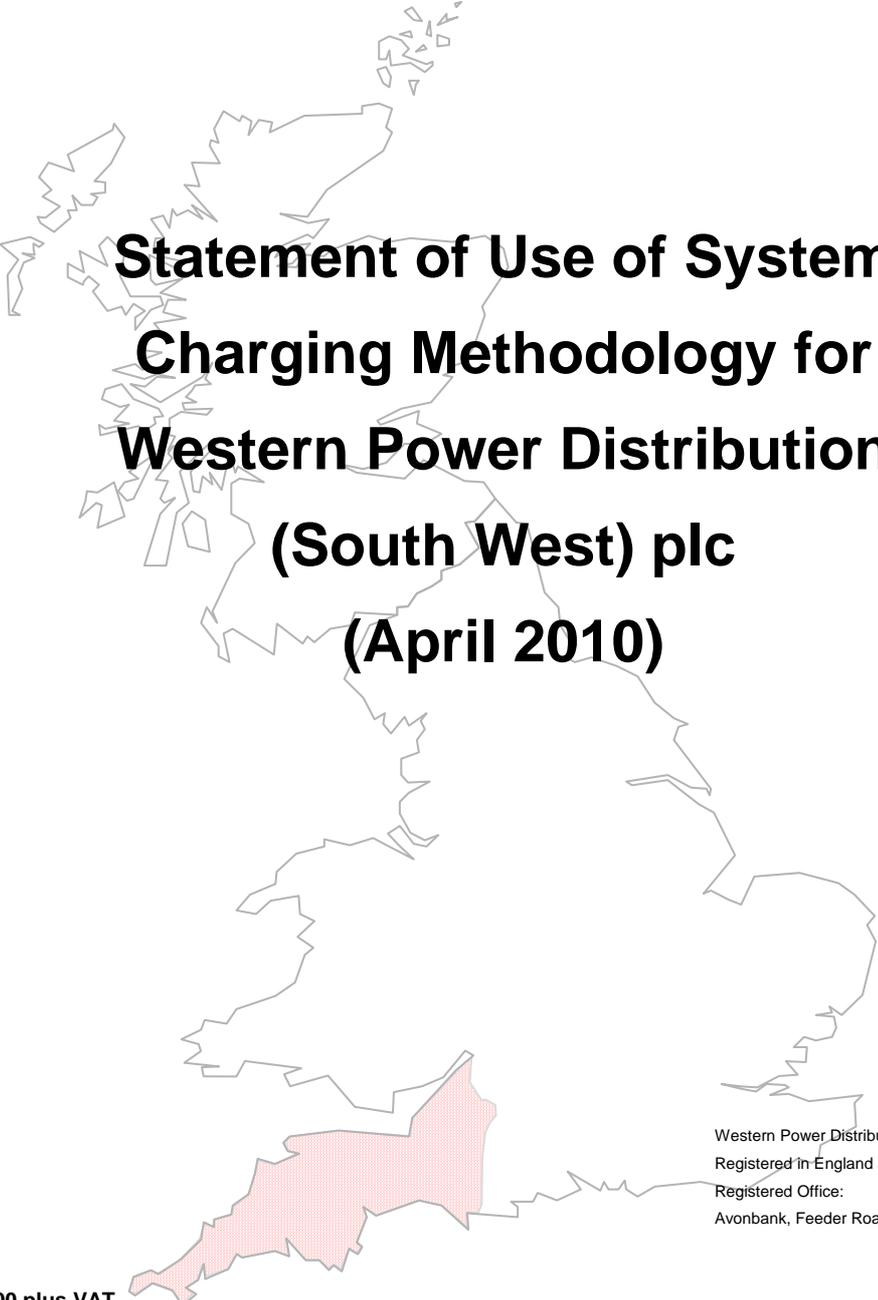


# **WESTERN POWER DISTRIBUTION**



*Serving the South West and Wales*



## **Statement of Use of System Charging Methodology for Western Power Distribution (South West) plc (April 2010)**

Western Power Distribution (South West) plc  
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**Price: £5.00 plus VAT**

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## **WESTERN POWER DISTRIBUTION (South West) plc**

### **STATEMENT OF USE OF SYSTEM METHODOLOGY FOR WESTERN POWER DISTRIBUTION (SOUTH WEST) plc**

(April 2010)

#### **Licence Obligations**

This statement describes the methodology that Western Power Distribution (South West) plc (WPD (South West) plc) employs to set charges for use of its electricity distribution system for the purposes of transporting electricity.

