UNION OF THE ELECTRICITY INDUSTRY
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Union of the Electricity Industry - EURELECTRIC
Comments on the ERGEG Position Paper for Public Consultation on Treatment of Losses by Network Operators

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Comments on the ERGEG Position Paper for Public Consultation on Treatment of Losses by Network Operators

This Paper was drafted by **WG Distribution Regulation & Policy** and **WG Distribution Smart Grids/Network of the Future** and approved by the Networks Committee on 8th October.

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The Union of the Electricity Industry - EURELECTRIC, is the sector association representing the common interests of the European Electricity Industry and its worldwide affiliates and associates. Its mission is to contribute to the development and competitiveness of the Electricity Industry and to promote the role of electricity in the advancement of society.

EURELECTRIC pursues in all its activities the application of the following sustainable development values:

Economic Development
Growth, added-value, efficiency

Environmental Leadership
Commitment, innovation, pro-activeness

Social Responsibility
Transparency, ethics, accountability

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1. Introduction and General Comments

The European Regulators' Group for electricity and gas (ERGEG) has issued an analysis of network losses giving an overview of national practices regarding the definition, procurement and financial recovery of network losses and incentives for their reduction. Furthermore, the paper shows the current practices regarding network losses in Europe by means of representative case studies from some Member States and comparative analysis.

In addition, the paper discusses relevant features that need to be tackled in order to promote a level playing-field in the treatment of losses at a Europe-wide level. To this end, some questions are put to stakeholders during this public consultation.

The ERGEG Position Paper together with the public consultation are intended to serve as the background for further discussions and for the development of Guidelines of Good Practice on losses, which will serve as the basis for future more detailed technical rules and / or codes according to the proposed amended Regulation 1228/2003[1].

EURELECTRIC welcomes the work done by ERGEG and takes the opportunity to contribute to the process with this set of comments on the Position Paper.

Modern economies are essentially dependent on reliable, secure and high quality electricity services. Electricity makes a fundamental contribution to economic performance, international competitiveness and community prosperity. The electricity sector is continually improving its efficiency over all parts of supply chain. The strong worldwide competition the European industry is facing, plus the continuously growing importance of information and communication technology for economic activities and prosperity, in industry, services and households, are reinforcing reliance on high-quality electricity networks services and on energy efficiency. Europe has always enjoyed a good level of quality of electricity supply. EURELECTRIC is pleased to note that ERGEG concludes that there is a need to assess and possibly improve the treatment of network losses and implement adequate incentives for reducing them further. This can encourage transmission system operators (TSOs) and distribution system operators (DSOs) to perform efficiently with regard to the priority given to energy efficiency improvements in general and to the reduction of electricity network losses in particular.

There is also a tendency for regulators to increasingly demand higher continuity, a more secure transmission and distribution system and in some cases higher energy efficiency values on the assumption that the benefits to electricity customers of such higher standards justify the costs involved to reduce network losses. However, increasing the present level of networks efficiency would in many cases require substantial financial efforts. At the same time, it is not clear whether customers actually see a need for higher efficiency and, importantly, whether they are prepared to pay for it.

[1] REGULATION (EC) No 1228/2003 of the European Parliament and of the Council of 26 June 2003 on conditions for access to the network for cross-border exchanges in electricity.

Electricity network losses will always exist and are unavoidable. However, the electricity industry is currently working to improve the treatment of losses in order to reduce them and to increase the efficiency of the entire electricity supply chain.

National Energy Efficiency Action Plans (NEEAPs) have been submitted by Member States to the European Commission between June 2007 and May 2008 under the 2006 Directive on Energy End-Use Efficiency and Energy Services[2]. With a view to improving the next round of NEEAPs, scheduled for submission in 2011, Energy Efficiency experts groups recommend that the European Commission harmonise the general structure of the Plans and the degree of information on measures required, by developing a methodological “toolkit” for assessing energy savings and creating a template to guide the way the NEEAPs are structured. EURELECTRIC believes that the structure of the NEEAPs can be improved and harmonised across the European Union before the next reporting round in 2011.

EURELECTRIC thinks that a good regulatory system providing the right incentives for electricity networks operators may lead to a more appropriate treatment of losses taking into account all the existing constraints. That is particularly the case for decisions on loss reduction in electricity networks where a balance between benefits and costs has to be maintained and much depends on the existing applied incentives. We welcome any attempt to promote implementation of adequate incentives.

