Statement of Line Loss Factor Methodology for Southern Electric Power Distribution plc Electricity Distribution Network

Effective from 1st September 2022

Effective for Charging Year 2023/24

Version 6

Index

Version Number	Description of Changes
Issue 1	Draft submission
Issue 2	Submitted Methodology
Issue 3	Update to BSCP 128 v2.0 – August 2010
Issue 4	Update to BSCP 128 v3.0 – August 2011
4.1	SVG comments incorporated
4.2	Update period of table 1.3 to match SLC 14 Statements period order
Issue 5	Revisions to methodology – August 2013
5.1	Revisions to formatting and updating content
5.2	Revisions to formatting and updating content
5.3	Revisions to formatting and updating content
5.4	Update Branding
5.5	Revisions to formatting and updating content
5.6	Revisions to formatting and updating content
5.7	Revisions to formatting and updating content
5.8	Revisions to formatting and updating content
Issue 6	Update to Out of Area Network Section 6 with clarifying details

Contents

1 General Information

1.1. This document describes the methodologies applied by Southern Electric Power Distribution plc (hereinafter referred to as 'we', 'our' or 'us') in the calculation of its Line Loss Factors (LLFs) for authorised users of our distribution network. LLFs were previously known as Loss Adjustment Factors (LAFs).

1.2. This document details the methodology that is used for the calculation of our published LLFs and is made available in order to provide clarity and transparency for users of our distribution network. Each Distributor that does not mirror LLFs must submit a methodology for calculating LLFs that complies with the BSCP128 LLF Methodology Principles. This methodology statement is not subject to approval by the Authority, and is in addition to our Use of System Charging Methodology statement.

1.3. We are obliged under Standard Licence Condition 14 of our Electricity Distribution Licence to publish a statement of charges and charging principles for the use of our distribution system. The form of the LC14 statement is approved by the Authority. The LC14 statement is required to contain a "Schedule of Line Loss Factors", which provides the LLFs which must be used to take account of losses on our distribution network. Our LLFs are also made available to Elexon (and therefore all market participants) through the provision of the dataflow, D0265 for SVA LLFs and an Elexon prescribed data format for CVA LLFs. All LLFs are calculated and submitted to an accuracy of 3 decimal places (BSCP128 Principle 2) and in accordance with the following Seasonal Time of Day (SToD) time periods[1] (BSCP128 Principle 8).

Time Periods (P)	Period 1 (P1)	Period 2 (P2)	Period 3 (P3)	Period 4 (P4)
	Winter Weekday Peak	Winter Weekday	Other	Night
Monday to Friday Nov to Feb	16:00 – 19:00	07:30 – 16:00 19:00 – 20:00	20:00 – 00:30	00:30 – 07:30
Saturday and Sunday All Year and Monday to Friday Mar to Oct			07:30 – 00:30	00:30 – 07:30
Notes	All the above times are in UK Clock time			

1.4. LLFs are determined through the application of two methodologies. The generic (or mass market) LLFs are calculated using a methodology similar to that developed by EA Technology, in conjunction with ourselves and the majority of distribution businesses. This methodology has been built into our "General System Losses model". This process produces averaged LLFs for use with all customers connected at LV and HV voltage levels, and temporarily for new customer sites connected at Extra High Voltage (EHV) until a site specific LLF is calculated.

1.5. Site specific LLFs are calculated for those sites connected at EHV as well as for those sites where we agree to apply Site Specific calculation following a Customer's particular request (BSCP128 Principle 1) using an electricity industry methodology employing specific load flow models developed for each individual site. The treatment of both demand and generation sites within these models follows the substitution method. This is described for generation in accordance with industry guidance documents issued by the Settlement Subcommittee Operations (SSC(OP)). In particular, the following documents, SSC(OP) 1390 (Revised), "Guidance note for the calculation of loss factors for embedded generators in settlement" (1992) and the sub group report MDC/54/1166 (1995).

