DISTRIBUTION LOSS ADJUSTMENT FACTORS (DLAFs) METHODOLOGY

Effective from 1 October 2019

Contents

1. Introduction

This paper describes the methodology applied by NIE Networks to calculate Distribution Loss Adjustment Factors (DLAFs) with the objective of providing clarity and transparency in relation to the calculation of DLAFs for users of the distribution network.

1.1 Background

Condition 32 of NIE Networks' Electricity Distribution licence requires NIE Networks to produce a schedule of adjustment factors to be made (where appropriate) in respect of distribution losses.

In 2018 NIE Networks publically consulted on changes to the methodology for calculating DLAFs. The consultation and decision papers are available on the NIE Networks website[1]. In the decision paper we advised that changes to the DLAF methodology would be introduced over two years as follows:

- Day and Night DLAFs for all demand and generator customers would be introduced from 1 October 2018 for the 2018/19 DLAFs; and

- Site Specific DLAFs for 33kV generator exports would be introduced the following year (i.e. from 1 October 2019 for the 2019/20 DLAFs).

The methodology set out in this paper aligns with the Decision Paper published on 12 June 2018.

DLAFs are published on the NIE Networks website[2] as Schedule B within the DUoS Statement of Charges[3]. The DUoS Statement of Charges is published annually and is normally effective from 1 October to 30 September for the relevant year.

1.2 Distribution Losses and DLAFs

The amount of energy delivered to the distribution network to supply electricity customers is greater than the aggregated amount of energy metered at customers' premises. The difference between these volumes is called distribution losses.

Distribution losses can be classified as either technical or non-technical losses. Technical losses, also known as system electrical losses, are an inherent characteristic of electricity networks and are a product of the load on the network, the distance the electricity has to travel across the network and the number of transformation (voltage) levels the electricity has to pass through. Non-technical losses are associated with unidentified and uncollected revenue, for example, arising from illegal connections, meter tampering, metering errors and estimations.

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[1] https://www.nienetworks.co.uk/about-us/regulation/distribution-loss-adjustment-factors-(dlafs)

[2] https://www.nienetworks.co.uk/about-us/regulation/network-charges
[3] 'Statement of Charges for use of the Northern Ireland Electricity Networks Ltd Electricity Distribution System by Authorised Persons'

Distribution Loss Adjustment Factors (DLAFs) are used to apportion these distribution losses to customer metered demand and generation.

The methodology for calculating distribution losses is set out in section 2 below and then section 3 describes how DLAFs are calculated.

2. Methodology for calculating distribution losses

The first step in producing DLAFs is to calculate the losses on the distribution network.

NIE Networks uses the metering data for a twelve month period to calculate the total losses on the entire distribution network. This is calculated as the difference between the energy entering the distribution network and energy exiting the distribution network.

When the total distribution losses have been calculated, we then determine the losses at each voltage level and the site specific losses for all 33kV connected generators. This is described in more detail in the steps below.

2.1 Step 1 – Calculation of total distribution losses

Total distribution losses are calculated as the difference between (i) units entering the distribution network from the transmission system and distributed generators, and (ii) units exiting the network based upon customer consumption.

- The units entering the distribution network are determined using half hour metering data for bulk supply sub-stations and distributed generators. Estimated export units for micro-generators are also included, using market agreed rules to assess the export volume.
- The units exiting the distribution network are determined using half hour metering data for 33kV and 11kV connected customers (including imports at distributed generator sites). Aggregated metering data (to an accuracy of at least month+4) is used for LV customer imports.

2.2 Step 2 – Calculation of losses for 33kV and 11kV networks

Half hour data for a twelve month period is collated for distributed generators and demand customers connected to the 33kV and 11kV networks.

Multiple power flow simulations are performed to calculate the electrical losses for each half hour in a selected week of each month for the twelve month period. The selected week of each month is assumed to be representative of the month and therefore a week will be selected that avoids public holidays. It is assumed that the simulated losses as a percentage of the energy delivered during a representative week can be extrapolated to the whole month, hence the weekly losses are extrapolated to determine the total losses for the Day and Night periods in each month.

The annual Day losses are the sum of the monthly Day losses and the annual Night losses are the sum of the monthly Night losses.

The losses calculated for the 33/11kV transformations are included with the total 11kV losses for the purpose of calculating the DLAFs.

2.3   Step 3 – Calculation of LV network losses

The LV losses are then calculated as the residual losses after the 33kV and 11kV losses have been subtracted from the total distribution losses.

For the purpose of the DLAF calculation, the 11kV/LV transformation losses are included with the LV losses.

2.4   Step 4 – Calculation of losses for 33kV Generators

Simulated Losses for single 33kV generators

A substitution method is used to calculate the losses attributed to generators connected to the 33kV network, which then feeds into the calculation of Site Specific DLAFs. A load flow simulation software network model is used for this purpose. The substitution method calculates losses in scenarios with and without generation and the resulting change in losses is attributed to the specific generator connection. Only technical losses are taken into account. The substitution method is described in more detail below:

- The maximum loading time point for the Day and Night periods in each month is initially recorded (i.e. 24 time points in the year).

