of 15-minute load flow solutions using normalised metering data where available (or SCADA data or PQ meter data)		
Zone Substation	132/11 kV, 132/22 kV, 66/11 kV, 33/11 kV		Summation of 15-minute load flow solutions using normalised metering data where available (or SCADA data or PQ meter data), in conjunction with manufacturer's data.	Use of manufacturer's data (fixed losses for each type of transformer)
HV Network	22 kV, 11 kV	Use of load flow at peak with LLF calculated on metering data where available (or SCADA data)		
Distribution Substation	22/0.415 kV, 11/0.415 kV		Use of load flow at peak with manufacturer's generic data on impedance and typical LLF for distribution transformers.	Use of generic manufacturer's data (fixed losses for each type of transformer)
LV Network	415/240 V	No calculations performed. Residual energy from above, based on billing data, apportioned to LV network.		

4.1 Energy Transferred

The loss factors calculated in this report are to be applied to customers' metered energy. Therefore, the kWh energy losses at any level of the network must be expressed as a percentage of the energy **delivered at that level** of the network, irrespective of whether it is delivered to customers at that level or to customers at lower levels of the network. In a simple hierarchical network this is a matter of starting with the energy supplied from the BSP and progressively subtracting loads and losses at each level.

Endeavour Energy's network is more complicated due to the following factors:

- In some cases, 132/11 kV Zone Substations bypass Transmission Substations and the 33/66 kV sub-transmission network
- Several 66 kV sub-transmission feeders and 66/11 kV zone substations are connected directly to BSP's thus bypassing transmission substations, and
- Endeavour Energy has a significant quantity of embedded generation connected at 132, 66 and 33 kV.

These factors have been considered in the calculation of the energy delivered at each level of the network and hence in the percentage loss factors.

4.2 Accumulation of Loss Factors

Due to the complicated nature of the network noted above, it has not been possible to simply add successive loss factors to arrive at an overall loss factor. Rather, account must be taken of the different paths by which the energy may reach the user.

Consequently, the resulting cumulative loss factors are derived by dividing the network losses attributable to only the tariff customers, within each level of the network, by the energy delivered to that same level of the network.

The applicable proportion of network losses is calculated using the linear estimation of each load flow solution, as described previously. Similarly, the delivered energy is derived through a subtraction of the loads and losses at each level, as described in Section 4.1.

4.3 Treatment of Theft

This study has identified theft as a separate line item and has taken a value of 0.5% of total sales (as recommended by the former 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 0.7% of low voltage sales (see Appendix A).

4.4 Treatment of Residential Solar PV

The calculation methodology allows for solar PV generation by inclusion of the known solar PV energy amount with other embedded generation in the calculation model. Energy for embedded generators is added at the appropriate voltage tier for the purposes of the loss calculation. The PV energy is added at the LV tier in the calculation as embedded generation, alongside imports from the upstream network.

4.5 Site-specific DLFs

A total of 34 site-specific DLFs have been calculated. In addition, 4 site-specific DLFs for embedded generators greater than 10 MW have also been calculated. A summary of the DLFs for all the site-specific customers is contained in Table 2 with comments on the proposed changes, where applicable.

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 next financial 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 11 kV 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.

The DLFs for the major embedded generators are as shown in Table 3. Due to the large volume of data produced from the load flow calculations, the derivation of these values is not provided in this report. However, the calculations are available for examination, should this be required. Note that a DLF less than 1.000 for generators corresponds to an increase in losses when the generators are connected to the network. The most likely explanation of the increased losses is due to generators producing more power than the local load can consume for significant amounts of time.

The applicable DLFs for embedded generators can have either positive or negative benefits depending on the level of generation and how much of the local generation is consumed locally. When the local generation is consumed locally, overall losses are reduced. However, overall losses incurred in the network increase if the local generation exceeds local load for significant periods during the year.

5 132 kV Lines

Endeavour Energy's 132 kV network supplies transmission substations, 132/11 kV zone substations and 132 kV customers. Load data from the last complete financial year was used to determine the 15-minute average line losses using a load flow calculation. This data was normalised to account for both the forecast peak demand and the forecast energy consumption from the network for the next financial year.

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

Due to the large volume of data produced from the load flow calculations, the derivation of the 132 kV losses is not provided with this report. However, the calculations are available for review.

6 Transmission Substations

Transformer series losses were calculated by applying the forecast load data for the next financial year 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 over half of the transmission substations. The average shunt losses for the known transformers, as a percentage of rating, were applied to the remainder.

Along with the 132 kV lines, the derivation of the transmission substation losses is not provided in this report. However, the calculations are available for review.

7 Sub-transmission Lines

The sub-transmission line series losses were also calculated by applying the forecast load data for the next financial year 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.

Due to the nature of the load flow calculations, the derivation of the sub-transmission line losses is not provided in this report. However, the calculations are available for review.

8 Zone Substations

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

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

The derivations of the zone substation line losses are not provided in this report. However, the calculations are available for examination.

9 Medium Voltage Lines (11 kV, 22 kV)

The medium voltage peak distribution line losses for the whole distribution network were modelled by applying the forecast peak demands for the next financial year to the DIgSILENT PowerFactory load flow model for each of the Zone Substation networks. The losses for each Zone Substation network were then calculated using the last financial year's LLF for that zone substation, applied to the peak line losses of feeders supplied from the 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.