The statement is prepared by WPD (South West) plc in accordance with the requirements of Condition 13, of its Electricity Distribution Licence issued under the Electricity Act 1989 as amended by the Utilities Act 2000. We are also obliged to review our Use of System Charging Methodology annually in accordance with the Licence Condition and make such modifications to the Use of System Methodology Statement that better achieve the relevant objectives. These are:

“(a) that compliance with the use of system charging methodology facilitates the discharge by the licensee of the obligations imposed on it under the Act and by this licence;

(b) that compliance with the use of system charging methodology facilitates competition in the generation and supply of electricity, and does not restrict, distort or prevent competition in the transmission or distribution of electricity;

(c) that compliance with the use of system charging methodology results in charges which reflect, as far as is reasonably practicable (taking into account of implementation costs), the costs incurred by the licensee in its distribution business; and

(d) that, so far as is consistent with sub-paragraphs (a), (b) and (c), the use of system charging methodology, as far as is reasonably practicable, properly takes account of developments in the licensee’s distribution business.”

Words and expressions used in this statement have (unless specifically defined herein) the definitions given to them in the Acts or the Licence and shall be construed accordingly. Charges and costs are current at the time of publication and will not be changed, except as provided for in DCUSA and subject to Condition 13 of the Licence.

This statement has been approved by the Gas and Electricity Markets Authority (the Authority). Future modifications will also be subject to approval by the Authority.

A fee of £5 plus VAT will be payable for each copy of this statement which is provided in accordance with a request. Copies may also be downloaded free of charge from WPD’s website at [www.westernpower.co.uk](http://www.westernpower.co.uk).

#### **Price Control**

WPD (South West) plc is a licensed distribution business and the Authority regulates it. The regulation is applied via the Distribution Licence and the price control mechanism. The price control period is 5 years and Ofgem prescribe the amount of revenue that WPD (South West) plc is allowed to recover from its customer base annually and over the price control period. Use of System charges may vary year on year as WPD (South West) plc sets its use of system charges to recover its allowed revenue.

### **Use of System**

WPD (South West) plc will levy use of system charges for utilisation of its network for the supply of electricity to end users. WPD (South West) plc's Use of System tariffs are published in our Statement of Charges for Use of System.

### **Connection and Use of System Boundary**

WPD (South West) plc splits the recovery of costs between connection to the distribution network and on-going use of system charges for utilisation of the network. This boundary point is common for both demand and generation customers. This statement contains the charging methodology that is applied for the calculation of use of system charges and the Statement of Charges for Use of System details the use of system charges that are applied. The Statement of the Basis of Charges for Connection details the Connection Charging Methodology that is used for calculation of connection charges and demonstrates the areas of cost that are recovered through connection charges. The latter statement also contains indicative charges and examples to aid understanding of connection charges. These statements can be obtained from our website, [www.westernpower.co.uk](http://www.westernpower.co.uk), or available on request at a cost of £5 from the address for contact given in the Use of System Charging statement.

### **The Contractual Framework**

Persons seeking to use the system will be required, prior to using the system, to accede to the DCUSA.

Terms and conditions for connection of premises or other electrical systems to WPD (South West) plc's distribution system, and for the provision of legacy distribution metering and data services, are contained in separate statements, which are available from WPD (South West) plc on request. These statements can be obtained from our website, [www.westernpower.co.uk](http://www.westernpower.co.uk), or available on request at a cost of £5 from the address for contact given in the Use of System Charging statement. Persons seeking use of the system with respect to a new supply must apply for connection in accordance with the terms and conditions described in that statement.

Where a person requires a connection to WPD (South West) plc's electricity distribution system pursuant to Section 44 of the Utilities Act 2000, the provisions of this statement are without prejudice to the provisions of sections 44 to 50 of the Utilities Act 2000 (those sections which deal with the rights, powers and duties of WPD (South West) plc, as an electricity distributor), in respect of the distribution of electricity to owners or occupiers of premises.

## Contact Details

If you have any questions about the contents of this statement please contact us at the address given in the Use of System Charging statement.

## Principles

Pursuant to the requirements of Condition 13 of the Electricity Distribution Licence, the following paragraphs relate to the transport of electricity on WPD (South West) plc's distribution system by Authorised Suppliers to exit points from the system, and to the transport of electricity on the system for supply to Suppliers and to/from generators including customers with on-site generation.