However, EURELECTRIC would like to stress that the need for harmonisation in this field should be carefully looked at. The "level playing-field" mentioned in the ERGEG consultation document seems to be of relevance if and only if grid operators were in competition with each other. As far as regulated natural monopolies are concerned, this argument is therefore not valid. Furthermore any undistorted comparison of the efficiency of grid operators may face more difficulties than different regimes for the treatment of losses. For these reasons EURELECTRIC recommends that the principle of subsidiarity be applied and some harmonisation rules regarding the treatment of losses – especially for DSOs – scrutinised thoroughly with the focus on whether different rules set by different national regulators really create problems. Harmonisation should not be pursued for the sake of harmonisation.

EURELECTRIC views on the questions raised in the ERGEG Position Paper are set out below.

2. Regulatory definition of losses

2.1 What is considered an acceptable definition of losses?

Losses in an electrical grid are in general calculated by taking the difference between the energy measured by input meters and the energy measured by consumption meters. Due to this some conclusions are possible:

- there are inaccuracies in the result when data collection time of input meters differs from data collection time of consumption meters
- own consumption of technical installations that are metered becomes part of the OPEX
- theft of electricity becomes part of losses

In order to compensate losses by an equivalent amount of energy bought from the electricity market the above mentioned loss energy has to be transformed into a load profile (on an hourly or a quarter- hour basis).

[2] DIRECTIVE 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC

Depending on the amount of losses there may be incentives in the regulatory model with the aim of reducing losses.

Losses could be defined as the difference between the metered units of electricity entering the distribution network and those leaving the network paid for through electricity accounts, whether estimated or metered, in a well defined period of time.

Losses may be referred either to emissions or to withdrawals. However, we regard the adoption of a common standard as an important step towards enabling the comparison of losses across network operators.

EURELECTRIC underlines that technical and non-technical losses are of quite different nature.

Technical losses occur during the transmission and distribution of electricity and vary with the level of utilisation of the network capacity and losses in the transformation process (HV to MV to LV). TSOs are subject to lower levels of losses, while at lower voltages (i.e. with DSOs) usually higher levels of losses occur[3].

Non-technical losses are a different issue. They usually result from consumption for operational purposes (non-metered operational current), theft, metering errors and/or deviations in the readout procedure. Moreover non-metered consumption such as public lighting could be the reason for non-technical losses, and these should be clearly differentiated from other forms of non-technical losses. So far the process of determining non-technical losses is not finalised everywhere. It is evident that the level of non-technical losses depends on various factors that differ from Member State to Member State and are not only the result of different procedures, but also of different historical evolution. For these reasons harmonising an acceptable definition of non-technical losses seems to be rather difficult.

EURELECTRIC reiterates its support for a common, transparent, objective and non-discriminatory definition of losses in different Member States, when sensible. Otherwise this issue should be left to subsidiarity.

2.1.1. EURELECTRIC survey on electricity distribution network losses

EURELECTRIC's Working Group on Distribution collected information on the operating environment of European electricity distribution companies, including on electricity distribution network losses. The result of this selected work is presented in Annex 1.

In principle all European countries had the opportunity to participate. Contributions on electricity network losses from the following countries were submitted and included as annex in this document: Austria, Belgium, Czech Republic, Denmark, Finland, Germany, Hungary, Ireland, Italy, Luxembourg, Netherlands, Poland, Romania, Portugal, Spain, Slovakia, Sweden and United Kingdom (excluding Northern Ireland).

The tables and figures are based on the answers received from the questionnaire sent out in 2002 and collected data relate to 2001 and 2002.

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[3] The reason for this is that higher voltage (HV) levels require a lower current to transmit/distribute the same amount of electricity. This interrelationship can be described as a proportionality of the losses to the square of the current, which should be accepted as a base formula for all calculations of network losses. Additionally the length of the lines, the historical development of the grid structure and the historical development of voltage levels should also be considered. These factors could all together form the base for a mathematical deduction of an acceptable level of technical losses.

Balancing power is considered to be an issue more related to transmission networks and energy suppliers, and therefore discussion of this topic was not included in the paper.

2.1.2 Reactive Power and network losses

A brief assessment of the reactive power management in a few DSOs in Europe is presented only for information in Annex 2. This survey may be completed later on if more companies show interest in further investigating the issue of power losses and their compensation.

2.2 Should power losses refer only to technical losses or is it acceptable to include also non-technical losses?

For the sake of comparability and control, both components should be taken into consideration.