The LLFs used and the calculations of losses are contained in Appendix C.

10 Distribution Substations

Losses incurred within distribution substations were assessed by using an average load and generic transformer characteristics due to the large number of distribution transformers in the Endeavour Energy network (>30,000). The numbers of each size of transformer were determined from Endeavour Energy's Asset Database (Ellipse).

Historical loading information for distribution transformers was used to determine an average utilisation for each transformer category, or rating. For those transformers with no corresponding historical load 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.

The detailed loss evaluation for distribution substations is contained in Appendix D.

11 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.

12 Location Specific Loss Factors

Location specific loss factors were calculated for significant customer connection points, as shown in Table 2. The factors were calculated using the same methodology as the general loss calculations; using forecast load data for the next financial year to determine the 15-minute average line losses using a load flow calculation.

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 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.

Due to the large volume of data obtained from the load flow calculations, the derivation of the location specific loss factors is not provided in this report. However, these calculations are available for examination, should this be required.

Appendix A – Calculation of Loss Factors

[illegible]

Appendix B – Billed Energy Data for 2020/21 Financial Year incl. Reconciliation of Calculated to Actual Losses

2020/21 Data	
Energy Imports	
Summary - Energy Imports	kWh
TransGrid - All BSP	15,857,435,637
Embedded Generators	1,595,369,385
Sunpower - included in "Embedded Generators" Total	-
Total Imports kWh	17,452,805,022
Embedded Generators breakdown	
kWh	
Landfill Gas	64,827,591
Non-Renewable	1,099,573,293
Renewable - PV, Hydro & Wind	430,968,502
Sunpower	424,607,789
Decommissioned	0
Total Embedded Generation	1,595,369,385
Energy Exports	
Consumption Data based on WAPC	
kWh	
Total Board Report	16,716,870,093
Dom & CLd (not including NSW Solar Bonus Scheme)	5,781,941,761
Domestic	5,001,636,159
Controlled Load	780,305,601
NSW Solar Bonus Scheme	424,607,789
Commercial	1,776,219,062
General Supply Non TOU	1,617,693,286
General Supply TOU	14,400,735
Unmetered -	144,125,041
Industrial	9,158,709,271
Low Voltage TOU Demand	3,608,730,716
High Voltage TOU Demand	1,613,137,030
Subtransmission TOU Demand	2,397,114,319
Bulk & Inter-distributor Transfer	1,539,727,205
Reconciliation (Finance)	
Total Board Report as per TM1 (before corrections for solar and IDT)	18,632,523,657
NSW Solar Bonus Scheme	(424,607,789)
Bulk & Inter-distributor Transfer	(1,491,045,775)
Total Energy Consumption	16,716,870,093

[illegible]

Subtract site specifics from HV TOU Demand (N29) Tariff	
N39 Tariff Consumption without site specifics in year to reconcile	1,077,315,737
Subtract site specifics from Subtransmission TOU Demand (N39) Tariff	
N39 Tariff Consumption without site specifics in year to reconcile	64,527,983
Subtract site specifics from N53 Tariff	
N53 Tariff Consumption without site specifics in current year	49,170,186
Total of all LV customers (including all unmeterd)	11,166,891,539
Total of all HV customers (excluding site specifics)	1,077,939,481
Total of all ST Customers (excluding site specifics)	130,178,939
Total energy consumption of all site specifics in current year >40Gwh or >10MW	4,341,860,134
Cross Check Total Consumption	16,716,870,093
Difference	0
Unallocated 132kV customers (energy) kWh	8,517,473
HV Customers Connected Directly to TS	0
Unallocated 33kv and 66kV customers (energy) kWh	121,661,466
HV Customers Connected Directly to Zone Sub HHVT	114,186,023
HV Customers Connected into HV network HHVL	963,753,459
LV Customers connected directly to Distribution Sub HLVT	1,360,899,003
LV Customers connected into the LV network HLVL * excludes unmetered	9,661,867,496
Unmetered LV Supplies	144,125,041
Site Specifics from above	4,341,860,134
Cross Check total Consumption	16,716,870,093
	0
Total Energy in	17,452,805,022
Total Billed Energy	16,716,870,093
Actual Losses (last Financial Year)	735,934,929
Overall losses as a function of Energy Imports	4.22%
Overall losses as a function of Energy Sales	4.40%
Allowance for Theft (0.5% of total sales)	83,584,350
Theft as a % of low voltage sales (s4.3 of report)	0.75%
General Customers Billed (Total Billed less Site Specific Customers)	12,375,009,959
Energy in ind Generation	17,452,805,022
Site Specifics	4,341,860,134
Overall Losses Energy In less General Customers Billed + CRP	735,934,929
Overall Loss factor as a function of Billed Energy	4.40%
Forecast Losses for 2020/21 (From that year's DLF report)	783,907,002
Loss Difference	47,972,073
Error as % of Energy Distributed	0.29%

