

Reactive Power Methodology and Charges		UU/002.1
Title: Modification proposal to implement a new Reactive Power Charging Methodology and Charges from 1 st April 2006.		
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Description of the Proposed Modification:		
<p>United Utilities proposes to implement a new reactive power methodology for the calculation of excess reactive unit charges and to re-align the threshold for the charging for excess reactive units (kVArh) consumed from 50% of number of active units (kWh) distributed (ie a power factor of 0.9) to 33% of number of active units distributed (ie a power factor of 0.95) to be consistent with the assumptions of the Distribution Reinforcement Model (commonly known as the 500MW model).</p>		
Reasons for the change with an explanation of how the proposed change better meets the relevant objectives:		
<p>Ofgem conditionally approved United Utilities' Licence Condition 4 (Use of System Charging Methodology) statement in February 2005. The conditional approval of the statement related to the United Utilities EHV demand transition arrangements, but in their constructive feedback on the statement Ofgem suggested further explanation on the calculation of the excess reactive unit charges. United Utilities recognised that the 'approved excess reactive power methodology and charges' may not provide sufficient transparency or clarity to network users and agreed to review its approach during 2005/6 in order to provide a greater level of transparency and reassurance that the reactive unit charges are cost reflective.</p>		
Current excess reactive power charging methodology		
<p>United Utilities levies reactive power charges on every additional kVArh unit above 50% of kWh units (i.e. at power factor of 0.9) and the reactive unit charges for 2005/6 are:</p> <ul style="list-style-type: none"> • 0.56 pence/kVArh for LV MD customers¹; and • 0.36 pence/kVArh for HV MD and EHV customers¹. 		
<p>United Utilities explains in paragraph 3.5 of Section 3 of its Licence Condition 4 statement the reasons for charging reactive units are that "reactive power charges are levied to recover the extra costs of providing the additional capacity needed to deliver their [the customer's] requirements. The reactive power charge expressed in pence/kVArh is calculated as the incremental cost of providing one unit of reactive power over the norm". No further reactive power information is included in the LC4 or LC4A statements.</p>		
Proposed excess reactive power charging methodology		
<p>United Utilities' review of the excess reactive power methodology examined the basis for the levying of excess reactive units and methodology of the reactive unit charges for each customer class. United Utilities considered a review to be important, as the details of the current methodology and the application of the current charges (having been applied since 1996/7) are unclear.</p>		
<p>The principle of levying a charge for the consumption of excess reactive power units is to recover the additional costs of providing the additional capacity needed to deliver the customer's requirements, operating at a poor power factor. During the annual tariff development process the 500MW model produces a matrix of yardsticks, shown in values of £/kW/year, which reflect the costs of the voltage and transformation levels of the network model. The yardsticks table for 2006/7 is shown overleaf.</p>		

¹ Demand customers and generation customers who are importing active units.

Connect	132kV	132/33	33kV	33/11kV	11kV	11kV/LV	LV	Total
at LV	£5.50	£3.69	£9.15	£7.51	£9.46	£8.63	£6.69	£50.63
at HV	£5.23	£3.51	£8.71	£6.27	£6.52			£30.23
at EHV	£5.16	£3.20	£7.50					£15.87

These yardstick values form the base costs from which use of system tariffs are developed. For each customer class² (at the respective voltage level), an excess reactive unit charge may be derived from the incremental change in the yardstick³ (for a defined change in power factor) divided by the incremental change in the kVAr (for the same change in power factor), adjusted by the customer class load factor to give the cost of an additional reactive unit (in pence/kVArh). For clarity this calculation is described below in six steps. The first three steps derive the costs of delivering a kWh at different power factors; the following three steps focus on the incremental effects of varying power factor, in terms of cost and unit volume, in order to derive prices. For each customer class at the respective voltage level:

1. Calculate the yardstick excluding the fraction used in the availability charge calculation (in £/kW pa), recognising that this assumes a power factor of 0.95.
2. Convert this to pence/kWh by dividing by the kWh/kW pa for the customer class and multiplying by one hundred.
3. For the range of power factors from 0.95 through to 0.05 (in increments of 0.05), derive the "adjusted pence/kWh" by multiplying the "yardstick pence/kWh" (calculated in step two above) by the ratio of 0.95 (the network design power factor) to the new power factor.
4. Derive, from the table produced in step three above, the incremental cost, in pence/kWh, of moving to each of the tabulated power factors, thereby defining power factor bands.
5. Calculate, and tabulate, the incremental change in reactive units per kWh (kVArh/kWh) for the same range of power factors bands.
6. Divide the incremental cost effect (shown in step four above) by the incremental reactive units (shown in step five above) to provide the excess reactive unit charge (in pence/kVArh) for each power factor band.

The output of this methodology is a matrix of the calculated charges for excess reactive units at a range of power factor per customer class. The table below shows an illustrative range of excess reactive unit charges (in pence/kVArh) derived from the LV yardstick for LV MD (from network) customers.

Bands	0.95 to 0.9	0.9 to 0.85	0.85 to 0.8	0.8 to 0.75	0.75 to 0.7	0.7 to 0.65	0.65 to 0.6	0.6 to 0.55	0.55 to 0.5	0.5 to 0.45	0.45 to 0.4	0.4 to 0.35	0.35 to 0.3	0.3 to 0.25	0.25 to 0.2	0.2 to 0.15	0.15 to 0.1	0.1 to 0.05
p/kVArh	0.329	0.423	0.495	0.553	0.603	0.647	0.684	0.717	0.746	0.771	0.793	0.812	0.829	0.843	0.854	0.863	0.870	0.874

It is proposed to implement from 1st April 2006 this approach for the calculation of the excess reactive unit charges as it better fulfils the cost reflective requirement of the relevant objectives of the distribution licence than the current approved methodology.

United Utilities' 500MW model has been developed with a network design (and therefore, constructed assets) based on the assumption of an average power factor of 0.95. But the calculation of chargeable reactive units levied on network users currently starts at 50% of active units distributed (ie at a power factor of 0.9). Anyone operating at a power factor of less than the 'norm' of 0.95 but above the chargeable threshold of power factor 0.9 does not incur charges, even though additional costs are incurred. It is proposed to remove this discrepancy (between the power factor assumption of the network design of the 500MW and the threshold at which reactive units are charged) by re-setting the threshold for charging excess reactive units to 33% of kWh active units distributed (ie at a power factor of 0.95) from 1st April 2006. This ensures that anyone operating below the 'normal' power factor of less than 0.95 incurs excess reactive power charges.

² Customer groupings are LV MD from network, LV MD substation, HV MD from network, HV MD substation and EHV.

³ The yardstick value used in the reactive power methodology excludes the element of the yardstick used in the calculation of the availability charge.

Illustrative charge, where the proposal results in changes, and details of which customers will be affected by the change:

United Utilities aims, through the use of reactive power charges, to encourage network users⁴ to utilise the distribution network efficiently. An excess reactive unit charge shall be levied in order to recover the additional costs imposed by inefficient utilisation of the network assets provided for their use. Excess reactive power consumption may be avoided by the use of corrective equipment, installed at a customer's premises. Reactive power charges will be levied on every additional kVArh unit consumed above 33% of kWh active units (i.e. at power factor of 0.95) for all customers fitted with reactive metering. Excess reactive power charges shall be levied only on those NHH MD customers⁵ that have reactive metering fitted and all HH MD customers⁵ that meet the above criteria.

To enable the implementation of a matrix of charges for every customer group requires a billing system that is capable of calculating the power factor in every half hour, calculating whether there are chargeable reactive units in that half hour, selecting the tariff to which the reactive units must be applied for that customer, multiply chargeable reactive units by the selected tariff and aggregating the half-hourly products for each billing period. This approach is theoretically the most appropriate solution as it calculates excess reactive charges every half hour and applies a higher charge for those customers with lower power factors. But applying this approach requires a significant change in processing power and capacity over and above the capability of the current billing system.