[1] 'Winter Peak', 'Winter Weekday' and 'Other' represents 'Day'

2. Generic Line Loss Factors (LLFs)

2.1. Generic LLFs are calculated for all SVA (non EHV) registered authorised users for the predetermined SToD time periods of the year. The allocation methodology and software model (program newLAF), similar to that developed by EA Technology, is utilised to calculate the generic LLFs. The generic LLFs are recalculated and published at least every 2 years (BSCP128 Principle 12) at the following[2] exit point voltage levels (BSCP128 Principle 7).

2.2. The LLFC (Line Loss Factor Class) groups for which generic LLFs are calculated in our Distribution Services Area are:

- 132kV Extra High Voltage (Generic EHV132)
- 132/33kV Extra High Voltage (Generic EHV132S)
- 33kV Extra High Voltage (Generic EHV33)
- 11kV provided at the terminals of a 132kV, 66kV or 33kV substation (HVS)
- High Voltage (HV) (11kV or 6.6kV)
- Low voltage provided at the terminals of a HV/LV substation (LVS)
- Low voltage (LV)

2.3. Non-EHV Generic LLFs for Import and Export at the same site where the voltage level is the same shall have the same values (BSCP128 Principle 6).

2.4. The overall process of estimating LLFs is as follows: a forecast is made of the demand in terms of units entering the system (from known purchases at GSPs and from embedded generation) and the units leaving the system, based upon known unit sales. The total system losses therefore take into account both technical and non-technical (BSCP128 Principle 4) losses and are given by the following expression:

Total System Losses = Units Entering System - Units Leaving System

2.5. The forecast is based on smoothing historic data from the settlement system allowing for weather corrections and unexplained fluctuations in the settlement data. This is extrapolated or interpolated to take into account the changed level of demand. Forecasts are also made of the metered volume of energy to be supplied by embedded generation at each voltage level. The remaining units to balance the [demand + losses - embedded generation] are used to define the units supplied from the transmission system at the GSPs (Grid Supply Point).

2.6. In detail, the five voltage levels of 132kV(or 66kV), 33kV(or 22kV), 11kV, 6.6kV and LV and the seven transformation levels of 132/33kV, 132/11kV, 66/22kV, 66/11kV, 33/11kV(or 6.6kV), 11kV/LV and 6.6kV/LV are represented within a network model. The model is populated with the set of standing data. For example, the fixed loss constant (megawatts) and the variable loss constant (megawatts per megawatt squared) for each voltage and transformation level are contained within the standing data.

2.7. The model is also populated with the metered volumes of energy per annum at the various network voltages. Energy metered profiles are included at the connection points with National Grid Company and for site specific demand and generation. Common profiles for demand and generation (net demand) are supplied for each of the HV/LV LLFC groups (HVS, HV, LVS). The LV profile is determined by subsequent calculation. The data enables accurate LLFs to be calculated for the predetermined SToD time periods of the year.

2.8. A 'Top-Down' approach is used for estimating network losses starting from the 132kV bar at GSPs. The energy delivered from the higher voltage level is used to deduce the losses on the assets and thus the energy passed through to the lower voltage level.

[2] Ofgem Structure of Charges Common EHV Distribution Charging Methodology (EDCM) and the EDCM Boundary consultation 23rd April 2010

2.9. The model calculates for each half-hour in the year the energy passed through the network into the next voltage level below using the following empirical equation

$$P_{out} = P_{in} \bullet v.P_{in}^2 \bullet f \bullet L + G$$

2.10. Where Pout = Power out of voltage level into lower voltage level, Pin = Power into voltage level from higher voltage level, v = Variable loss constant for voltage level, f = Fixed loss constant for voltage level, L = Metered sales at voltage level, G = Metered generation at voltage level.