In fact, as outlined in the ERGEG Position Paper, the definition of total losses requires that, due to the lack of continuous metering in all input and output points of the electricity networks, estimations based on calculations are carried out. Hence, both comparisons and control processes depend on the methods of calculation.

Difficulties will be greater and the reliance on estimates will increase if losses are to be defined net of non-technical losses. EURELECTRIC would like to point out that any increase in the requirements for separate measurement of non-technical losses is very expensive and would generate additional outlay in network investments. For the EU-27 the order of magnitude of this expense can be estimated at least at billions of euro per year.

For the purpose of the separate measurement of non-technical losses all medium/low voltage local transformers and connections in low voltage need to be metered continuously. At the DSO level it is for these reasons not feasible to isolate technical from non-technical losses in an efficient way. Moreover, in many Member States the amount of non-technical losses compared to the whole amount of losses seems to be negligible. Because of the high ratio of metering costs and the amount of non-technical losses, one option could be to refer to overall losses instead of separating them into technical and non-technical losses[4].

2.3 Which are the key components for defining losses?

The key components for defining losses are, on the one hand, the network where losses are to be defined – transmission or distribution, where the voltage levels of each one are important factors, as is the boundary between transmission and distribution (there is no harmonised definition in the EU, e.g. in Belgium Elia is formally considered a TSO (<70 kV) and DSO (30-70 kV) as distribution is defined in the legislation as LV + MV/HV up to 70 kV.) – and, on the other hand, the source of the losses – technical or non-technical.

EURELECTRIC is in favour of separating transmission losses from distribution losses. The reason for this is that these two activities are operated by legally separate companies, which are in addition subject to some different issues and constraints.

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[4] An exception to this should be non-technical losses that can be estimated through appropriate mathematical calculations. The consumption of public lighting can be calculated by reference to the lighting hours. Other non-technical losses can in some cases be quantified by reliable estimates. Therefore where reliable quantifications are possible, non-technical losses should be subtracted from the whole amount of losses in order to improve the evaluation of losses. This issue can be sometimes solved according to the individual situation in each Member State.

As far as sources of losses are concerned, EURELECTRIC thinks it is appropriate that the sources of power losses be clearly identified and quantified wherever possible, in order to facilitate the comparison processes. For example this is the case for public lighting, in-house consumption in offices and depot facilities.

We regard technical losses as electrical system losses which are caused by impedance, current flows and auxiliary supplies including transformers. The sources of technical losses may be directly driven by network investment or by network operation.

Non-technical losses, sometimes referred to as commercial losses, arise from several areas including theft, un-billed accounts, estimated customer accounts, errors due to the approximation of consumption by un-metered supplies and metering errors.

3. Valuation procedures

3.1. What ways exist to improve the evaluation of losses in distribution networks?

Smart metering, if adequately integrated in Energy Data Management systems (EDM), has the potential to deliver significant improvements, as far as the evaluation of losses is concerned.

The considerable investment and OPEX involved in extending smart metering to low voltage customers, and the impact on the costs and on the organization, need a careful assessment of the economic feasibility and a clear definition of specifications and roll-out design.

This is a significant challenge. Specific non-technical losses that can be estimated (like public lighting) should be isolated and treated accordingly. Further research would be necessary to obtain reliable estimates for technical losses, which again would be the prerequisite for obtaining quantification for the remaining non-technical losses that cannot be attributed to certain isolated causes[5].

[5] Some of these questions can be addressed individually at the Member State level as both the causes for non-technical losses as well as the parameters influencing the magnitude of technical losses are heavily dependent on historical developments of the electricity grid.

3.2. What should be a reasonable and acceptable level of power losses at the distribution level and at the transmission level?

In general terms, the level of power networks losses is acceptable when its environmental and economic impact does not justify measures to reduce the losses (CAPEX and OPEX in e.g. new grid equipment e.g. high efficient transformers or increase grid capacity in order to reduce load factor and consequently grid losses, plus measurement and control). In practice, this acceptable level of power losses at the distribution and transmission level may be difficult to establish for a multitude of reasons. It is also important to remember that a certain level of technical losses is a an inevitable consequence of operating a grid and not a sign of inferior quality.

These range from the different voltage levels being operated by TSOs and DSOs in the various countries to their network historic design regarding conductor lengths and conductor cross sections. Also, the customer density and the level of utilization of the grid capacity (load factor) vary considerably with geography and with the predominant economic activity, which influence the level of power losses. Additionally, the varying impact of distributed generation on the profile of losses due to both operation and legal framework (different connection requirements are in place across Europe) should not be overlooked.