1. Where a supply of electricity is provided over electric lines or electrical plant comprising a part of WPD (South West) plc's distribution system, a charge for use of the system will be levied on the Supplier or Generator of the electricity. The relevant charges, which are generally applicable, are described in the Licence Condition 14 statements and are payable by reference to the characteristics of the supply, in accordance with the categories of supply described in the section headed 'General Notes'.
2. The charges for use of the system reflect:
  - the costs to WPD (South West) plc of providing, operating and maintaining the distribution system to the standards prescribed by the Act and WPD (South West) plc's Electricity Distribution Licence, other than those costs which are recovered through charges paid to WPD (South West) plc in respect of connection to the system, such that electricity can be transported efficiently through the system to exit points; and
  - the costs to WPD (South West) plc of providing certain services and performing functions for Supplier or Generators, on terms which WPD (South West) plc is under a duty to offer under its Electricity Distribution Licence, in order to support the operations of a fully competitive supply market in its authorised area. These services include: Metering Point Administration Services; Energisation and De-energisation and Re-energisation services; and Radio Teleswitch Services. WPD (South West) plc is either wholly or partly remunerated through use of system charges or through transaction charges for these services. The cost for provision of these services is detailed in our Licence Condition 14 Statements.

All charges for use of the system include a reasonable return on the relevant assets, and the revenues arising from the charges are subject to regulation in accordance with the terms of the Licence.

3. Charges are applied to the electricity as measured at the exit points for the whole of the site.
4. Depending on the tariff, the charges for use of the system may include some or all of the following elements:

- **Fixed or daily charges** to cover the costs that do not vary with the extent to which the supply is taken up;
  - 
  - an **availability charge** to cover capacity on the local distribution system, which is attributed to the supply in the case of LV and HV supplies;
  - **unit charges** per kWh unit delivered to the exit point from the system, designed to reflect use of the system at all relevant voltages;
  - an **excess reactive unit charge** per kVArh unit delivered to the exit point from the system. The excess reactive power charge provides a behavioural pricing signal to customers to improve their power factor. Reactive power charges are applied only to those customers who exhibit poor power factors; and
  - **operation and maintenance charges** to cover operation and maintenance of sole use assets.
  - a **network access rebate** for generators which provides rebates for network unavailability.
5. The fixed charges for use of the system referenced above may include an amount to reflect the cost of provision of the service cable to the premises and its termination, ongoing repair and maintenance, replacement and a contribution to the costs of the local network except as recovered within the connection charge.
6. Charges for use of the system will be payable in accordance with the DCUSA. Security will be required in accordance with DCUSA.

7. Where a supply is to be provided wholly or partly over WPD (South West) plc's distribution system to an exit point from that system, the supplier must demonstrate that at all times the quantity of electricity entering the system for the purposes of providing that supply equals the metered quantity delivered from the system to that exit point plus the amount of electrical losses appropriate to the voltage at which the supply is delivered and to the source of the supply as shown in the tables of loss adjustment factors published in our Licence Condition 14 Statement. WPD (South West) plc is regulated on total electrical losses on its system through a yardstick in the Licence price condition, and the adjustment factors are an allocation of the total. Relevant metering information or membership of the Balancing & Settlement Code will be considered to be adequate demonstration. Suppliers should refer to the tables to calculate the amount of electricity which they must provide. The same loss adjustment factors are reflected automatically in the settlement system.
8. Where the supply is to be provided over WPD (South West) plc's distribution system on either an intermittent or continuing basis to any premises with own generation, charges for use of the system will be levied with respect to the system capacity provided to meet the maximum power required to be supplied to the premises as requested by the party seeking use of the system and the extent to which that supply is taken up. These take the form of availability charges.
9. Where, after evaluation of the characteristics of the requested use of the system, WPD (South West) plc accepts that none of the categories of charges in the attached schedules is appropriate, WPD (South West) plc will offer special arrangements. It is expected that these circumstances will be very rare. This may include cases where multiple exit points are separately supplied at a site. In these circumstances, the use of system charges offered will be based on the same principles to those used for determining the charges in the schedules and will include some or all of the elements detailed in paragraph 4. WPD (South West) plc will endeavour to make its offer of terms within 28 days of receiving the application.
10. For supplies provided at EHV or for premises with demands close to or above 10MW, use of system charges at the voltage of connection will be individually costed to take account of the specific WPD (South West) plc connection assets employed in providing connection. For sites of this type, the charges will include an appropriate component to meet the charges levied on WPD (South West) plc by the National Grid Electricity Transmission plc in respect of Exit Charges at Grid Supply Points.
11. Where use of the system is sought at a standard of security different from that referred to in the Distribution Code, WPD (South West) plc may consider special arrangements with respect to that supply. Special arrangements may apply also to supplies/loads with power factors of less than 0.8. In such cases, specially assessed loss adjustment factors may also apply at WPD (South West) plc's discretion.