DLF HISTORICAL RECONCILIATION				
for YEAR 2020/21				
Customers Type		Actual Sales Gwh	DLF applied in 2020/21	DLF x Sales Gwh
1 Site specific customers	4310857952		1.0149	
2	4310866743		1.0083	
3	4310942441		1.0049	
4	4311159207		1.0054	
5	4311168207		1.0044	
6	4311275493		1.0027	
7	4311028276, 4311028297, 4311246109, 4311246110		1.0136	
8	4311061116, 4311061119		1.0067	
9	4311179347, 4311179743		1.0107	
10	4311206443, 4311173727		1.0041	
11	4311251697, 4311297310		1.0012	
12	4311265997, 4311265950		1.0062	
13	4311271253, 4311271260		1.0012	
14	NEEE000003		1.0103	
15	NEEE000005		1.0135	
16	NEEE000006		1.0497	
17	NEEE000014		1.0087	
18	NEEE000046		1.0026	
19	NEEE000049		1.0134	
20	NEEE000066		1.0266	
21	NEEE000506		1.0153	
22	NEEE000758, NEEE000759		1.0148	
23	NEEE000760, NEEE000762, NEEE000764, NEEE000766, NEEE000768		1.0071	
24	NEEE000881		1.0032	
25	NEEE001591		1.0055	
26	NEEE001656		1.0035	
27	NEEE001892		1.0136	
28	NEEE004639		1.0116	
29	NEEE005219		1.0074	
30	NEEEW00001, NEEEW00002		1.0031	
31	NEEEW04150, NEEEW04151, NEEEW04152, NEEEW04153, NEEEW04154		1.0073	
32	NEEEW04511, NEEEW04512, NEEEW04513, NEEEW04514		1.0024	
TOTALS Site specific customers		4,051.996		4,097.908
NON Site Specific Customers	132 kV Network	138.067	1.0026	138.419
	Transmission Substation	0.000	1.0062	0.000
	Subtransmission Network	158.705	1.0107	160.402
	Zone Substation	157.348	1.0116	159.178
	High Voltage Distribution Network	1090.179	1.0170	1108.743
	Distribution Substation	1360.899	1.0477	1425.796
	Low Voltage Distribution Network	9661.867	1.0687	10325.491
	Unmetered	144.125	1.0687	154.024
TOTALS NON Site specific customers		12,711.190		13,472.054
		GWh		
Actual Purchases		17,452.805		
Billed Sales		16,716.870		
Actual Losses		735.935		
Reconciled Purchases		17,569.962		
Reconciled Losses		853.092		
Loss Error		117.157		
Error as a % of Actual Purchases		0.67%		
Error as a % of Actual Sales		0.70%		
Error as a % of Losses		15.92%		