- For each of these recorded time points, each 33kV generator is switched out, the load/generation of the network is scaled to 60% (to represent normal operation) and a power flow simulation is performed.

- Then, the generator is switched in, its production set to the maximum capacity and the power flow simulation is performed again for each time point.

- The simulated losses (in kilowatts) attributed to the individual generator are calculated as the difference between the recorded system losses with, and without that generator at each time point.

Simulated losses in cases of multiple 33kV generators sharing network

Where there is more than one 33kV generator locally on the network, the following method is applied to determine the network losses (in kilowatts) attributable to each 33kV generator in the group:

- Calculate the simulated losses attributable to all 33kV generators in the group as the difference between the losses without these generators connected and with generators connected. For example, in a case of two generators in the group:
    - Network losses excluding generators 1 and 2 = $Losses_{ExcGens}$
    - Network losses including generators 1 and 2 = $Losses_{IncGens}$
    - Total losses to be apportioned ($Losses_{Total}$) = $Losses_{IncGens}$ – $Losses_{ExcGens}$

- Additional power flow simulation studies are then conducted to calculate losses with each generator disconnected in turn:
  - Network losses excluding generator 1 = $Losses_{ExcGen1}$
  - Network losses excluding generator 2 = $Losses_{ExcGen2}$

- This determines the loss component which is attributable to each of the generators in the group. The total losses are then apportioned between the generators in the group using the formulae below:

  - Part of total losses apportioned to generator 1 =

$$Losses_{Total} * \frac{Losses_{IncGens} - Losses_{ExcGen1}}{(Losses_{IncGens} - Losses_{ExcGen1}) + (Losses_{IncGens} - Losses_{ExcGen2})}$$

  - Part of total losses apportioned to generator 2 =

$$Losses_{Total} * \frac{Losses_{IncGens} - Losses_{ExcGen2}}{(Losses_{IncGens} - Losses_{ExcGen1}) + (Losses_{IncGens} - Losses_{ExcGen2})}$$

2.5 Step 5 – Converting simulated losses for 33kV Generators into attributed Losses for the time period (kWh)

Loss Load Factors

Loss Load Factors are required for each generator in order to produce average loss values for each Day and Night period in every month. The average loss values make allowance for the connection not continuously operating at its maximum export capacity within any given time period and, therefore, not contributing to losses on a constant basis. The Loss Load Factors relating to each generator's export profile over the Day and Night periods in each month are calculated based on the generator's half-hourly metering data using the expression:

$$Loss\ Load\ Factor\ (SToD) = \frac{\sum export^2}{MEC^2 * No.of\ periods}$$

Export   - Export figures in kW for each Half Hour period

MEC   - Maximum Export Capacity

No. of periods - Number of Half Hours within the relevant Day or Night period in the relevant month

SToD   - In this expression, all values correspond to the respective Seasonal Time of Day (SToD), (i.e. Day or Night periods within each month).

Attributed Losses (kWh)

The simulated loss values for each Day and Night period in each month are multiplied by the number of hours in the respective Day and Night period and by the respective Loss Load

Factor to produce the attributed losses figures (in kilowatt-hours) for each Day and Night period in each month.

$$Attributed\ Losses\ (SToD) = Simulated\ Losses\ x\ No. of\ Hours\ x\ Loss\ Load\ Factor$$

Each generator's Day losses figures for each month in the year are summed to produce the total Day losses attributable to the generator connection and the monthly Night losses figures are summed to produce the total Night losses attributable to that generator over the year.

$$Total\ Day\ Losses = \sum Attributed\ Day\ Losses$$

$$Total\ Night\ Losses = \sum Attributed\ Night\ Losses$$

These annual Day and Night losses figures are then later used for the calculation of Site Specific DLAFs as described in Section 3.2 below.

3. Methodology for calculating DLAFs

This section sets out the methodology used to calculate the generic and site specific DLAFs using the losses calculated in section 2 above.

3.1 Calculation of Generic DLAFs

DLAFs are calculated for each Day and Night period based on network losses expressed as a proportion of the energy entering the relevant voltage system. The calculation takes into consideration the fact that load in lower voltage systems cause losses in higher voltage systems.

Generic DLAFs for 33kV connections take into account the effects of Site Specific DLAFs (i.e. the attributed losses incurred by the 33kV connected generators, as calculated in section 2.5).