Regarding non-technical losses, it may be easier to define a reasonable and acceptable level of theft provided sufficient regulation (relating to definitions and metering) plus balanced incentives are put in place by regulatory authorities.

In any case, the definition of an acceptable level of losses should be treated differently for TSOs and DSOs. When possible, it should also be defined individually for every single grid following a set of guidelines.

In the case of every single TSO an individual determination of the acceptable level of losses is feasible, but has to take several factors into account[6]. In addition, although the development of the infrastructure is the responsibility of the TSO, it is not only subject to regulatory approval, but also only effective in the medium term. Significant extensions or modifications to the existing infrastructure are certainly a long-term issue.

As a consequence, although the losses of a TSO can be measured quite reliably, they are subject to large fluctuations beyond the control of the grid operator. The effects of any measures undertaken by the TSO are not only of a smaller magnitude, but will only yield results in the medium or long term. For these reasons it is not always possible to set a harmonised value of acceptable losses at the TSO level throughout Europe. Instead losses should be regarded as an external factor resulting from the energy transmitted through the grids. As a consequence, where TSOs are legally obliged to purchase energy to cover losses in their networks they should be allowed to pass through the associated costs. For the DSO the problem is different. A mathematical formula taking account of the length of the grid, the structure of the grid and the voltage level may result in a typical level of technical losses. However as a large part of the non-technical losses cannot be separated from technical losses and non-technical losses are

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[6] Electrical losses increase proportionally to the square of the current. The utilisation of a power line or a certain infrastructure will influence the level of losses. For instance much heavier loads for German TSOs were caused by an increase in transits in recent years. The next decade will probably see a northward migration of electricity generation in Germany while the load centres remain in the south. The main reasons for this are the intended phase-out of nuclear energy, the construction of large off-shore wind parks and a general trend to site new plants based on fossil fuels close to the source of imported coal. These effects will most probably result not only in the construction of new lines, but also in an even higher use of existing infrastructure. This again will lead to significantly higher losses. All these developments are beyond any significant influence of the TSO.

dependent on the individual conditions in each country and for each DSO, a harmonised approach to determine an acceptable level of losses for a DSO is difficult. Referring to overall losses instead of separating them into technical and non-technical losses is a better option.

As a consequence of the wide range of sources for power losses, the level of power losses differs from country to country and even from grid to grid. For benchmarking purposes, a general determination of the level of power losses or even percentages of cost reduction seems to be difficult to apply.

3.3. Which types of losses could be more easily reduced?

In general power losses can be more easily reduced:

- the bigger the losses (due to the increasing marginal cost)
- the better their cause or location can be identified
- the higher the accessibility of the technology needed for reduction
- the bigger the difference between benefits and cost of/ for the reduction (e.g. in the case of replacing old equipment)
- the greater the recognition of the cost by the regulator

Regarding the reduction of losses, it must be kept in mind that the marginal cost of the reduction of losses increases. This implies that a DSO with a high technical standard and accordingly a low level of losses face proportionally higher costs to reduce its technical losses than a DSO with a lower technical standard. Often the further reduction of losses will thus not offer a valid and sensible alternative. However, the limitations already mentioned for TSOs are obvious and any reduction of technical losses by the grid operators is only possible in the long term.

Furthermore technical losses also depend on factors like length and cross sections of the lines and voltage level, which differ between different grids. As a result it is not always possible to make a statement about an acceptable level of power losses for TSOs and DSOs in general. The acceptable amount of technical losses may be defined individually for every single grid through an appropriate calculation taking into account the length of grid, the historical development of the infrastructure and the historical development of the voltage levels. Usually, grids have been developing over decades and it requires significant time to change their basic properties. A general independent cap may result in an unfair treatment. This also applies to the fact that grids in certain Member States already have a high technical standard which makes further reduction extremely expensive.

The degree of difficulty in reducing power losses will depend on the actual level of losses. It will also depend on the growth and profile of the electricity demand which is expected to be a major driver of the rate of network development. In most cases, reduction of losses will lead to an increase in the costs and/or investment which should be compared with the benefits derived from that reduction.