12. In all cases for demand use of system, use of system charges include a contribution towards recovery of NGET's connection (exit) charges in respect of the provision by them of WPD (South West) plc's Grid Supply Points.
13. Use of System charges exclude charges for the provision of non-half hourly distributor metering and data services that are published separately in the "Statement of the Basis of Charges for Metering and Data Services provided by Western Power Distribution (South West) plc". That statement details charges for the provision of disaggregated non-half hourly metering services; Meter Asset Provision (MAP), Meter Asset Maintenance (MAM) and Meter Point Administration Service (MPAS).

## **Methodology**

### **Use of System Charges for LV, HV and EHV networks**

Different methodologies are used to calculate charges for the EHV network and lower voltage networks respectively. EHV networks use a long run incremental costs method (LRIC) and lower voltage networks the CDCM method.

The boundary between the two methods is the lower voltage side busbar of the EHV to HV transformation.

### **Long run incremental cost methodology**

The method calculates the brought forward (or deferred) reinforcement cost as a result of the addition of an increment of demand or generation at each node.

#### Model inputs

- The EHV network expected to exist in the year that charges are being calculated for. The network is detailed in our Long Term Development Statement (published in accordance with Licence Condition 25)
- The security factors applicable to each asset derived from a full N-1 contingency analysis of the network
- A modern equivalent asset (MEA) value for each element of the EHV network
- An assessment of future reinforcement costs for each element of the EHV network
- Network demands expected for the year that charges are being calculated for.
- Generation exports consistent with the export that can be used to support system security in accordance with P2/6 expected for the year that charges are being calculated for
- The underlying demand and generation growth forecast for the medium term

#### Calculation

An initial load flow is undertaken and the time that it will take for each component to reach its capacity is evaluated using the underlying load growths. Given these timings, and the future reinforcement costs, a net present value of the future reinforcement cost for the network is calculated using a discount rate equal to the cost of capital assessed by Ofgem as part of the price control (currently 5.6%).

For each node, an increment of demand/generation is added and a new load flow generated. The evaluation of the net present value of the future reinforcement needs is repeated for the network with this increment present. The difference between the initial and incremental study represents the impact on future reinforcement investment and this is represented as an annual £/kVA at each node by multiplying the difference by an annuity factor. The annuity factor reflects the rate of return on investment and an allowance for operation, repairs and maintenance (the latter is currently 0.9%).

A full AC load flow is used in the methodology. The increment used is 0.1 MVA at 0.95 power factor for demand and unity power factor for generation. The assets used to calculate the locational price are those that see a change in flow greater than 1kVA as a result of the increment.

The algorithm used to achieve the above is as follows:

The long run incremental cost at node N is given by

$$LRIC_N = \sum_i \Delta U_i$$

Where:

$\Delta U_i$  is the change in the net present value of the future reinforcement cost of the network as a result of the incremental injection  $\Delta P_{in}$  given by the equation

$$\Delta U_i = A \times V \times \left( \frac{1}{(1+d)^{n2}} - \frac{1}{(1+d)^{n1}} \right)$$

Where:

A is a 40 year annuity calculated as

$$A = \frac{d}{\frac{1}{(1 - (\frac{1}{1+d}))^{40}}}}$$

V is the cost of the reinforcement when the asset becomes overloaded

d is the discount rate (the regulatory cost of capital of 5.6% is used)

n1 is the original number of years to reinforcement given by

$$n1 = \frac{\log C_1 - \log D_1}{\log(1 + r)}$$

Where:

$C_1$  is the capacity of asset 1

$D_1$  is the power flow in asset 1 and

$r$  is the expected growth rate

and  $n_2$  is the new number of years to reinforcement following a change in the flow ( $\Delta P_1$ ) through asset 1 as a result of the injection at node N is given by

$$n_2 = \frac{\log C_1 - \log (D_1 + \Delta P_1)}{\log(1 + r)}$$

The above analysis is undertaken for both winter loading conditions and summer loading conditions using the appropriate ratings for the season.

