SA Power Networks

Distribution Loss Factor Methodology

February 2026

Contents

1. Introduction

SA Power Networks is responsible for determining the distribution loss factors (**DLFs**) for the connection points to its distribution network. These loss factors describe the average electrical energy losses for the electricity conveyed between the point of connection to the transmission network and the point of connection to the distribution network. The DLFs apply to all loads and embedded generators connected to the distribution network.

The National Electricity Rules (**NER or Rules**)[1] set out the requirements for the calculation of DLFs and the processes leading to their approval by the Australian Energy Regulator (**AER**) and implementation in the market settlements by the Australian Energy Market Operator (**AEMO**).

Prior to the publication of the 2010/11 DLFs, SA Power Networks developed a methodology that was reviewed by the Electricity Supply Industry Planning Council (**ESIPC**). At the time, ESIPC were the authorised body for determining loss factors, until a derogation ceased in December 2002. In subsequent years, the Essential Services Commission of South Australia (**ESCoSA**) annually certified to the AER that SA Power Networks had followed the methodology in preparing proposed DLFs. In 2003, ESCoSA required a balance of under/over-recovery of losses through DLFs to be maintained.

In March 2009, following changes to the jurisdictional regulatory responsibilities in South Australia, ESCoSA advised the AER that it would no longer review SA Power Networks' DLFs. An independent audit of the proposed loss factors is now carried out.

The AER has not developed a methodology for the calculation of distribution losses for South Australia. This document sets out the methodology that has been developed, published and will be maintained by SA Power Networks, in compliance with the NER.[2] This approach is consistent with that which has historically been used for the calculation of DLFs by SA Power Networks and ESCoSA.

This document is published and available on SA Power Networks website:

https://www.sapowernetworks.com.au/

This document is also made available upon request to interested persons.

1 NER 3.6.3

2 NER 3.6.3 (g)(2)

2. Summary of the National Electricity Rule requirements

The following is a summary of the relevant sections of the NER[3] concerning the calculation of distribution losses. In SA Power Networks' case, there are several simplifying factors that act to reduce the number of applicable rule provisions. These are as follows:

- there are no market network service providers using SA Power Networks distribution network;[4]
- SA Power Networks has a single distribution pricing zone for South Australia;[5] and
- no embedded generator with a capacity of less than 10MW or 40GWh has requested SA Power Networks to provide a site-specific loss factor.[6]

Distribution loss factor requirements

DLFs are required for each connection to the distribution network,[7] and are to be determined as follows:

- a site-specific DLF is required for each embedded generator with a capacity of greater than 10MW;
- a site-specific DLF is also required for a customer connection point with a demand of greater than 10MW or energy consumption greater than 40GWh pa; and
- for smaller customers, DLFs are the volume weighted average of the average losses for customers of different connection voltages and patterns of consumption.

Assignment of distribution connection points

For the purpose of DLF calculations, all connection points to the distribution network must be assigned to a transmission connection point (**TCP**) or a virtual transmission node (**VTN**), which represents the volume weighted average of a number of transmission connection points. This is the case for both site-specific and non-site-specific connections as covered by the Rules.[8]

General principles applying to the distribution loss calculation

The methodology for determining DLFs must have regard to a number of principles, as set out in the Rules.[9] The relevant principles are summarised as follows:

1. For the financial year in which DLFs are to apply, the aggregate of the loss-adjusted energy delivered into the distribution network should, as closely as reasonably practicable, equal the sum of the energy delivered to connection points to the distribution network and the losses taking place on the network.

2. Provision is required for a reconciliation of the previous year's aggregate of loss-adjusted energy delivered into the distribution network, with the sum of energy delivered to connection points to the distribution network and the losses taking place on the network.

3. For non-site-specific connection points, the DLF represents the volume weighted average of the average electrical energy loss between the assigned TCP or VTN and each distribution network connection point in the relevant class of distribution network connection points.

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[3] NER 3.6.3
[4] NER 3.6.3(b)(2)(i)(C) and 3.6.3(h)(6)
[5] NER 3.6.3(e)(2)
[6] NER 3.6.3(b1)
[7] NER 3.6.3(b)(2)
[8] NER 3.6.3(c) to 3.6.3(f)
[9] NER 3.6.3(h)

4. For a site-specific connection point, the DLF represents the average electrical energy loss between the assigned TCP or VTN and the distribution connection point.

5. The most recent 12 months of actual load and generation data are used to determine the average electrical energy losses referred to in points 3 and 4 above, adjusted if necessary to take into account projected load and or generation growth in the financial year in which DLFs are to apply.