Appendix C – Calculation of Losses for HV Distribution Network

Load	Bus No. (within the)	Transmission Substation	Average Po	LLF (loss load facto	Peak Demand (MVA)	Series Losses at Peak Load (kW)	Distribution Losses (MW)
Abbotsbury ZS	2ABBO11A_LD	Liverpool BSP	8.803681507	0.060507341	40.3822981	324.7391128	0.019649
Albion Park ZS	2ALBI11*_LD	Mount Terry TS	0.092860337	0.115466442	28.437788132	389.6040303	0.044986
Ambarvale ZS	2AMBA11A_LD	Macarthur 66 TS (BSP)	8.007345287	0.077126499	31.2949555	187.6913624	0.014476
Anzac Village ZS	2ANZA11A_LD	Liverpool TS	7.589743852	0.088106296	27.68491286	435.78	0.038395
Appin ZS	2APPI11A_LD	Macarthur 66 TS (BSP)	1.954426835	0.096744142	6.830076959	143.0343807	0.013838
Arndell Park ZS	2ARND11*_LD	Sydney West TS (BSP)	14.37487699	0.261477835	28.90354232	142.98	0.037386
Baulkham Hills 11kV	2BAUL11A_LD	Sydney West TS (BSP)	12.59909495	0.141879764	35.59901684	304.8671854	0.043254
Berrima Junction ZS	2BERJ11A_LD	Fairfax Lane TS	0.47433026	0.019116169	4.610952179	9.986	0.000191
Berry ZS	2BERR11A_LD	Shoalhaven TS	3.459118812	0.137523868	10.061667	220.4053877	0.030311
Blackmans Flat ZS	2BFLA11A_LD	Mount Piper TS (BSP)	2.701428279	0.267000605	5.634891303	186.4302081	0.049777
Blackheath ZS	2BHEA11A_LD	Katoomba North TS	3.003318794	0.197312118	7.254798412	116.8201174	0.023050
Blaxland ZS	2BLAX11A_LD	Warrimoo TS	7.45132969	0.08269254	28.34213824	244.2660131	0.020199
Bolong ZS	2BOLO11A_LD	Shoalhaven TS	1.567299727	0.414598941	2.634080637	60.57818971	0.025116
Bomaderry ZS	2BOMA11A_LD	Shoalhaven TS	8.51385041	0.164914475	22.30141161	221.9160575	0.036597
Bonnyrigg ZS	2BONN11A_LD	West Liverpool TS	11.31974385	0.123981927	33.71330325	158.4142218	0.019641
Bossley Park ZS	2BOSS11A_LD	Blacktown TS	11.33137705	0.133605536	32.41027393	135.2615275	0.018072
Bow Bowling ZS	2BOWB11*_LD	Ingleburn BSP	20.01779977	0.364928725	35.03759879	123.8603382	0.045200
Bowral ZS	2BOWR11A_LD	Fairfax Lane TS	8.945478552	0.193604779	21.67086243	467.5847124	0.090527
Bringelly ZS	2BRIN11A_LD	Macarthur TS (BSP)	4.878650434	0.174975144	12.49102878	392.05	0.068599
Bulli ZS	2BULL11A_LD	Bellambi TS	4.778509221	0.159668949	12.77693234	169.4681491	0.027059
Bella Vista ZS	2BVIS11A_LD	Vineyard TS (BSP)	16.13621585	0.167009356	41.19409666	280.0127468	0.046765
Bylong ZS	2BYLO22A_LD	Ilford TS	0.170896858	0.271329719	0.365944914	2.109126594	0.000572
Cabrarnatta ZS	2CABR11A_LD	Guildford TS	8.195206801	0.214099339	18.37928757	62.08172861	0.013292
Cambridge Park ZS	2CAMP11A_LD	Penrith TS	7.075121585	0.086062457	26.4963913	183.8788937	0.015825
Campbelltown ZS	2CAMP11*_LD	Macarthur 66 TS (BSP)	19.51840278	0.172036987	49.52272206	366.5860191	0.063066
Canley Vale ZS	2CANL11A_LD	Liverpool TS	13.89904941	0.146106246	37.8477212	274.6421469	0.040127
Carramar ZS	2CARR11A_LD	Guildford TS	4.978287568	0.19579996	11.71389329	43.59974452	0.008537
Castle Hill ZS	2CAST11A_LD	Carlingford TS	8.60247635	0.105540728	28.40574927	163.4466675	0.017250
Casula ZS	2CASU11A_LD	Liverpool TS	8.536705943	0.101300255	19.14309524	161.2450076	0.016334
Cattai ZS	2CATI11A_LD	Hawkesbury TS	4.375584796	0.092103812	16.09638494	722.1061034	0.066509
Cawdor ZS	2CAWD11A_LD	Nepean 33 TS	9.746934768	0.113659003	31.45695472	679.8992224	0.077277
Cheriton Avenue ZS	2CHER11*_LD	Vineyard TS (BSP)	9.303500683	0.129749667	27.3380687	259.8373578	0.033714
Chipping Norton ZS	2CHIP11A_LD	Liverpool TS	7.671648736	0.168352685	20.13256069	41.86727483	0.007048
Claremont Meadows ZS	2CMEA11A_LD	Mount Druitt TS	9.113812045	0.126874059	27.32489707	330.14	0.041886
Corrimal ZS	2CORR11A_LD	Bellambi TS	7.346957536	0.173804277	18.40978001	197.2567259	0.034284
Cranebrook ZS	2CRAN11*_LD	Penrith TS	7.005306307	0.133790626	20.50077809	260.7964331	0.034892
Culburra ZS	2CULB11*_LD	West Tomerong TS	4.443157451	0.117807905	14.06164997	1005.645901	0.118473
Dapto ZS	2DAPZ11*_LD	Springhill TS	10.37398149	0.102008597	35.011176742	377.7770595	0.038537
Darkest Forest ZS	2DARK11A_LD	Bellambi TS	0.104640796	0.092522539	0.382154419	7.723890601	0.000715
Dundas ZS	2DOON11A_LD	Sydney West TS (BSP)	12.68388832	0.084535742	48.20995748	499.8057108	0.042251
Dundas ZS	2DUND11*_LD	Carlingford TS	13.12263137	0.134640566	38.47056355	248.4598594	0.033453