2.11. This is illustrated by the following example which is carried out for each half-hour:

	Units of power are average MW for each half-hour					
	Import	LLF	Losses	Residual demand	Residual losses	Generic LLF
GSP import	2000	1.000		2000	0	**1.00000**
132kV fixed losses			0.5	1999.5	0.5	
132kV variable losses			9.5	1990	10	
132kV site specific generation	100	1.001		2090	10.1	
132kV site specific demand	-300	1.004		1790	8.9	
132kV network generic LLF				1790	8.9	**1.00497**
132/33kV fixed losses			10	1780	18.9	
132/33kV variable losses			20	1760	38.9	
132/33kV site specific demand	-200	1.025		1560	33.9	
132/33kV generic LLF				1560	33.9	**1.02173**
33kV fixed losses			0.1	1559.9	34	
33kV variable losses			15.4	1544.5	49.4	
33kV site specific demand	-100	1.030		1444.5	46.4	
33kV generic LLF				1444.5	46.4	**1.03212**

2.12. The above illustrates how losses caused by site-specific customers are incorporated into the generic LLF calculation. Aggregated data from all Site Specific SVA and CVA sites and weighted Site Specific LLFs at each voltage level are entered into the model. The model then calculates the specific generic losses associated with these groups of Site-Specific sites along with the losses for the other generic LLFC groups (BSCP128 Principle 5). This process is repeated through the voltage and transformation levels until the LV network is reached. The half-hourly metered load for that half-hour is then subtracted to leave the estimated demand for that half-hour attributed to the quarterly metered customers. This is not known for each individual half-hour. Therefore, the total estimated quarterly metered demand for the year is compared with that used in producing the estimate of the 'Units Leaving System'. There will always be at least a very small discrepancy in these two figures due to assumptions in the model (BSCP128 Principle 4) and variations in LV metered data accuracy, e.g. time registration unmetered supplies, theft etc. This discrepancy represents unapportioned electrical losses and is thus reapportioned iteratively across all voltage levels by the model itself to match the two values. The model achieves this by adjusting the variable losses via the variable loss constants. Since estimates of fixed losses and of variable loss constants at EHV are more robust than the estimates of the variable loss constants at lower voltages the adjustments are weighted towards the variable loss constants at the lower voltages.

2.13. At this stage the model also apportions losses in the system at each voltage level to each electrical unit of energy flowing through that level.

2.14. The output is a generic LLF for each half-hour at each voltage level. This is identical for import and export.

2.15. The LLF for a predefined time period, at each voltage level, is calculated as the average weighted value for that time period. For the HVS, HV, LVS these are based on the profiles supplied for the net demand at each level.

2.16. A customer's import or export supply is thus allocated LLFs dependent upon their point of connection with the network in relation to the 7 exit points identified.

3. Site Specific Line Loss Factors (LLFs)

3.1. Site specific LLFs are calculated for all EHV CVA and EHV SVA registered authorised users on an individual basis at the exception of all 11kV users provided at the terminals of a 33kV substation (HVS). Each customer's supply is modelled individually using a model representation of the distribution network that contains details of the customers load profile, the system load profile and the specific DNO assets used to supply them. They are recalculated when there has been a relevant change[3] to the site or network, and at least every 5 years (BSCP128 Principle 13).

3.2. The site specific LLF comprises of a fixed loss element and a variable loss element. Losses are calculated for the four periods of the year similar to the system losses, taking into account real current flows and asset sharing. They therefore account for technical losses only (BSCP128 Principle 3).

3.3. Significant changes year to year are much more likely to occur when losses are calculated on a site-specific basis. Changes in demand or consumption on one site can cause significant changes to the losses incurred due to that particular customer's connection. Such changes are not swamped by the overall inertia of the entire network and consequently site-specific losses are more volatile. However, such significant changes are the exception rather than the rule as customers' overall demands and consumptions tend to remain fairly consistent (allowing for seasonal variations) given no major site or economic changes.

3.4. Site specific LLFs are calculated for both load and generation customers using the substitution method.

4. Substitution method

4.1. Load flow and energy loss calculations are carried out with the customer connected and then disconnected from the network in the 4 time periods as specified. The change in losses is attributed to the customer.

4.2. A load flow approach is used for calculating network losses on all assets employed to service each customer, from the 132kV bar (or other lower voltage where applicable) at the GSP to the user's point of metering with the network.

4.3. As a general principle, load flow studies calculate a single set of results based upon a single set of network parameters and conditions. Therefore, load flow studies are carried out, one for each of the time periods of interest using the customer's maximum demand attained in each period and the network demand corresponding to the time of maximum demand at the supply point. An adjustment factor of 0.8 is applied to the change in variable losses to make allowance for the customer and the network demand not continuously operating at their maximum values within any given time period and therefore not contributing to losses on a consistent basis.