#### Detailed model input assumptions

EHV network used - the EHV network used is the existing and committed network that is expected to exist in the December of the year that charges are to be calculated for. New connections expected to connect during the year that charges are being calculated for will only be included where a connection offer has been accepted and all consents have been obtained. A further set of charges will be calculated using customers' loads/generation for all those with accepted connection offers. The network model will include any changes required to accommodate these loads/generation. This enables potential users to see the charges they will incur if their connection proceeds and allows existing users to see the potential impact on their charges in future years. These additional charges will be published separately to our condition 14 charging statement. Where there is expected to be a system overload, for example due to a derogation the expected system changes to resolve the overload are included in the network mode used for charging purposes.

Demands used – for the winter peak demands, the model uses demands consistent with those used to assess reinforcement. This includes diversity to allow a complete EHV system model to be run. Summer minimum demands are taken as being a percentage of winter peak demands. This percentage is derived for each GSP and applied to the demands supplied by that GSP. These are consistent with the annual data we provide to NGET under the Grid Code.

Generation Exports used – the generation export used during the winter period is generally zero unless it is deemed to contribute to security under P2/6. The generation export used for the summer period is the maximum agreed export capacity. These are the same assumptions that are used for investment planning.

Security factors – Security factors have been assessed for each asset using a full N-1 contingency analysis. These factors are recalculated each time the network is changed or new load estimates used.

Growth rates – two underlying growth rates are used to assess future reinforcement timing, one for demand growth and one for generation. To facilitate predictability and stability, the same growth rates are used throughout the model and will only be reset at price controls.

Reinforcement costs – A modern equivalent asset (MEA) value for each element of the EHV network is used. Reinforcement costs are set as a multiple of the MEA value of the asset needing reinforcement. These are derived using data from historic projects and will be reassessed periodically.

An example of how the LRIC method works is shown in attachment 1.

### **Calculation of site specific charges**

For individual EHV connected customers, the winter demand used for charging purposes (winter charging demand) is calculated by weighting together the customers average demands in the time periods ending 17.00, 17.30 and 18.00 during winter weekdays (excluding Christmas and New Year) over the months November to February for the latest year that data is available. The weights used are 38%, 48% and 14% for the half hours ending 17.00, 17.30 and 18.00 respectively and are consistent with those used to derive coincidence factors for lower voltage tariffs. The summer demand used for charging purposes (summer charging demand) for individual EHV customers is the average of their demand in the time periods ending 06.00 on Sundays in the months of July and August. Where the connection is new or significant changes have been made to the agreed capacity a best estimate will be used for the winter charging demand and summer charging demand taking into account the typical ratio seen of agreed supply capacities to charging demands for existing customers.

For connections to other Licence Distributors, the demand used for charging purposes (both winter charging demand and summer charging demand) is that agreed between WPD and the distributor. We would expect this to be the level of capacity necessary to allow them to achieve compliance with their security standard.

For EHV demand sites, the charge is calculated as follows:

- For each branch used by the demand determine whether reinforcement is driven first by winter or summer conditions.
- Where winter, the branch charge is the winter price multiplied by the winter charging demand at the time of peak
- Where summer, the branch charge is the negative of the summer price multiplied by the summer charging demand
- The demand charge is the sum of;
  - the relevant branch charges
  - the annuitised cost of the future replacement value of the sole use assets associated with the connection point
  - the O&M cost associated with the sole use assets associated with the connection point
  - the allocation of network rates

These charges are further adjusted by the revenue reconciliation process described below. Where the resulting demand charge is negative, the scaled marginal £/kVA charge will be set to zero and the overall reconciliation to allowed revenue adjusted accordingly.

For EHV generation sites, the charge is calculated as follows:

- For each branch used by the generation determine whether reinforcement is driven first by winter or summer conditions.
- Where summer, the branch charge is the summer price multiplied by the agreed export capacity
- Where winter, the branch charge is the negative of the winter price multiplied by the P2/6 contribution to security.
- The generator price is the sum of;
  - the relevant branch charges
  - the annuitised cost of the future replacement value of the sole use assets associated with the connection point
  - the O&M cost associated with the sole use assets associated with the connection point

These charges are further adjusted by the revenue reconciliation process described below.

When an EHV distributed generator accepts a connection offer, the applicable Agreed Export Capacity will remain fixed for 5 years.

### **EHV Generators with connection agreements dated pre April 1<sup>st</sup> 2005**

Charging arrangements for EHV generators connected prior to 1<sup>st</sup> April 2005 are subject to appropriate charging arrangements being developed through industry collaboration. Until this is developed, no charges will apply to these generators.

If a generator connected prior to April 1<sup>st</sup> 2005 makes a significant alteration to their export requirement (due to, for example, increased export capacity) the incremental increase in export capacity will be charged generator use of system on the same basis as post April 1<sup>st</sup> 2005 generators.

