TasNetworks

Distribution Loss Factor Calculation Methodology

Version Number 3.0

February 2022

Overview

TasNetworks must develop, publish and maintain a methodology for calculating distribution loss factors in accordance with National Electricity Rules clauses 3.6.3(g) and (h).

Tasmanian Networks Pty Ltd (ACN 167 357 299)

Table of Contents

1. Introduction

Network losses are electrical energy (active energy) losses incurred in transporting electricity over transmission and distribution networks. Electrical energy losses associated with a distribution system can be classified as technical losses comprising:

- Series losses associated with the flow of electricity and the resistance of the electricity circuits;
- Shunt losses which is "leakage" of electrical energy associated with "charging up" or "excitation" of the network and occur regardless of the amount of electrical power flowing through the network; and
- Non-technical losses due to metering data errors, un-metered supplies, unbilled customers, information system deficiencies, modelling assumptions and theft.

Distribution Loss Factors (**DLFs**) are calculated annually by Distribution Network Service Providers (**DNSPs**) in accordance with the requirements of the National Electricity Rules (**the Rules**) in order to determine the average electrical energy losses attributable to a distribution network in conveying electricity from a transmission network connection point (or virtual transmission node) to a distribution customer connection. These loss factors account for both technical and non-technical losses. DLFs impact the Australian Energy Market Operator's (**AEMO's**) settlement process and are used to calculate the electrical energy attributed to each retailer at each transmission network connection point.

This document set outs TasNetworks' methodology for calculating DLFs. This methodology has been prepared in accordance with the requirements of the Rules, in particular having regard to the principles contained in clause 3.6.3(h) of the Rules.

This document is published on TasNetworks' website at www.tasnetworks.com.au/Planning-our-network and made available upon request to interested persons.

2. Requirements of the National Electricity Rules

Rules clause 3.6.3 provides for the determination of DLFs; in particular, clause 3.6.3(i) requires:

> Each year the DNSP must determine the distribution loss factors to apply in the next financial year in accordance with 3.6.3(g) and provide these to AEMO for publication by 1 April. Before providing the distribution loss factors to AEMO for publication, the DNSP must obtain the approval of the AER for the distribution loss factors it has determined for the next financial year.

Clause 3.6.3(b)(2) requires that DLFs will be either site specific for certain types of connection points or not site specific.

Site specific DLFs are calculated individually according to the actual network and connection point characteristics and will be determined in relation to:

- an embedded generating unit with actual generation of more than 10 MW;
- an end-user with actual or forecast load of more than 40 GWh or an electrical demand of more than 10 MW;
- a market network service provider; and
- between two or more distribution networks.

Clause 3.6.3(b1) requires the calculation of a site specific DLF where a Generator, or a Small Generation Aggregator, meets the reasonable cost of the DNSP in performing the necessary calculation in respect of a generating unit of up to 10 MW or 40 GWh per annum capacity.

For distribution connection points that are not site specific, the DLF should be based on network average DLFs based on voltage or connection point classes.[1]

Clauses 3.6.3(c), (d), (e) and (f) require the assignment of distribution connection points to either a single transmission network connection point or to a virtual transmission node and also to a class of distribution network connection points. In addition, the assignment must be consistent with the geographic boundaries of the pricing zones for use in distribution service pricing, and the voltage levels incorporated within those pricing zones.

Rules clause 3.6.3(h) requires that the methodology must be developed having regard to principles; summarised as:

- the aggregate of all of the adjusted gross energy amounts for a distribution network should equal, as closely as is reasonably practicable, the sum of:
    - the aggregate of electrical energy flowing at all connection points in the distribution network; and
    - the total "actual" electrical energy losses incurred on the distribution network;

- being able to demonstrate the extent to which the objective in (1) has been achieved through a reconciliation based on the previous financial year's actual results;

- for non-site specific connection points, determining the DLF by using a volume weighted average of the average electrical energy loss between the transmission network connection point or virtual transmission node to which it is assigned and each distribution network connection point in the relevant class of distribution network connection points;

- for site specific connection points, determining the DLF by reference to the average electrical energy loss between the distribution network connection point and the transmission network connection point to which it is assigned;

- using the most recent actual load and generation data available for a consecutive 12 month period to determine the average electrical energy losses referred to in (3) and (4), adjusted if necessary to take into account projected load and or generation growth in the financial year in which the distribution loss factors are to apply; and

- treating flows in network elements that solely or principally provide market network services as invariant. It is noted that this principle is not relevant to Tasmania.