Based on the calculated and disaggregated losses for each voltage level, and by taking into account losses caused by Site Specific generation, the Day and Night DLAFs are then calculated for each voltage level using the following formulae. All values correspond to the respective Time of Day (ToD), (i.e. Day and Night periods).

$$DLAF_{33kV}(ToD) = \left(1 + \frac{Losses_{33kV} + Losses_{33kVGen}}{Energyin_{33kV} + Energy_{33kV} - Losses_{33kV}}\right)$$

$$DLAF_{11kV}(ToD) = DLAF_{33kV}(ToD) \times \left(1 + \frac{Losses_{Total\ 11kV}}{Energyin_{11kV} - Losses_{Total\ 11kV}}\right)$$

$$DLAF_{LV}(ToD) = DLAF_{11kV}(ToD) \times \left(1 + \frac{Losses_{Total\ LV}}{Energyin_{LV} - Losses_{Total\ LV}}\right)$$

DLAF_{33kV}   -   DLAF for the 33kV network in respective ToD

DLAF_{11kV}   -   DLAF for the 11kV network in respective ToD

DLAF_{LV}   -   DLAF for the LV network in respective ToD

Energy_{33kV}   -   Units generated by the Site Specific generation at 33kV

Losses_{33kV}   -   Losses in the 33kV network

Losses_{Total11kV}   -   Losses in the 11kV network, including the 33/11kV substation losses

Losses_{Total LV}   -   Losses in the LV network, including the 11kV/LV substation losses and non technical losses

Losses_{33kVGen}   -   Calculated losses corresponding to Site Specific generation in the 33kV network. (Losses figure is negative if generation increases losses and positive if losses are decreased).

Energyin_{33kV}   -   Power flowing into the 33kV network from the higher voltage system

Energyin_{11kV}   -   Power flowing into the 11kV network from the higher voltage system

Energyin_{LV}   -   Power flowing into the LV network from the higher voltage system

3.2   Calculation of Site Specific DLAFs for 33kV generator exports

Site Specific DLAFs for each 33kV generator are calculated as the annual losses attributable to the respective generator connection in each Day and Night period (as calculated in section 2.5 of this paper) averaged over the number of annual units generated in that period. The formula used for Site Specific DLAFs is:

$$Site\ Specific\ DLAF\ (ToD) = 1 + \frac{the\ losses\ attributable\ to\ the\ generator\ connection\ (ToD)}{units\ generated\ by\ generator\ connection\ (ToD)}$$

In this expression, all values correspond to the respective Time of Day (ToD), (i.e. Day or Night periods).

Under this Site Specific methodology, the DLAF values calculated for each 33kV generator depend on the impact the individual generator has on the network losses over the year. In effect:

- If the generator export is found to be increasing network losses, then the Site Specific DLAF will be less than 1.000;
- If the generator export is found to be decreasing network losses, then the Site Specific DLAF will be greater than 1.000.

3.3   Default DLAF of 1.000 for 33kV generator exports

Under the Site Specific methodology, the DLAF value calculated for each 33kV generator depends on the impact the individual generator has on the network losses over a year. For cases where there is no metered information or incomplete historic information available to calculate the generator impact on losses (e.g. for newly connected generators), we will use a default DLAF of 1.000 for the generator export. This DLAF of unity assumes that the generator had no impact on losses (either to increase or reduce). This default DLAF figure will apply for the full tariff year and will be reviewed the following year when additional data becomes available.

4. Additional Information

4.1 Time of Day DLAFs

The methodology produces time-differentiated DLAFs for Day and Night periods. The Day and Night time periods are defined in the Table 1 below.

Meter Type	DAY		NIGHT	
	Summer	Winter	Summer	Winter
LV customers with non half-hour meters	09:00 to 00:00	08:00 to 23:00	00:00 to 09:00	23:00 to 08:00
All customers with half-hour meters	08:00 to 23:00	08:00 to 23:00	23:00 to 08:00	23:00 to 08:00

Table 1: Definition of Day and Night

Equivalent Whole Day DLAFs are also published in NIE Networks' annual DUoS Statement of Charges. Only the Day and Night DLAFs are used for settlement purposes. The Equivalent Whole Day DLAFs are included for indicative purposes only.

Time-differentiated DLAFs can provide appropriate signals to customers about their impact on network losses; if customers react to these signals they could reduce their total energy requirements and network losses would potentially reduce.

4.2 DLAFs for Customer Types

Site Specific DLAFs are limited to generators connected at 33kV and will only be applied to the export volumes from these 33kV generators. The Generic DLAFs for the 33kV voltage level will apply to the import volumes from 33kV generators.

In addition, the appropriate Generic DLAFs for each voltage level will apply to all demand customers connected to the distribution network, and to any distributed generators connected to the 11kV or LV voltage levels.

The DLAF types that apply are summarised in Table 2 below. For clarity, "demand" refers to metered consumption at demand customer and generator customer sites.

Connected Voltage	DAY		NIGHT	
	Generator Export	Demand	Generator Export	Demand
33kV	Site Specific Day DLAF	33kV Generic Day DLAF	Site Specific Night DLAF	33kV Generic Night DLAF
11kV	11kV Generic Day DLAF		11kV Generic Night DLAF	
LV	LV Generic Day DLAF		LV Generic Night DLAF	

Table 2: DLAF types to apply to Generator Exports and Demands

4.3 Frequency of Updating DLAFs

NIE Networks will review and update Generic DLAFs annually.

The Site Specific DLAFs will typically be revised annually; however where NIE Networks considers there are no material changes to the connections or network, the Site Specific DLAFs may be retained for a maximum of five years.

5. Contact Details

Any queries relating to the methodology for calculating DLAFs should be sent to: NetworkPricing@nienetworks.co.uk.