Eastern Creek ZS	2ECCR11A_LD	Sydney West TS (BSP)	14.56893784	0.374792568	24.56521932	177.27	0.066439
Edmondson Park ZS	2EDMO11*_LD	Denham Court TS	2.251921215	0.134457765	6.785410847	66.27	0.008911
Emu Plains ZS	2EMUP11A_LD	Penrith TS	11.26806032	0.092585954	39.859459	306.6350183	0.028390
East Richmond ZS	2ERIC11A_LD	Hawkesbury TS	10.25520479	0.161083081	27.08523583	284.951016	0.045901
Fairfield ZS	2FFIE11A_LD	Guildford TS	11.88131831	0.208782605	27.01499584	180.7353354	0.037734
Figtree ZS	2FIGT11A_LD	Springhill TS	8.735607354	0.14159618	24.71315439	238.3426696	0.033748
Gerrigong ZS	2GERR11A_LD	Mount Terry TS	2.728761954	0.158339694	7.26892014	52.27032564	0.008276
Glenmore Park ZS	2GLEN11A_LD	Regentville BSP	9.610809426	0.06060097	44.59598637	345.6136004	0.020945
Glenorie ZS	2GLEO11A_LD	Hawkesbury TS	2.413245674	0.154436615	6.400781202	108.9889304	0.016832
Glossodia ZS	2GLOS11B_LD	Hawkesbury TS	5.234333333	0.080956955	20.70842611	510.0463362	0.041292
Granville ZS	2GRAN11A_LD	Holroyd TS (BSP)	12.92056296	0.184537623	31.15461443	139.6482152	0.025770
Greystanes ZS	2GREY11A_LD	Blacktown TS	5.439014557	0.117617624	16.74918812	142.2945107	0.016736
Hartley Vale ZS	2HART11A_LD	Mount Piper TS (BSP)	0.169510675	0.064355666	0.754692926	54.21243741	0.003489
Hazelbrook ZS	2HAZE11A_LD	Lawson TS	3.77553076	0.163681503	10.17891279	103.2313502	0.016897
Helensburgh ZS	2HELE11A_LD	Bellambi TS	5.030483796	0.250860403	10.40007692	126.9026979	0.031835
Hinchinbrook ZS	2HINC11A_LD	West Liverpool TS	12.0727459	0.069650671	50.76219065	408.0120446	0.028418
Holroyd ZS	2HOLR11A_LD	Blacktown TS	13.69453837	0.126011544	41.01914187	305.01	0.038435
Homepride ZS	2HOME11*_LD	West Liverpool TS	18.02310473	0.288696265	34.5	130.3771734	0.037639
Horsley Park ZS	2HORS11A_LD	Mount Druitt TS	4.585586151	0.303759637	8.943465286	201.69	0.061265
Huntingwood ZS	2HUNT11A_LD	Sydney West TS (BSP)	9.313702502	0.255884433	19.14371212	579.7524	0.148350
Huskisson ZS	2HUSK11A_LD	West Tomerong TS	6.418153689	0.191210532	15.34681309	359.452648	0.068731
Ilford Hall ZS	2ILFH11A_LD	Ilford TS	0.176900546	0.185219304	0.567497242	14.84136185	0.002749
Inner Harbour ZS	2INNE11A_LD	Springhill TS	4.126458607	0.216550517	9.328221747	2.758097061	0.000597
Jamberoo ZS	2JAMB11A_LD	Mount Terry TS	1.080551639	0.146444937	3.045565957	30.79455273	0.004510
Jasper Rd ZS	2JASP11A_LD	Baulkham Hills TS	10.96305214	0.09634844	38.59637289	243.0469723	0.023417
Jordan Springs ZS	2JORD11A_LD	Penrith TS	5.317901867	0.058398056	25.15313102	368.2136022	0.021503
Kandos ZS	2KAND22A_LD	Ilford TS	1.782364413	0.1891465	4.400090908	100.0590117	0.018926
Kangaroo Valley ZS	2KANG11A_LD	Shoalhaven TS	1.035341245	0.174027433	2.61382574	71.0189847	0.012359
Katoomba ZS	2KATO11A_LD	Katoomba North TS	9.33631599	0.235045613	20.02561495	182.5969087	0.042919
Kellyville ZS	2KELL11A_LD	Sydney North TS (BSP)	4.901818318	0.054099785	25.616401	245.6061214	0.013287
Kembla Grange ZS	2KEMB11A_LD	Springhill TS	1.722905588	0.12188132	5.314286	188.4203454	0.022965
Kemps Creek ZS	2KEMP11A_LD	West Liverpool TS	4.948090278	0.21103537	11.67604385	758.6	0.160091
Kenny Street ZS	2KENN11A_LD	Springhill TS	6.17784863	0.157076547	17.41379326	26.53785586	0.004168
Kenthurst ZS	2KHUR11A_LD	Sydney North TS (BSP)	7.916031459	0.123654007	25.00352263	621.516929	0.076853
Kiama ZS	2KIAM11C_LD	Mount Terry TS	5.600514278	0.174118934	14.15579475	187.3680188	0.032624
Kingswood ZS	2KING11*_LD	Penrith TS	16.48644173	0.154409102	44.13508176	522.05	0.080609
Kentlyn ZS	2KLYN11A_LD	Macarthur 66 TS (BSP)	12.5136607	0.136655073	36.2825708	322.608817	0.044086
Kurrajong ZS	2KURR11A_LD	Hawkesbury TS	4.316740574	0.105012193	14.89430641	412.3365431	0.043300
Leabons Lane ZS	2LEAB11A_LD	Blacktown TS	9.582160137	0.17528249	23.93658288	103.3793862	0.018121
Lennox ZS	2LENN11A_LD	Camellia TS	7.954909338	0.194688502	20.95674914	69.67	0.013564
Lithgow ZS	2LITH11A_LD	Wallerawang TS (BSP)	8.544011329	0.293943885	16.44152775	270.6203988	0.079547
Liverpool 11kV	2LIV211A_LD	Liverpool TS	17.6010525	0.23092869	37.77444268	199.53	0.046077
Luddenham ZS	2LUDD11A_LD	Regentville BSP	2.680199454	0.129203831	8.13794667	492.3383576	0.063612