Rules clause 3.6.3 (g) requires that DLFs must be determined for all connection points either:

- individually, for all connection points assigned to a single transmission network connection point; or
- collectively, for all connection points assigned to a transmission network connection point or a virtual transmission node and a particular distribution network connection point class.

This methodology is consistent with these non-prescriptive principles and aims to provide a fair and equitable result consistent with ensuring that the application of DLFs results in all energy losses being accounted for and recovered from the relevant distribution customers.

[1] NER clause 3.6.3(b)(2)(ii) DLFs will be derived using the **volume weighted average of the average electrical energy loss** between the transmission network connection point or virtual transmission node to which it is assigned and each distribution network connection point in the relevant voltage class.

3. Methodology

TasNetworks has recently reviewed its DLF Calculation Methodology against the NER and Australian Energy Regulator (**AER**) guidelines to allow it to be simplified and more consistent with these requirements. One of the outcomes was to reduce its number of DLF classes by removing the geographic regional area breakdown. TasNetworks' revised methodology now encompasses one state-wide region for all of its DLF calculations. As an interim measure to allow for legacy systems to be updated TasNetworks will continue to publish all previous geographic areas; however, they will all reflect the same calculation and DLF values across each network level.

The network levels (voltage classes) are classified as:

- Sub-transmission being either 44 kV or 33 kV distribution lines that either emanate from transmission connection points or interconnect between zone substations;
- Zone substation direct connection at either 22 kV or 11 kV;
- High voltage distribution feeder being either a 22 kV or 11 kV distribution line that emanates either from a transmission connection point or a zone substation;
- Distribution substation direct connection at 400 V; and
- Low voltage distribution being 400 V distribution lines that provide reticulation to customer premises.

3.1. Average DLF Calculations

The volume-weighted average DLF calculations of the average electrical energy losses are conducted at each of the network levels (voltage classes) specified in Section 3 in accordance with clause 3.6.3(b)(2)(ii) of the Rules. Previously this was derived by running a single load flow representing the network at a particular point in time and using appropriate factors to determine the average loss value from the loss in the one load flow result. Under the new methodology TasNetworks uses the following approaches:

- Maximum Demand and Loss Load Factor;
- Average Demand and Form Factor;
- Root Mean Square Demand; and
- Half-hourly loading.

TasNetworks' revised methodology allows for average losses to be calculated using the most appropriate of these methods for the feeder in question. The methods utilise forecast load and generation data for the year in which they apply.

The methodology for calculating DLFs determines an average loss level for five different network segments based on modelling of the segments. A DLF is calculated for each network segment and customers are allocated the appropriate DLF for the network segment to which their electrical installation is connected. The DLF categories relating to the five network segments are:

- $DLF_{Subtrans}$ is the distribution loss factor to be applied to a second tier customer or market customer connected to a sub-transmission line (at 44 kV or 33 kV). It is calculated using the following equation:

$$DLF_{Subtrans} = 1 + \frac{\sum(Subtrans\ network\ losses) - \sum(Subtrans\ losses\ due\ to\ SSCs)}{\sum(Sales\ through\ Substrans\ network) - \sum(Sales\ to\ Subtrans\ connected\ SSCs)}$$

- $DLF_{ZoneSub}$ is the distribution loss factor to be applied to a second tier customer or market customer connected to the lower voltage side of a zone substation. It is calculated using the following equation:

$$DLF_{ZoneSub} = 1 + \frac{\sum(Subtrans + Zone\ Tx\ losses) - \sum(Subtrans + Zone\ Tx\ losses\ due\ to\ SSCs)}{\sum(Sales\ through\ Substrans + Zone\ Txs) - \sum(Sales\ to\ Subtrans + Zone\ Tx\ connected\ SSCs)}$$

- DLF_{HVFdr} is the distribution loss factor to be applied to a second tier customer or market customer connected to a distribution line from a zone substation at voltages of 22 kV, 11 kV or 6.6 kV. It is calculated using the following equation:

$$DLF_{HVFdr} = 1 + \frac{\sum(Subtrans + Zone\ Tx + HV\ network\ losses) - \sum(Subtrans + Zone\ Tx + HV\ network\ losses\ due\ to\ SSCs)}{\sum(Sales\ through\ Substrans + Zone\ Txs + HV\ network) - \sum(Sales\ to\ Subtrans + Zone\ Tx + HV\ connected\ SSCs)}$$