3. SA Power Networks distribution loss factor methodology

SA Power Networks' DLF methodology has been established in compliance with the provisions of the NER and having due regard to the applicable principles (outlined in section 2 above). The methodology contains the following main stages:

Stage 1: The assignment of distribution connection points to TCP and the VTN.

Stage 2: Calculation of the actual system losses historically taking place on the distribution network.

Stage 3: Calculation of the system losses and DLFs for site-specific distribution connection points.

Stage 4: Allocation of the losses and DLFs associated with non-site-specific distribution connection points.

Stage 5: Reconciliation of actual system losses, any balance of past over/under recovery of losses and those arising from the application of proposed DLFs.

The stages of this methodology are described in this section.

Stage 1: Assignment of distribution connection points

The AER approved SA Power Networks' definition of a VTN for South Australia prior to the commencement in 2003 of Full Retail Contestability (**FRC**) in South Australia. The South Australian VTN (identified as SJP1) includes all load transmission connection points, with the exception of the following two transmission connections points:

- Snuggery Industrial, as nearly its entire capacity services an industrial facility at Millicent; and
- Whyalla MLF, as its entire capacity services an industrial plant in Whyalla.

SA Power Networks assigns its customers to the TCP or VTN in accordance with this approved arrangement, as follows:

- all site-specific connection points are assigned to a TCP, taking into account the normal network connections and predominant energy flows;
- customer and generator connections with an energy consumption or export exceeding 160 MWh pa are assigned to a TCP, taking into account the normal network connection and predominant energy flows; and
- customer and generator connections with energy consumption or export not exceeding 160 MWh pa are assigned to the VTN.

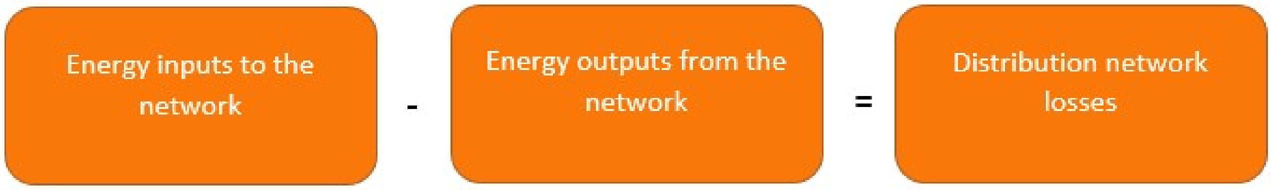
This arrangement is in accordance with the Rules[10] and the AER's approval of a VTN for South Australia.

10 NER 3.6.3(c) to 3.6.3(f)

Stage 2: Calculation of historical system losses on the distribution network

The second stage of the process of determining distribution losses is the calculation of the actual distribution losses. This is the difference between the energy inputs to the network and the energy outputs from the network. This equation is represented in Figure 1.

Figure 1: Loss balance for the distribution network



This calculation may only be carried out several months after the completion of each financial year, because of the significant proportion of customer premises that are equipped with accumulation meters and have a three-monthly meter reading and billing cycle. Generally, by December each year, the quantum of accrued sales has diminished to a sufficient level to permit this calculation to be performed with acceptable accuracy.

Energy inputs to the network

There are two categories of energy inputs at connections to SA Power Networks' distribution network, as follows:

- connection points to the transmission network; and
- connections to embedded generators at different locations and voltages.

These are described in the follow sections.

Connection points to the transmission network

There are approximately 50 points at which SA Power Networks' distribution network is connected to ElectraNet's transmission network (TCP). These operate at voltages of 33 to 132 kV. Each of these connection points is equipped with interval metering, which is used for market settlements.

The interval data derived from the meters is aggregated to provide a half-hourly record of the total energy input to the SA Power Networks' network through its TCP.

Embedded generators

There are effectively two classes of embedded generators, from which energy is exported to the distribution network:

- embedded generators equipped with interval meters at all locations where site-specific loss factors apply, as well as some smaller generators with non-site-specific DLFs. For these generators, interval data is available; and
- smaller embedded generators connected to the low voltage network, such as solar photovoltaic (**PV**), are not necessarily equipped with interval meters and their accumulation meters are generally read on a three-monthly or one-monthly schedule, in a similar manner to small customers. The estimate of annual energy generated from these sources requires an accrual estimate, for consumption taking place between meter reading dates.

The outputs of all embedded generators are adjusted by their respective DLF, to reflect their equivalent input into SA Power Networks' distribution network at the TCP level.

The total energy input to the network is the sum of energy conveyed through the TCPs and the distribution loss-adjusted inputs of the generators.