Macquarie Fields ZS	2MACQ11A_LD	Ingleburn BSP	12.14404434	0.174017935	30.83843605	199.4209619	0.034703
Maldon ZS	2MALD11A_LD	Nepean 66 TS	9.042315574	0.135846362	25.69345442	471.9442345	0.064112
Mamre ZS	2MAMR11*_LD	Sydney West TS (BSP)	24.67976434	0.204465963	56.26944108	499.1959138	0.102069
Marayong ZS	2MARA11*_LD	Blacktown TS	15.17155538	0.26775124	30.83458196	206.10417	0.055185
Meadow Flat ZS	2MFLA11A_LD	Wallerawang TS (BSP)	0.60241291	0.269280098	1.224021176	25.32517178	0.006820
Minto ZS	2MINT11*_LD	Ingleburn BSP	27.44276231	0.208942097	61.98265887	468.61	0.097912
Mittagong ZS	2MITT11A_LD	Fairfax Lane TS	7.722464822	0.18901743	19.11462895	581.08	0.109834
Moorebank ZS	2MOOR11A_LD	Liverpool TS	12.24555739	0.27508705	24.36715588	50.63782073	0.013930
Moss Vale ZS	2MOSS11A_LD	Fairfax Lane TS	9.265756357	0.272762251	18.81962776	560.91	0.152995
Mount Ousley ZS	2MTOU11A_LD	Bellambi TS	9.350635246	0.238813074	19.71655142	85.4326262	0.020402
Mungerie Park ZS	2MUNG22A_LD	Vineyard TS (BSP)	19.48936248	0.070151299	82.74846706	587.64	0.041224
Narellan ZS	2NARE11*_LD	Nepean 66 TS	19.59909836	0.102420335	65.8182224	519.8521174	0.053243
North Eastern Creek ZS	2NECK11A_LD	Sydney West TS (BSP)	7.119680669	0.292880928	14.06164997	102.5624	0.030039
Nepean 11kV	2NEPZ11A_LD	Nepean 66 TS	8.640579463	0.057220266	40.39034538	658.02	0.037652
Newton ZS	2NEWV11A_LD	Blacktown TS	11.1901715	0.213607011	28.13086083	123.6954419	0.026422
Northmead ZS	2NMEA11A_LD	Baulkham Hills TS	8.793203552	0.159953063	22.91069619	158.0977586	0.025288
Nowra ZS	2NOWR11A_LD	Shoalhaven TS	9.872782901	0.175061894	24.41823089	257.4202131	0.045064
North Parramatta ZS	2NPAR11A_LD	Holroyd TS (BSP)	14.20946743	0.181791968	34.60105456	149.3413893	0.027149
North Richmond ZS	2NRIC11A_LD	Hawkesbury TS	6.273933852	0.147502208	17.06447007	392.8563086	0.057947
North Rocks ZS	2NROC11A_LD	Baulkham Hills TS	7.747309908	0.122633753	23.63082248	115.9065524	0.014214
North Warragamba ZS	2NWAR11A_LD	Regentville BSP	3.907468995	0.109411728	13.1041978	335.4282072	0.036700
North Wollongong ZS	2NWOL11A_LD	Springhill TS	7.052298361	0.30260545	13.49918398	78.88164718	0.023870
Oakdale ZS	2OAKD11A_LD	Nepean 33 TS	0.762288093	0.074037433	3.084380122	59.30024645	0.004390
The Oaks ZS	2OAKS11A_LD	Nepean 33 TS	2.429141052	0.091529632	8.973850901	196.7514521	0.018009
Oran Park ZS	2ORPK11A_LD	Macarthur TS (BSP)	7.566865893	0.048137317	40.04722213	674.63	0.032475
Parklea ZS	2PARK22A_LD	Vineyard TS (BSP)	8.891336521	0.052421622	46.86149806	482.3442224	0.025285
Port Central ZS	2PCEN11A_LD	Outer Harbour TS	5.019535633	0.21825155	11.7030135	86.13609456	0.018799
Penrith 11kV	2PENZ11A_LD	Regentville BSP	19.03413053	0.210211127	43.68672567	206.4073166	0.043389
Port Kembla ZS	2PKEM11A_LD	Springhill TS	6.367981557	0.262994555	13.02305648	168.610441	0.044344
Portland ZS	2PLAN11A_LD	Wallerawang TS (BSP)	1.097454918	0.167679057	2.967495914	17.01850498	0.002854
Plumpton ZS	2PLUM11A_LD	Mount Druitt TS	11.77718233	0.117891091	37.01362954	256.2157531	0.030206
Prestons ZS	2PRES11A_LD	West Liverpool TS	7.972513661	0.059922357	36.48315776	310.59	0.018611
Prospect ZS	2PROS11A_LD	Blacktown TS	12.41332698	0.251508704	25.43902184	179.0101177	0.045023
Quakers Hill ZS	2QUAK11*_LD	Sydney West TS (BSP)	19.97180943	0.0899117	72.26353769	314.277525	0.028257
Quarries ZS	2QUAR11A_LD	Blacktown TS	12.33264344	0.238419466	25.93110873	215.29	0.051329
Ringwood ZS	2RING11A_LD	Fairfax Lane TS	3.11725296	0.19549967	7.516648189	306.2590431	0.059874
Riverstone ZS	2RIVE11*_LD	Hawkesbury TS	7.026611851	0.177040441	17.96431467	151.2161548	0.026771
Robertson ZS	2ROBE11A_LD	Fairfax Lane TS	2.432726117	0.272731841	4.902033228	177.2767643	0.048349
Rooty Hill ZS	2ROOT11*_LD	Sydney West TS (BSP)	14.42061305	0.173791335	35.9724281	260.9150367	0.045345
Rosehill ZS	2ROSE11A_LD	Camellia TS	11.78607411	0.418670089	18.63249849	260.39	0.109018