4.4. Half hourly metered profile data is available for these customers. From this the customer's maximum demand can be readily determined for each of the predetermined SToD time periods from using actual or assumed half hourly metered data or assumed profiles. Where the customer's maximum demand is less than 200kVA or the customer's generation is less than 200kW in any time period, then in order to reduce numerical inaccuracy, the values of 200kVA or 200kW are used (BSCP128 Principle 17).

[3] As defined within BSCP 128

4.5. For a site that has multiple connections to our network where its primary connection is at EHV and subordinate connection(s) at lower voltage(s), as per BSCP128 Principle 17 (a) (b) definition, the same maximum demand replacement process as described in paragraph 4.4 above also applies, and the allocation of LLFs to the subordinate MPANs will be in accordance with the appropriate generic LLFs as per Section 2 above (BSCP128 Principle 17).

4.6. The network model used to calculate site specific losses is based on our Long Term Development Statement and uses the best available asset data throughout.

4.7. Fixed and variable losses at transformers are determined using the actual transformer iron and copper loss data derived at commissioning for each transformer supplying the customer. In general, using the substitution method the change in fixed losses will be zero except in the case when the customer is the sole user of the asset.

4.8. Variable losses within cables and overhead lines are determined using actual impedances derived from manufacturers' cable data together with the calculated current flows.

4.9. Where assets are only used to supply the customer then 100% of the losses generated by those assets are allocated to the customer.

4.10. Where more than one site specific customer exists locally on the network then the substitution method is carried out similarly with the customers being connected to the losses model in the order of their date of commissioning e.g. For a network containing two customers the following calculations are performed:

- Total energy loss calculated in absence of both customers (T)
- Total energy loss calculated with customer 1 connected (T1)
- Total energy loss calculated with customer 1 and 2 connected (T2)

Difference in loss attributable to customer 1 = T1 – T (normally negative for a generator)
Difference in loss attributable to customer 2 = T2 – T1

Where the order of connection is unknown or indeterminate due to historic changes in customers' maximum demand or generation, then the analysis is carried out independently for each customer assuming the demand of other customers is unchanged.

4.11. The LLF is given for demand customers by using the following ratio, calculated as described above for each time period:

Demand LLF = 1 + (the losses attributable to the customer) ÷ (customer demand)

4.12. The LLF is given for generators by using the following ratio, calculated as described above for each time period:

Generation LLF = 1 + (decrease in losses attributable to the customer) ÷ (customer generation)

4.13. LLFs for generation whose output causes an overall reduction in system losses will be >= 1 (generators are assigned a benefit). Generation whose output causes an overall increase in system losses will have LLFs <=1. Demand customers which offset generation losses and provide an overall reduction in losses also would receive a LLF <=1.

5. Revision of Published LLFs, Quality Assurance and Publication of LLFs

5.1. We take all reasonable efforts to maintain the consistency and accuracy of LLFs output by the calculation process. Examples of the steps taken, but not limited to, are:

- To calculate Generic LLFs, we shall utilise Settlement data from a Settlement Run at R3 or greater and from a complete 12-month period. The 12-month period to be used shall be the BSC Year[4] three years prior to the BSC Year for which the LLFs are being calculated. (BSCP128 Principle 9),
- Validation of input data by comparison with previous year(s) to identify potential errors, inconsistencies or trends with corrective action taken where appropriate,
- Use of proven models and automated processes wherever practicable to increase consistency and reduce the introduction of errors,
- Thorough documentation of calculations and associated quality assurance processes,
- Validation of calculated LLFs by comparison with previous year(s) to identify potential errors, inconsistencies or trends with corrective action taken where necessary,
- Identification of the main contributory changes in electrical network parameters where LLFs change significantly,
- Adjustments to calculation or application of LLFs, to take into account historic market wide issues noted in the BSC Auditor's latest Report, can only be made if agreed to be appropriate by the Panel (BSCP128 Principle 10).