### **Reconciliation of LRIC and CDCM output to required revenue**

The CDCM requires a target revenue excluding charges that will be made to EHV connections. EHV target revenue for the LRIC model is determined as follows:

- Total target revenue is the sum of all regulated income.
- Excluding rates and NGET exit charges the total required revenue is split between the EHV network and lower voltage networks using the 500MW model used in the CDCM.
- NGET exit charges are recovered with the reconciliation of the LRIC part of the model
- At the EHV level reconciliation will be made by a £/kVA adder using the winter total kVA
- The £/kVA adder is only applied to demand connections

The LRIC model recovers forecast network rates in proportion to the revenue recovered.

Where after the revenue reconciliation process the resulting EHV demand charge is negative, the £/kVA charge applicable to that demand site will be set to zero and the overall reconciliation to required revenue adjusted accordingly.

### **Setting Prices using the LRIC Model**

For EHV demand sites the fixed charge is set to recover the marginal charge as determined under the LRIC approach plus the annuitised cost of the future replacement and O&M costs of all sole use assets; both on site and off site. The charge per kVA per day is set to recover all other costs including the £/kVA adder applied within the LRIC approach. For EHV customers with power factors worse than 0.95 the charge will show the reduction in charge that would result from operating at an improved power factor. For EHV generation sites, charges will be recovered on a charge per kVA per day basis.

When a licensed distribution network operator connects a network to WPD's System, capacity may be taken up over a period of time up to 3 years from the date of initial energisation. In these circumstances, the capacity used for DUoS charging purposes will also be allowed to rise over time in line with the specified incremental required capacity as agreed under the Bilateral Connection Agreement.

Arrangements for review of the Required Capacity are detailed in the Connection Charging Methodology.

### **Network Unavailability Rebate Payments**

A compensation payment may be payable to customers for network outages.

For customers with generation connected at EHV and who have agreed a standard connection the following scheme will apply. This scheme is known as Distributed Generation Network Unavailability Rebate and payments will be calculated for each generator on the following basis:

$$\text{Payment} = A * B * (C - D)$$

Where:

A = the network unavailability price of £2 per MW per hour.

B = incentivised generator capacity; the highest active electrical power that can be generated (or the relevant incremental change of this amount in cases of the expansion of existing generation plant) by the generator for the year, according to the connection and/or use of system agreement(s).

C = network interruption duration; the total duration of all occurrences (in minutes) on the distribution system each of which involves a physical break in the circuit between itself and the rest of the system or due to any other open circuit condition, which prevents the generator from exporting power. It excludes:

- - 50 per cent of the total duration of cases where the DNO takes pre-arranged outages of its equipment for which the statutory notification has been issued to the generator;
- - the cases where the generator has specific exemption agreements with the DNO in the connection and/or use of system agreement(s); and

- - the cases which are part of exempted events in the quality of service incentive or the Guaranteed Standard Statutory Instrument (such exemptions include interruptions of less than three minutes duration and industrial action).

D = the baseline network interruption duration for the relevant year which either has a default value of zero or some other value agreed between the customer and the DNO and recorded within either; the connection offer, connection agreement and/or use of system agreement(s).

Distributed Generation Network Unavailability Rebate scheme payments will be calculated by the network operator on an annual basis (1st April - 31st March) and payments made shortly after the end of each year. This payment is automatic and does not need to be claimed by the generation customer. The de minimis level of rebate is £5.

## Glossary

the Act	The Electricity Act 1989 as amended by the Utilities Act 2000
the Licence	The Electricity Distribution Licence granted to Western Power Distribution (South West) plc under Section 6 (1) (c) of the Act
the Authority	The Gas and Electricity Markets Authority (GEMA) as established by the Act
OFGEM	The Office of Gas and Electricity Markets
WPD (South West) plc	Western Power Distribution (South West) plc
NGET	National Grid Electricity Transmission – who own and operate the transmission network in England and Wales
MRA	Master Registration Agreement – the multi-party agreement that all Licensed Suppliers and Distributors have entered into that governs the interactions between them
BSC	Balancing and Settlements Code – wholesale electricity trading arrangements introduced in England and Wales in 2001
Distribution Code	The Distribution Code of the Distributors of Great Britain ( <a href="http://www.dcode.org.uk">www.dcode.org.uk</a> ); produced in accordance with Condition 9 of the Licence and approved by the Authority to define the technical aspects and planning criteria of the working relationship between the Distributor and all those connected to its distribution system
EHV	Extra High Voltage – A voltage of 22kV or above or at a sub-station with a primary voltage of 66kV or above.
HV	High Voltage – 6,600 volts or 11,000 volts plus or minus 6% measured between any two phase conductors
LV	230 volts plus 10% or minus 6% measured between the neutral and any phase conductor
S/S	Electricity Substation – voltage transformation points
O/H	Overhead Lines
U/G	Underground Cables
O&M	Operation, Repair and Maintenance
DG	Distributed Generation
MPAN	Meter Point Administration Number
LTDS	Long Term Development Statement as required under SLC 25
NER P2/6	System security standard applicable to the network in accordance with SLC 5
LRIC	Long run incremental cost methodology use to derive charges for the EHV network
CDCM	Common Distribution Charging methodology