Russell Vale ZS	2RUSS11*_LD	Bellambi TS	3.215798611	0.119468433	9.8	198.040612	0.023660
Rydalmere ZS	2RYDA11*_LD	Carlingford TS	16.21606045	0.18930654	38.80115978	244.7052567	0.046324
Schofields ZS	2SCHOI1*_LD	Vineyard TS (BSP)	7.367403802	0.063276757	32.73316361	456.89	0.028911
Seven Hills ZS	2SEVE11*_LD	Baulkham Hills TS	8.693336895	0.202875349	21.72475666	99.18306601	0.020122
South Granville ZS	2SGRA11A_LD	Guildford TS	7.537667919	0.147929192	20.76944872	125.8287581	0.018614
Shellharbour ZS	2SHEL11A_LD	Mount Terry TS	12.84663483	0.148788718	34.7	380.4709978	0.056610
Sherwood ZS	2SHER11A_LD	Guildford TS	8.792470287	0.11628746	27.81178829	107.0496902	0.012449
South Erskine Park ZS	2SERS22A_LD	Sydney West TS (BSP)	14.56893784	0.374792568	24.56521932	42.37470347	0.015882
South Leppington ZS	2SLEP11A_LD	Macarthur TS (BSP)	2.738230874	0.050624668	13.86217876	227.81	0.011533
South Marsden Park ZS	2SMAR11*_LD	Vineyard TS (BSP)	4.371422996	0.189123317	10.72800075	109.95	0.020794
Smithfield ZS	2SMIT11*_LD	Guildford TS	13.40614754	0.122291252	40.23070469	230.6285988	0.028204
South Nowra ZS	2SNOW11A_LD	West Tomerong TS	3.942881944	0.172203619	10.21077862	124.7459626	0.021482
Springwood ZS	2SPRW11*_LD	Warrimoo TS	8.689732877	0.107104296	29.07441879	348.76	0.037354
St Marys ZS	2STMA11A_LD	Mount Druitt TS	11.19992501	0.120050663	33.88049769	227.9760655	0.027369
Sussex Inlet ZS	2SUSS11*_LD	West Tomerong TS	2.174748233	0.108043698	7.052570097	152.3688941	0.016462
South Windsor ZS	2SWIN11A_LD	Hawkesbury TS	14.30931808	0.200934724	33.86384503	562.9800934	0.113122
South Wollongong ZS	2SWOL11A_LD	Springhill TS	6.673542623	0.223524774	14.58656741	70.34441557	0.015724
Tahmoor ZS	2TAHM11A_LD	Nepean 66 TS	6.783367486	0.141418812	19.05696723	676.6856593	0.095696
Tomerong ZS	2TOME11A_LD	West Tomerong TS	3.591342213	0.13832277	10.70566205	602.535862	0.083345
Ulladulla ZS	2ULLA11C_LD	Dapto BSP	10.54057714	0.139709509	30.03097095	1650.573533	0.230601
Unanderra ZS	2UNANI1*_LD	Springhill TS	7.201827049	0.304286341	13.70765037	112.529912	0.034241
Warilla ZS	2WARI11A_LD	Mount Terry TS	8.563952869	0.212324646	19.7403465	266.1603441	0.056512
West Castle Hill ZS	2WCAS11*_LD	Vineyard TS (BSP)	5.82697213	0.151873252	15.90894088	261.0606811	0.039648
Wentworth Falls ZS	2WENT11A_LD	Katoomba North TS	2.977954098	0.183115156	7.458602293	94.59376849	0.017322
Werrington ZS	2WERR11A_LD	Mount Druitt TS	17.61178962	0.262067986	35.52	427.0020809	0.111904
Westmead ZS	2WESM11A_LD	Baulkham Hills TS	4.535956602	0.215551115	10.17535229	95.02684402	0.020483
Wetherill Park ZS	2WETH11*_LD	Sydney West TS (BSP)	17.95934224	0.19588938	50.07290324	136.88	0.026813
Whalan ZS	2WHAL11A_LD	Mount Druitt TS	11.43519467	0.155964862	30.11384399	163.413024	0.025487
Wilton ZS	2WILT11A_LD	Nepean 66 TS	1.096185109	0.062580345	4.937894288	52.60992849	0.003292
Windsor ZS	2WIND11A_LD	Hawkesbury TS	7.637690688	0.117180604	24.38237068	316.9658522	0.037142
Wisemans ZS	2WISE11A_LD	Hawkesbury TS	1.821771175	0.151258653	5.234971633	285.3864667	0.043167
West Liverpool 11kV	2WLIZ11A_LD	West Liverpool TS	12.33957423	0.136806434	35.33624202	173.9658535	0.023800
Wombarra ZS	2WOMB11A_LD	Bellambi TS	2.303057263	0.128108846	6.989277502	165.2390766	0.021169
Woodpark ZS	2WOOD11A_LD	Guildford TS	8.748844803	0.232597402	20.81431953	52.22034851	0.012146
West Parramatta ZS	2WPAM11A_LD	Holroyd TS (BSP)	21.34058609	0.195686992	52.14029152	130.41	0.025520
West Pennant Hills ZS	2WPEN11A_LD	Carlingford TS	7.252043716	0.085218004	27.6978301	117.6945794	0.010030
West Wetherill Park 11kV	2WWET11A_LD	Sydney West TS (BSP)	10.95460496	0.218423627	27.22737593	98.10596699	0.021429
West Wollongong ZS	2WWOL11*_LD	Springhill TS	5.841288545	0.21039949	13.3002594	130.6766505	0.027494
Yatte Yattah ZS	2YATT11A_LD	West Tomerong TS	1.233270313	0.090397405	4.723243235	217.2939129	0.019643
Yennora ZS	2YENN11A_LD	Guildford TS	8.719857582	0.211870302	19.65613187	128.1001699	0.027141