United Utilities' is not minded to increase the complexity of the calculation of reactive power charges in this interim period before the development and implementation of an enduring solution for the longer term. The introduction of a variant excess reactive power calculation considerably different and more complex than the current practices employed by the distribution business would impose a heavy burden on suppliers and/or end users that intend to confirm the charges levied by United Utilities. United Utilities proposes to apply a single excess reactive unit charge per customer group for simplicity and practicality. The single charge, calculated by demand weighting the range of charges, will be applied across all users (in a customer group) whatever their power factor. It is proposed to add a seventh step to the methodology described overleaf detailed as follows:

7. The seventh, and final step, is to calculate a single excess reactive unit charge per customer class by taking the average of the reactive unit charges weighted by the chargeable reactive units for each power factor band.

The table below compares illustrative excess reactive unit charges per customer class calculated from this described methodology against the current approved methodology.

	Proposed charges
LV MD from network	0.500
LV MD substation	0.450
HV MD from network	0.240
HV MD substation	0.120
EHV	0.090

Note, values shown in pence/kVArh

Proposed wording for the methodology statement and (if applicable) the charging statement:

The proposed changes to United Utilities' Licence Condition 4 and 4A statements are shown below. Additions are highlighted in blue and deletions are shown as strikethrough.

Licence Condition 4 (Use of System Charging Methodology) Statement

2.13 Where use of the system is sought at a standard of security different from that referred to in the Distribution Code United Utilities may consider special arrangements with respect to that supply. Where the power factor of the supply is less than 0.905, it will normally be possible for

⁴ For the avoidance of doubt 'network users' means all demand and generation customers who have reactive power metering fitted.

⁵ For the avoidance of doubt the proposed charging threshold impacts all demand customers and only generation customers importing active units whilst the proposed charges impacts all demand and generation customers.

United Utilities to offer use of system, subject to paying appropriate charges (see our Licence Condition 4A document titled 'Statement of Charges for Use of United Utilities Electricity PLC's Electricity Distribution Network', Tables 2A, 2B and 3). In such cases, specially assessed loss adjustment factors may apply at United Utilities' discretion.

- 3.5 To calculate the yardstick costs, the model is developed for each class of customer. The model takes into account the costs at each level of the system, from 132 kV to LV, building in diversity factors to reflect the usage of network remote from the connection point and once divided by 500 MW, derives the £/kW yardstick cost. Average load factors and assumed coincidence factors and power factors are then utilised, to turn the £/kW into a cost reflective unit rate, expressed in £/kWh, for the customer class.

The 500 MW model assumes an average power factor within the range 0.95 leading and 0.95 lagging, so for customers whose power factor deviates from the norm, **excess** reactive power charges are also levied to recover the extra costs of providing the additional capacity needed to deliver their requirements. The **excess** reactive power charge expressed in **pence/kVArh** is calculated as the incremental cost of providing one unit of reactive power over the norm. Reactive power charges are only applied to those kVArh units in excess of **half a third** of the kWh units supplied.

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- 3.9 **Excess reactive power charges are derived from the same network yardstick costs used for other DUoS components. However those elements of the yardstick that are recovered through kVA based availability charges are excluded. What remains are network yardstick costs that are recovered on a kW or kWh basis. Since standard kW and kWh charges assume a power factor of 0.95, the excess reactive power charge is based on the variation in the appropriate yardstick costs as power factor varies below 0.95. These costs are converted into a p/kVArh charge using the customer class load factor and the weighted average power factor for qualifying customers.**

- 7.1 Chargeable reactive power units

A reactive power charge is made for each kVArh in excess of **5033%** of the number of **active** units (kWh) distributed in each month. This represents a threshold value for power factor of **0.95**, below which reactive units are chargeable. The diagram below shows the calculation of power factor.

Licence Condition 4A (Use of System Charges) Statement

- 5.21 For each kVArh consumed in excess of **5033%** of the number of units (kWh) distributed in each month, a Reactive Power charge is made.

A timetable for the implementation of the modification and charge changes:

It is proposed to implement the new regime from 1st April 2006.