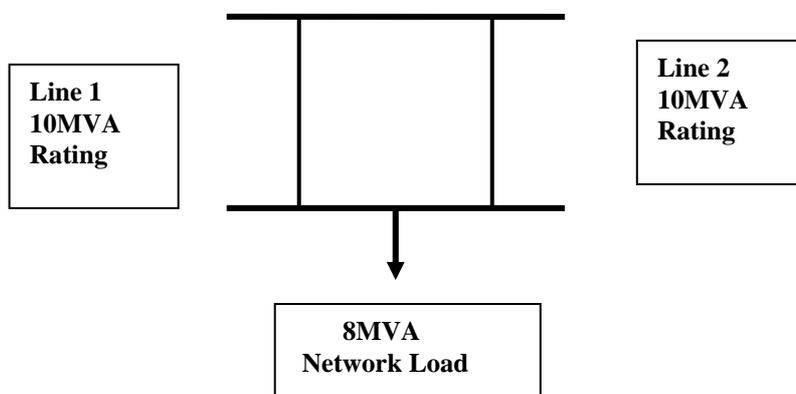
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## Appendix 1

Example of LRIC method

Taking a simple two feeder network as follows:



The long run incremental cost is given by:

$$LRIC_N = \sum_1 \Delta U_1 = 2 \times 3,838 = \text{£}7,676/\text{MVA}$$

Where:

$\Delta U_1$  is the change in the net present value of the future reinforcement cost of each feeder as a result of the incremental injection of 1MVA ( $\Delta P_{in}$ ) (this will be shared equally by the two feeders) given by the equation

$$\Delta U_1 = A \times V \times \left( \frac{1}{(1+d)^{n_2}} - \frac{1}{(1+d)^{n_1}} \right) = 0.0721 \times 200,000 \times \left( \frac{1}{(1+0.056)^{10.6}} - \frac{1}{(1+0.056)^{22.4}} \right)$$

$$= \text{£}3,838/\text{MW}$$

Where:

A is a 40 year annuity calculated as

$$A = \frac{d}{1 - \left( \frac{1}{(1+d)^{40}} \right)} = \frac{0.056}{1 - \left( \frac{1}{(1+0.056)^{40}} \right)} = 0.06314 \text{ i.e. } 6.31\% \text{ plus a } 0.9\% \text{ O\&M uplift} = 7.21\%$$

V is the cost of the reinforcement when the asset becomes overloaded, £200,000

d is the discount rate (the regulatory cost of capital of 5.6% is used)

n1 is the original number of years to reinforcement given by

$$n1 = \frac{\log C_1 - \log D_1}{\log(1 + r)} = \frac{\log 5 - \log 4}{\log(1+0.01)} = 22.4 \text{ years}$$

Where:

C1 is the capacity of asset 1, 10MVA

D1 is the power flow in asset 1 , 4MVA and

r is the expected growth rate, 1%

and n2 is the new number of years to reinforcement following a change in the flow of 0.5MVA (as increase in load at node of 1MW will be equally shared between the two feeders) ( $\Delta P_1$ ) through asset 1 as a result of the injection at node N is given by

$$n2 = \frac{\log C_1 - \log (D_1 + \Delta P_1)}{\log(1 + r)} = \frac{\log 5 - \log(4+0.5)}{\log(1+0.01)} = 10.6 \text{ years}$$

## Appendix 2

### 1. Loss Adjustment Factor Methodology

- 1.1. This appendix describes the methodologies applied by Western Power Distribution (WPD) in the calculation of its loss adjustment factors for authorised users of its distribution network in 2006/2007.
- 1.2. WPD is not required to publish a statement detailing its methodology for the calculation of its published loss adjustment factors but has chosen to prepare this statement to provide clarity and transparency. This appendix is not approved by and is not subject to approval by the Authority.
- 1.3. WPD is obliged by Standard Condition 14 of the Distribution License to publish a “schedule of adjustment factors” in our Condition 14 statement.
- 1.4. WPD’s loss adjustment factors are determined through the application of two methodologies. Generic loss adjustment factors are calculated using the methodology and software developed in the late 1990s by EA Technology, in conjunction with several other distribution businesses from England & Wales. For a number of customers, generally those connected at EHV or with demands close to or above 10MW and those CVA registered users LAFs are individually calculated.