5.2. LLFs production will follow our internal procedures and checks (BSCP128 Principle 11). LLFs published through the above process are made available as an annual update and take effect from the 1st April each year. No changes will be made to approved generic LLFs mid BSC year. Where default LLFs have been applied due to an audit failure, these may be replaced with the approved LLFs on a prospective basis as determined when the LLFs resubmitted by us have been approved by the Panel. (BSCP128 Principle 14). A change to site specific LLFs will only be made mid year if there has been a material change[5] affecting the site and when approved by the Panel (BSCP128 Principle 16). Annual updates will have an effective from date of 1 April. Where default LLFs have been applied due to an audit failure, these may be updated to the approved LLFs on a prospective basis as determined from time to time by the Panel.

5.3. In addition, retrospective changes shall not be made to approved site specific or generic LLFs other than to correct material manifest errors (BSCP128 Principle 15).

6. Out of Area Networks

6.1. Where we operate embedded distribution networks outside of our Distribution Services Area, the LLFs will be determined as described in this section.

6.2. Networks connected to Host Distribution Networks

- For all customers whose sites are metered at HV and LV voltage levels, and temporarily for new customer sites connected at Extra High Voltage (EHV) until a Site-Specific LLF is calculated, Generic LLFs apply. We will mirror the host Distribution Network Operator's figures for the GSP Group in which our network is situated.

- For each customer site connected at Extra High Voltage (EHV) and whose settlements half-hourly metered data over a historical 12-month period (1 April to 31 March) is reliably available, Site-Specific LLFs apply, which shall reflect:

  a) the host LDNO's Site-Specific assessment of the losses associated with our customer utilising its network assets (i.e Site-Specific boundary LLFs) and

  b) technical (fixed and variable) losses associated with utilisation of our network assets. The model utilises the Customer's site settlement half-hourly metered

[4] This principle only applies to the calculation of Generic LLFs. The BSC Year is 1 April to 31 March, LLFs for use in the BSC Year commencing 1 April 2012 should be calculated using the Settlement Data from the 2008 BSC Year, 1 April 2009 to 31 March 2010.
[5] As defined in the BSCP 128

volumes over a historical 12-month period (1 April to 31 March), from which the Customer's site import/export data can be determined for each of the prescribed time periods.

- The Site-Specific LLFs calculation will be dependent on the host Distribution Network Operator providing us Site-Specific 'boundary' LLFs for any site(s) for which Site-Specific LLFs are calculated.

6.3. Networks directly connected to the OOA Transmission Network:

- Where we operate distribution networks outside of our Distribution Services Area and our network is not connected to the host Distribution Network (i.e., directly connected to the Transmission network), import/export LLFs calculation reflects losses arising from the transportation of electricity over our network between the GSP(s) and customer(s).

- Each network is modelled individually which is a representation of the distribution system that contains the details of the customers and system load profiles and our assets that deliver the electricity.

- Generic LLFs are calculated for each voltage level that reflects Technical (fixed and variable) and non-technical losses. The methodology utilises network loadings data including where appropriate historical settlements half-hourly metered historical data.

- Site-Specific LLFs are calculated using the substitution method described in Section 3 for both load and generation customers.

6.4. The Generic LLFs are recalculated and published at least every 2 years (BSCP128 Principle 12). We will recalculate the LLFs when there has been a relevant change (as defined in BSCP 128) to the site or network, and at least every 5 years (BSCP128 Principle 13).

7. Contact Details

7.1. This statement has been prepared to provide clarity and transparency for users of our distribution network. If you have any questions about the contents of this statement, please contact the relevant person at the address shown below.

7.2.