Appendix D – Calculation of Losses for Distribution Substations

Rating (kVA)	No. in service	Total Losses (MW)	Assumed LLF	Avg full load series loss %	Avg full load series loss kW	Utilisation Factor	Series losses per tfr (kW)	Total Series Loss (MW)	No load Loss %	No load loss per tfr (kW)	Total No Load Losses (MW)
0	3	-	0.21	1.50%	0	50.00%	-	-	0.50%	0	0.0000
3	0	-	0.21	1.50%	0.045	50.00%	0.00	-	0.50%	0.015	0.0000
5	76	0.0022	0.21	1.50%	0.075	50.00%	0.00	0.00030	0.50%	0.025	0.0019
6	0	-	0.21	1.50%	0.09	50.00%	0.00	-	0.50%	0.03	0.0000
8	0	-	0.21	1.50%	0.1125	11.00%	0.00	-	0.50%	0.0375	0.0000
10	555	0.0340	0.21	1.50%	0.15	60.00%	0.01	0.00629	0.50%	0.05	0.0278
15	353	0.0325	0.21	1.50%	0.225	60.00%	0.02	0.00600	0.50%	0.075	0.0265
16	415	0.0407	0.21	1.50%	0.24	60.00%	0.02	0.00753	0.50%	0.08	0.0332
20	10	0.0012	0.21	1.20%	0.24	65.00%	0.02	0.00021	0.50%	0.1	0.0010
23	7	0.0011	0.21	1.20%	0.276	81.00%	0.04	0.00027	0.50%	0.115	0.0008
25	3515	0.5510	0.21	1.20%	0.3	71.00%	0.03	0.11163	0.50%	0.125	0.4394
30	0	-	0.21	1.20%	0.36	60.00%	0.03	-	0.50%	0.15	0.0000
50	1162	0.3381	0.21	1.20%	0.6	57.00%	0.04	0.04757	0.50%	0.25	0.2905
55	0	-	0.21	1.20%	0.66	54.60%	0.04	-	0.40%	0.22	0.0000
58	7	0.0020	0.21	1.20%	0.696	60.00%	0.05	0.00037	0.40%	0.232	0.0016
63	1685	0.5332	0.21	1.20%	0.756	63.70%	0.06	0.10855	0.40%	0.252	0.4246
75	5	0.0019	0.23	1.20%	0.9	60.00%	0.07	0.00037	0.40%	0.3	0.0015
100	2703	1.3427	0.23	1.20%	1.2	59.20%	0.10	0.26146	0.40%	0.4	1.0812
110	10	0.0041	0.23	1.10%	1.21	54.70%	0.08	0.00083	0.30%	0.33	0.0033
150	398	0.2483	0.23	1.10%	1.65	67.70%	0.17	0.06923	0.30%	0.45	0.1791
160	139	0.0870	0.23	1.10%	1.76	60.00%	0.15	0.02026	0.30%	0.48	0.0667
200	2680	2.1126	0.23	1.10%	2.2	61.00%	0.19	0.50460	0.30%	0.6	1.6080
220	9	0.0076	0.23	1.00%	2.2	61.00%	0.19	0.00169	0.30%	0.66	0.0059
250	746	0.7900	0.23	1.00%	2.5	73.30%	0.31	0.23047	0.30%	0.75	0.5595
260	1	0.0009	0.23	1.00%	2.6	63.10%	0.24	0.00024	0.25%	0.65	0.0007
300	3538	3.7234	0.23	1.00%	3	66.20%	0.30	1.06985	0.25%	0.75	2.6535
315	3135	3.3090	0.23	0.95%	2.9925	62.40%	0.27	0.84017	0.25%	0.7875	2.4688
400	1470	1.7727	0.23	0.95%	3.8	48.54%	0.21	0.30271	0.25%	1	1.4700
500	7074	11.2561	0.23	0.90%	4.5	57.42%	0.34	2.41363	0.25%	1.25	8.8425
600	46	0.0807	0.23	0.90%	5.4	45.35%	0.26	0.01175	0.25%	1.5	0.0690
750	270	0.6006	0.23	0.90%	6.75	47.44%	0.35	0.09435	0.25%	1.875	0.5063
800	26	0.0661	0.23	0.90%	7.2	57.13%	0.54	0.01405	0.25%	2	0.0520
910	0	-	0.23	0.90%	8.19	52.19%	0.51	-	0.25%	2.275	0.0000
1000	2646	9.8878	0.23	0.90%	9	77.30%	1.24	3.27280	0.25%	2.5	6.6150
1500	555	2.4284	0.23	0.90%	13.5	44.88%	0.63	0.34710	0.25%	3.75	2.0813
2000	0	-	0.23	0.90%	18	55.00%	1.25	-	0.25%	5	0.0000
2500	0	-	0.23	0.90%	22.5	52.36%	1.42	-	0.25%	6.25	0.0000
3000	19	0.1782	0.23	0.90%	27	55.00%	1.88	0.03569	0.25%	7.5	0.1425
5000	0	-	0.23	0.90%	45	56.21%	3.27	-	0.25%	12.5	0.0000
10000	0	-	0.23	0.90%	90	38.93%	3.14	-	0.25%	25	0.0000
Total	33258	39.4339						9.7800			29.65