### 2. Calculated System Losses

- 2.1. Losses fall into two categories, fixed losses and variable losses. Fixed losses are dependent on the presence of voltage differences and do not vary significantly with load. The most significant contributions to fixed losses come from iron losses in transformers and dielectric losses on the 132kV system. Variable losses vary with the magnitude of the current such as ohmic losses in conductors and transformer windings.
- 2.2. In order to calculate the LAFs, a fixed loss constant and a variable loss constant are required. The value of each loss constant is directly linked to system configuration. Therefore, any alterations or additions to the electrical network will result in an adjustment to the value of the fixed and the variable loss constants.
- 2.3. The fixed and variable loss constants are derived from system data such as length of underground cable and overhead line network, number of feeders and transformer capacity.
- 2.4. The total annual system losses are the difference between the annual units supplied at the connection points with National Grid together with the contribution from Distributed Generation within WPD’s distribution network and the annual units sold. The EA Technology model allocates these losses to the units distributed at the various voltage levels, after making an allowance for unmetered usage. LAFs can then be calculated which recover the losses attributable to unit consumption within each tariff period at each voltage level.

### 3. Site Specific Loss Adjustment Factor Methodology

- 3.1. Site Specific Loss Adjustment Factors are calculated for a number of customers, generally those connected at EHV or with demands close to or above 10MW and those CVA registered authorised users.
- 3.2. Individual LAFs are calculated for each half hour using individual customer's half hourly load profiles at the appropriate voltage level. Mean LAFs are then allocated to the different tariff periods as indicated below:

Period 1	1600 -1900 Mon - Fri Nov - Feb'
Period 2	0630 - 1600 Mon - Fri Nov - Feb'
Period 3	2330 - 0630'
Period 4	Other

### 4. Generic Loss Adjustment Factor Methodology

- 4.1. Generic loss adjustment factors are calculated for all remaining SVA registered authorised users. The allocation methodology and software program developed by EA Technology in the late 1990s is utilised to calculate the generic loss adjustment factors.
- 4.2. The voltage levels of 132kV, 66kV, 33kV, 11kV and LV and the transformation levels are represented within a network model. The model is populated with the set of standing data. For example, the fixed loss constant in megawatts and the variable loss constant per megawatt for each voltage and transformation level are contained within the standing data.
- 4.3. The model is also populated with the metered volumes of energy per annum at the various network voltages, including the energy metered at the connection points with National Grid Company and the contribution from Distributed Generation within WPD's distribution network. This metered data is transformed into half-hourly data using the settlement profiles, Profile Classes 1 to 8.
- 4.4. Loss Adjustment Factors are calculated at all voltage levels for every half hour period throughout the year.
- 4.5. As a simple overview, the 'LAF' program determines the power passed through the network into the voltage level below by:

$$P_{out} = P_{in} - v \times P_{in}^2 - f - L$$

Where:

$P_{in}$  = Power into voltage level from higher voltage level

$P_{out}$  = Power out of voltage level into lower voltage level

L = Half hourly metered net sales at voltage level

f = Fixed loss constant for voltage level

v = Variable loss constant for voltage level

- 4.6. This is repeated through the voltage and transformation levels until the LV network is reached. This produces the first estimate of the LV network non half-hourly metered load in every half-hour. As we have used the settlement profiles, these values will differ from the meter readings and therefore the program undertakes a series of iterative cycles to match the two values.
- 4.7. The program adjusts the variable losses by amending the variable loss constants. Greater weight is assigned to the 11kV network, 11kV/LV transition and LV network as the greatest losses are generated at these networks coupled with the greatest uncertainty in the losses figures.
- 4.8. This results in the losses for the whole period and the losses for each half-hour for each voltage and transformation level being calculated and therefore the half-hourly loss adjustment factors are calculated.
- 4.9. Within Western Power Distribution, there is an overall target loss figure that is typically 6.1% for the South West as a percentage of imports.

## **5. Contact Details**

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

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