Energy outputs from the network

As with embedded generators, there are different classes of customer connected to the network. From the perspective of determining the total energy delivered by the network, the following groupings apply:

- major customers are equipped with interval meters at all locations where site-specific DLFs apply. Large customers have interval meters and use non-site-specific DLFs. As well, there are an increasing number of smaller interval metered customers at connections with non-site-specific DLFs. For these customers interval data is available;
- a declining number of smaller customers are equipped with accumulation meters, of which the majority are read on a three-monthly basis. A proportion of these accumulation meters are read monthly. For these customers, estimating the energy consumption which has taken place within a given year requires an apportionment of the consumption recorded at adjacent meter readings.
- there is a diverse range of unmetered connections to the network, such as public lighting, traffic lights, cable television and repeater installations, bus shelters and advertising signs. The consumption of these connections is estimated from their typical demand profile and the number of installations.

The total energy outputs of the network are the aggregate of the energy delivered to the groupings of customers above.

Historical losses in the distribution network

The historical calculation of the actual losses in SA Power Networks' distribution network is illustrated in Table 1. The steady increase in embedded generation may be observed during recent years.

Table 1: Distribution network losses – GWh

	Energy Inputs to the Distribution Network				Losses	
Year	ElectraNet	Embedded Generation[11]	Total	Energy Delivered	GWh	% of Input
2020/21	8,765	1,731	10,496	9,666	830	7.90%
2021/22	8,542	2,097	10,639	9,774	864	8.12%
2022/23	8,481	2,199	10,681	9,809	872	8.17%
2023/24	7,907	2,446	10,353	9,729	624	6.03%
2024/25	7,977	3,007	10,985	10,006	979	8.91%

There is a noticeable annual variation in the percentage of distribution network losses. The longer term average of losses since 2020/21 is 7.83%. This arises in part because of the continued low amount of energy delivered by ElectraNet and record Embedded Generation 2024/25.

11 Includes an adjustment for the distribution losses of embedded generators.

Stage 3: Calculation of system losses for site-specific distribution connection points

This third stage in the DLF process involves the calculation of the distribution losses that are attributable to site-specific customer and generator connections. In addition, there are two high voltage connections to the Powercor distribution network, on the eastern boundary of SA Power Networks' network.

These site-specific calculations are amendable to being directly estimated using the engineering calculations which are routinely employed in the planning and design of the network.

The two high voltage connections between SA Power Networks and Powercor are as follows:

- Berri-Paringa-Border; and
- Blanche-Allendale East-Border.

In 2004, in accordance with the approach preferred by AEMO[12] DLFs were determined for these two connections. The DLFs apply between the associated TCP (at Berri and Blanche respectively) and the border metering locations. These arrangements continue to apply.

Major customers and generators

The method of calculation of individual DLFs for major customers and generators is outlined below. These calculations are site-specific, accounting for the electrical characteristics, configuration and loading on the relevant portion of the distribution network.

These major customers and generators are all connected at voltage levels of 11 kV or higher. Each also has an interval meter for the purpose of market settlements, and the historic interval data for the previous financial year may be used to determine the electrical losses taking place in the network.

SA Power Networks' approach to establishing site-specific DLFs employs the most recent consecutive 12 months of data wherever it is available. If this data is not available, a projection of data is made, in accordance with the terms of the relevant connection agreement.

A loss load factor (LLF) is determined for the relevant parts of the network associated with each site. This is calculated as the average of the square of every half-hourly load reading, expressed as a percentage of the square of peak half-hourly demand. This factor represents the ratio of the average loss to the peak loss and is used to determine total annual energy losses in the relevant parts of the network.

The losses occurring in different portions of the distribution network are then calculated, as follows. The DLF for a customer connection at 11kV will contain components of loss for each of the relevant upstream higher voltage networks.

Subtransmission system losses (66 kV meshed lines)

- A standard system load flow model is used to determine the portion of 66 kV network losses attributable to the customer's load or generation at the time of system peak load. This is done using two studies. For customer's load, a "5% method" is used, analysing a 5% reduction of the customer connection and a 5% reduction of the relevant network area. For customer's generation, one study consists of the generator(s) on at a typical output and the other is with the generator(s) off.
- The DLF for subtransmission-connected customers is determined as the percentage of lost energy attributable to the customer to the total energy at the customer's load or generator connection.

[12] Previously National Electricity Market Management company (NEMMCo)

Subtransmission system losses (33 kV radial lines)

- The DLF for 33 kV connected customers comprises losses for the 33 kV system to the load connection plus (if necessary) upstream losses for the relevant point of connection to the 66 kV subtransmission network.
- The load data for relevant 33 kV system is used in conjunction with load flow studies to calculate the energy lost in the 33 kV system.
- As with 66 kV connected customers, the 33kV subtransmission DLF is calculated as the percentage of lost energy attributable to the customer to total energy supplied at the specified substation.