- $DLF_{DistSub}$ is the distribution loss factor to be applied to a second tier customer or market customer connected to the lower voltage terminals of a distribution transformer (at 400/230 V). It is calculated using the following equation:

$$DLF_{DistSub} = 1 + \frac{\sum(Subtrans + Zone\ Tx + HV\ network + LV\ subs\ losses) - \sum(Losses\ due\ to\ SSCs)}{\sum(Sales\ through\ Substrans + Zone\ Txs + HV\ network + LV\ subs) - \sum(Sales\ to\ SSCs)}$$

- $DLF_{LVLines}$ is the distribution loss factor to be applied to a second tier customer or market customer connected to a low voltage line at 230/400 V. This DLF is calculated as the balancing item to ensure that forecast purchases are equal to the sum of sales times DLF at each level of the network. TasNetworks reports its overall distribution network losses in its annual Regulatory Information Notice response. Individual adjustments are made to account for copper and iron losses.

Forward Looking DLFs

Clause 3.6.3(b)(1) of **the** Rules states

"Distribution loss factors notionally describe the *average electrical energy losses* for …the financial year in which they apply".

Accordingly, TasNetworks use forecast network flows in the network analysis used to derive DLFs.

Consideration of future trends in network losses would include changes in load patterns including embedded generation penetration, power factor and network configuration and expansion. In particular equipment utilisation changes, asset replacements, development of new sub-transmission, zone substations, and HV distribution all are taken into account when determining the DLFs.

Consideration of future trends in network losses also includes changes in load patterns including embedded generation penetration, power factor and network configuration and expansion. Equipment utilisation changes, asset replacements, development of new sub-transmission, zone substations, and HV distribution all are taken into account when determining the DLFs.

3.2. Adjusted Gross Energy Reconciliation

TasNetworks undertakes a reconciliation of DLFs for the past financial year between the aggregate of the adjusted gross energy amounts for the previous financial year using the DLF from the previous year and the sum of:

- The amount of energy flowing at all connection points on the distribution network during the previous financial year; and
- The total energy losses incurred on the distribution network during the previous financial year.

as required under clause 3.6.3(h)(2) of **the Rules**.

The equation below describes the reconciliation calculation utilised by TasNetworks:

$$\sum AGE = \sum ME + \sum Losses$$

Where

ME = Metered Energy (MWh)

Losses = Total Network Losses (MWh)

DLF = Distribution Loss Factor that applied in the past financial year

AGE = Adjusted Gross Energy = ME x DLF (MWh)

$$\sum Losses = \sum ME_{Inflows} - \sum ME_{Outflows}$$

Note that $\sum ME_{Inflows}$ includes all inflows to the distribution network, including at transmission connection points and embedded generation.

This reconciliation is included by application of the DLFs to distribution customer metered energy and comparison with metered energy entering the distribution system.

3.3. Site Specific Customer Connection Points

Clause 3.6.3(b)(2)(i)(A) states that site specific DLFs must be provided for an embedded generating unit with actual generation of more than 10 MW, based on the most recent data available for a consecutive 12-month period, at the time of determining the DLF. If no data is available for a consecutive 12-month period, TasNetworks uses its best projection for the relevant generator, considering the terms of the relevant connection agreement.

Clause 3.6.3(b)(2)(i)(B) states site specific DLFs must be provided to an end-user with an actual or forecasted load of more than 40 GWh or an electrical demand of more than 10 MW, based on the most recent data available for a consecutive 12-month period at the time of determining the DLF. If no data is available for a consecutive 12-month period, TasNetworks uses its best projection for the relevant generator, considering the terms of the relevant connection agreement.

Rule clause 3.6.3(2)(i) requires site specific DLFs to be calculated for qualified distribution network users therefore it is necessary to allocate network losses between qualified end users and other customers. Site specific DLFs are calculated using Rules principle 3.6.3(h)(4) that requires the application of average electrical energy loss.

To achieve this, the methodology is as follows:

- The losses on each segment of the network due to all listed specific customers is aggregated and subtracted from the total calculated network losses on each segment of the network;
- All site specific customer sales in each segment of the network is aggregated and subtracted from the total network sales on each segment of the network; and
- The balances in the network losses and sales is then used to determine the volume weighted average DLFs for general users.