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8. Glossary

In addition to the Definitions in section 1.8.2 of the BSCP 128 version 6.0:

Term	Definition
Balancing and Settlement Code (BSC)	The Balancing and Settlement Code contains the governance arrangements for electricity balancing and settlement in Great Britain.
Central Volume Allocation (CVA)	As defined in the BSC.
Customer	A person to whom a User proposes to supply, or for the time being supplied, electricity through an Exit Point, or from whom a User, or any relevant exempt Supplier, is entitled to recover charges, compensation or an account of profits in respect of electricity supplied through an Exit Point; Or A person from whom a User purchases, or proposes to purchase, electricity, at an Entry Point (who may from time to time be supplied with electricity as a Customer of that User (or another electricity supplier) through an Exit Point.
Day (Generic)	Time Periods 1, 2 and 3, represent 'Day' as 'Winter Weekday Peak', 'Winter Weekday' and 'Other'.
Distribution Licence	SEPD is the holder of a distribution licence ("the Licence") granted or treated as granted pursuant to section 6(1)(c) of the Electricity Act 1989 ("the Act").
Distribution Network Operator (DNO)	An electricity distributor that operates one of the 14 distribution services areas and in whose Electricity Distribution Licence the requirements of Section B of the standard conditions of that licence have effect.
Distribution Services Area	The Area specified by the Gas and Electricity Markets Authority within which each DNO must provide specified distribution services.
Distribution System	The system consisting (wholly or mainly) of electric lines owned or operated by an authorised distributor that is used for the distribution of electricity from: • Grid Supply Points or generation sets or other entry points to the points of delivery to: • Customers or Users or any transmission licensee in its capacity as operator of that licensee's transmission system or the Great Britain (GB) transmission system and includes any remote transmission assets (owned by a transmission licensee within England and Wales) that are operated by that authorised distributor and any electrical plant, electricity meters, and metering equipment owned or operated by it in connection with the distribution of electricity, but does not include any

Term	Definition
	part of the GB transmission system.
Entry Point	A boundary point at which electricity is exported onto a Distribution System to a connected installation or to another Distribution System, not forming part of the total system (boundary point and total system having the meaning given to those terms in the BSC).
Extra High Voltage	Nominal voltages of 22kV and above. In practice, this means sites with exit points at 132kV, 66kV, 33kV and 22kV or at a 132/33kV, 132/11kV, 66/22kV or 66/11kV substation.
Exit Point	A point of connection at which a supply of electricity may flow from the Distribution System to the Customer's Installation or User's Installation or the Distribution System of another person.
Grid Supply Point (GSP)	A metered connection between the National Grid Electricity Transmission (NGET) system and the licensee's Distribution System at which electricity flows to or from the Distribution System.
GSP Group	Grid Supply Point Group; a distinct electrical system, that is supplied from one or more Grid Supply Points for which total supply into the GSP Group can be determined for each half-hour.
High Voltage (HV)	Nominal voltages of at least 1kV and less than 22kV, excluding any site defined as EHV.
High Voltage Sub-station (HV Sub)	HV Sub applies to customers connected to the licensee's distribution system at a voltage of at least 1 kV and less than 22 kV at a substation with a primary voltage (the highest operating voltage present at the substation) of at least 22 kV and less than 66 kV, where the current transformer used for the customer's settlement metering or for metering used in the calculation of the customer's use of system charges or credits is located at the substation. In practice, this means sites with exit points at 33/11 kV.
Line Loss Factor (LLF)	The factor that is used in Settlement to adjust the Metering System volumes to take account of losses on the Distribution System.
Line Loss Factor Class	An identifier assigned to an SVA Metering System which is used to assign the LLF and Use of System Charges.
Loss Adjustment Factor (LAF)	Previously used for Line Loss Factor.
Low Voltage (LV)	Nominal voltages below 1kV.
Low Voltage Sub-station (LV Sub)	LV Sub applies to customers connected to the licensee's distribution system at a voltage of less than 1 kV at a substation with a primary voltage (the highest operating voltage present at the substation) of at least 1 kV and less than 22 kV, where the current transformer used for the customer's settlement metering is located at the substation.
newLAF	A spreadsheet based application that calculates generic LLFs.

Term	Definition
Settlement	The determination and settlement of amounts payable in respect of charges (including reconciling charges) in accordance with the BSC.
Supplier Volume Allocation (SVA)	As defined in the BSC.
Third Reconciliation Run (R3 Data)	Settlement run carried out for purposes of settlement, R3 being re-run six months after the initial run.
User	Someone who has a use of system agreement with the DNO e.g. A Supplier, Generator or LDNO.