Substation losses

- Where applicable, load data for each substation is used to calculate the DLF as the percentage of lost energy to total energy supplied by the substation.
- An adjustment to the customer DLF is made to include transformer no load losses and auxiliary equipment losses within the substation.

HV feeder losses

- The DLF for 11 kV connected customers includes a proportion of the upstream losses from the relevant point of connection to the transmission connection point. This can include losses for the 66 kV and/or the 33 kV subtransmission networks, the zone substation and the 11 kV system.
- For customers connected via dedicated high voltage (HV) feeders, load data for each feeder is used to calculate this DLF component as the percentage of the lost energy to total energy supplied from that feeder.

These individual calculations are reviewed whenever a material change takes place to any of the following:

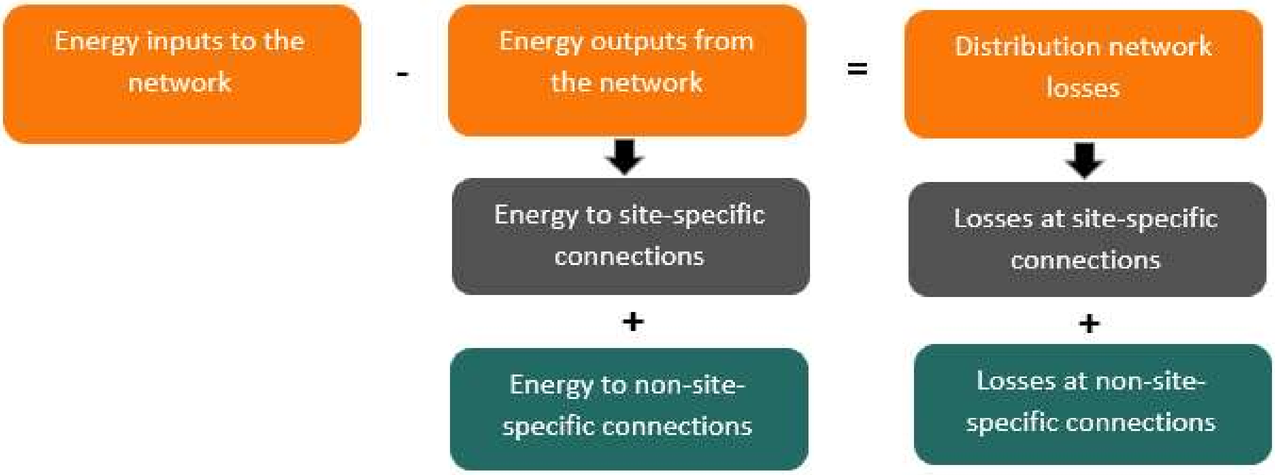
- the customer’s (or generator’s) circumstance or load characteristics;
- the background load of other customers on the local network; or
- the configuration or equipment installed on the local network, e.g. the addition of new transformers or changes to subtransmission systems.

Stage 4: Allocation of system losses with non-site-specific distribution connection points

The final stage in the determination of DLFs is the allocation of the remaining losses, after the determination of the site-specific consumption and loss factors, to the non-site-specific classes of customers and embedded generators.

The extension of the equation in Figure 1 is presented in Figure 2. The quantities determined in the two earlier stages are shaded in orange and grey and the quantities derived in this stage are shaded in green.

Figure 2: Distribution losses at non-site-specific connections



The aggregate energy delivered to non-site-specific customer connections and the aggregate loss associated with those connections is thereby calculated by subtraction of the site-specific quantities from the totals for the distribution network.

Energy losses for the year are factored into the adjustments necessary to DLFs to return the closing balance towards zero each year. Starting in 2022/23 SA Power Networks considered only those energy losses incurred within the year to be factored into the DLFs rather than also incorporating the cumulative closing balance from previous years into the calculation to achieve a zero balance. This methodology will continue forwards.

SA Power Networks' selection of non-site-specific customer classes

The NER[13] requires the non-site-specific customer connections to be assigned to classes based on their location, voltage of connection and consumption pattern. SA Power Networks has met this requirement by assigning non-site-specific customer connections to the voltage and consumption classes set out in Table 2.

Table 2: Non-site-specific customer classes

Connection Class	Voltage	Type of customer connection
NLV2	Low voltage	Residential, small business, unmetered, controlled load, PV and micro generation. Typically, the residential and small business tariff classes.
NLV1	Low voltage	Large LV business
NHV1	High voltage	Large HV business, HV connected embedded generation (e.g. landfill gas)
NZS1	High voltage substation connection	Major business below 10 MW or 40 GWh pa
NST1	High voltage sub-transmission connection	Major business below 10 MW or 40 GWh pa

13 NER 3.6.3(d)(2)

DLFs for non-site-specific customer classes

The allocation of distribution losses to the non-site-specific customer classes is covered by the NER[14]. Specifically, the volume weighted average of the average energy losses between the VTN and TCP is assigned to the distribution connections in each customer class.

The relativity between the DLFs at each voltage level has been determined by SA Power Networks by reference to other Australian utilities with similar network characteristics. This relativity has been reviewed and approved by ESIPC prior to 2002 and subsequently by ESCoSA to 2009.

In 2026 SA Power Networks again considered the DLF relativities of DNSPs in Queensland and Victoria as their network characteristics are considered to be similar to SA Power Networks. Review of the 2025/26 published DLFs for these DNSPs informed SA Power Networks allocation of distribution losses to the non-site-specific customer classes. With the increase in total distribution losses, the impact of this reform was to increase all voltage steps with LV Line and LV Distribution Transformer DLFs having the largest increase given that in 2025/26 they have seen the largest decreases.

Large LV scale businesses are assumed to take supply directly from (or adjacent to) a distribution transformer. It is assumed that supply to these customers do not utilise LV lines and therefore do not incur LV line losses. Small businesses are assumed to incur LV line losses.

Stage 5: Reconciliation of system losses

SA Power Networks is required by the NER[15] to undertake a reconciliation of the gross energy amounts with actual network losses, with the gross energy amounts arising from the application of the DLFs.

An example of SA Power Networks compliance with this rule is presented in Table 3 below. The two gross energy amounts to be reconciled are in columns labelled (A) and (B). It may be observed that as minor changes have been made to the non-site-specific DLFs from time to time, the losses determined from DLFs are maintained within approximately 10% of the actual loss. This is notwithstanding the significant annual variation in actual losses that is demonstrated in Table 1.

Table 3: Reconciliation of actual and DLF losses – GWh

Year	Energy Inputs (A)	Energy Outputs			Balances		
		Customer Loads	DLF Losses	Total (B)	Annual (A-B)	Opening	Closing
2020/21	10,496	9,666	814	10,480	15	129	144
2021/22	10,639	9,774	911	10,685	(47)	144	97
2022/23	10,681	9,809	826	10,635	46	97	144
2023/24	10,353	9,729	849	10,578	(225)	144	(82)
2024/25	10,985	10,006	892	10,897	87	(82)	5

The reconciliation in Table 3 highlights the annual movement which contributes to the closing balance of the over/under recovery for any given year.

An annual reconciliation and independent assessment of SA Power Networks DLF calculations, in line with the methodology presented in this document, are provide to the AER for approval each year.

14 NER 3.6.3(d)(2) and NER3.6.3(e)(2)
15 NER 3.6.3(h)(2)

4. Distribution loss factors

Once approved by the AER, DLFs are published in AEMO's Annual Distribution Loss Factors Report.

5. Glossary/Shortened Forms

Abbreviation	Definition or Description
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
Demand	Energy consumption at a point in time.
DLF	Distribution loss factor, the adjustment for average energy losses used for connection points to the distribution network.
Distribution Network	The assets and service that link energy customers to the transmission network.
DNSP	Distribution Network Service Provider
ESCoSA	Essential Services Commission of South Australia
ESIPC	Electricity Supply Industry Planning Council
High Voltage	Operating voltage of 11 kV.
LLF	Loss load factor
Low Voltage	Equipment or supply at a voltage of 230 V single phase or 400 V three phase.
NEM	National Electricity Market
NER/Rules	National Electricity Rules
Retailer	A market participant (business) supply electricity to customers.
Sub transmission	Equipment or supplies at voltage levels of 66 or 33 kV.
ToU	Time of Use, a system of pricing where energy or demand charges are higher in peak periods.
Transmission Network	The assets and services that enable generators to transmit their electrical energy to population centres. Operating voltage of equipment is 500, 275, 132 and some at 66 kV.
TCP	Transmission connection point, a point at which the distribution network is connected to the transmission network.
Unmetered supply	A connection to the distribution system that is not equipped with a meter and has estimated consumption. Connections to the public lights, phone boxes, traffic lights and the like are not normally metered.
VTN	Virtual transmission node, a construct used for the market settlement of distribution connection points, which represents the volume weighted average of several constituent transmission connection points.