It should also be noted that a reduction in non-technical losses does not lead to energy efficiency improvements. However it would lead to an improved allocation process and a higher degree of fairness in the treatment of customers and shareholders. In fact, if non-technical losses are passed through to customers via tariffs, the existence of these losses will mean that some customers are paying for others. On the other hand, if non-technical losses are not passed through in full to customers, the losses "retained" by the distribution operator are paid by shareholders instead.

Reductions of non-technical losses may be possible provided significant additional investment and costs are secured notably for improved and more accurate metering; data management systems supporting it; and more field inspectors. It should be noted that the potential for further reductions of non-technical losses may be limited in most Member States given the levels of accuracy already attained.

Technical losses are essentially associated with energy-and environmental-efficiency. This type of losses is mainly conditional on investment in network assets. Reducing these losses requires fundamental changes in the design and topology of the networks as well as using more efficient technologies such as low-loss transformers or higher cross section conductors. In addition there are trade-offs with CAPEX and OPEX efficiencies and with the quality of supply, which must be seen in the context of the current regulatory framework.

4. Procurement of losses

4.1. Who should be responsible for procuring electrical energy to cover losses?

The grid operators – both TSO and DSOs are responsible for the level of losses that can to a certain extent be influenced at least in the medium and long term. What is relevant rather than who should be responsible for procuring losses is the level of losses allowed by the regulator and the regulatory mechanism to give incentives to grid operators to reduce losses. The responsibility of losses procurement does not by itself automatically ensure a reasonable and acceptable level of losses, if no target or standard is set by the regulator. EURELECTRIC supports any solution that brings efficiency as far as the procurement of losses is concerned. Losses may be procured either by transmission/distribution operators or suppliers.

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4.2. How should electrical energy to cover losses be procured in a market-oriented way?

When the grid operators as regulated entities are obliged to procure the energy, they should do it in a transparent, non-discriminatory and market-based way, although confidentiality of relevant information provided by bidders must be maintained in any case. However, harmonisation of procurement procedures across all Member States may not be needed.

As shown above, both TSOs and DSOs can reduce the amount of technical losses only to a small degree and only in the medium to long term. The fact that the amount of losses thus basically cannot be easily influenced by the grid operators makes it even more important to have clear rules on how the energy for the compensation of losses is procured and accordingly the price that is paid for it. This is the major reason why market-based procedures are important. On the other hand if the grid operators adhere to agreed procurement procedures (based on the EU Procurement Directive), the cost incurred should be acknowledged by the regulator as a cost component to include in the grid tariffs in a transparent way.

In addition, all procurement should be strictly market-based and non-discriminatory, provided there is a liquid wholesale market.

A number of special characteristics of the TSO should be observed however: losses of a TSO are dependent on load flow patterns that may change more frequently. TSOs can reliably and quickly measure the losses, which makes short-term procurement an option for a TSO (not via auctions/tenders but direct purchase on a power exchange) which DSOs will purchase the energy further in advance. However, harmonisation of procurement procedures may not be needed. This can be left to Member States, according to the subsidiarity principle.

4.3. Which solution is the most efficient?

EURELECTRIC is in favour of any solution that will increase transparency and efficiency in the procurement of electricity to cover losses. EURELECTRIC prefers that the procurement of electricity to cover losses be based on market principles, e.g. through an auction system or through bilateral long-term agreements to be concluded on the basis of open and non-discriminatory tender.

4.4. Should the cost of losses be covered by a special tariff?

In most cases this seems to be preferable to the alternative of continuing to recover the cost of losses through the use of the network tariff.

If the costs for the compensation of losses are included in the regular network tariff, the transparency of the costs of the regulated entity is significantly impaired. A separate tariff would enable all parties involved to discuss any issues in a more focussed manner. In any case it is most important that the costs incurred can be recovered by the grid operator.

In the case of a single tariff there is a danger that higher costs for losses may be compensated by deeper cuts in other costs of the grid operators or vice versa. On the other hand in the case of lower costs for losses it might happen that these are not fully used to the benefit of grid users, but rather to give room for rising costs in other areas.

5. Regulatory incentives

5.1. What are the advantages and disadvantages of the aforementioned incentive mechanisms?

In general terms, a moderate incentive for both TSOs and DSOs to reduce the cost of their losses is an appropriate design element of a regulatory mechanism. Regulatory measures should incentivise them to bring losses to an acceptable level (see question 3.3 above) in the medium to long term. However, only a small part of the costs of technical losses - and only in the long term - can be influenced by the grid operator and the regulator should take this carefully into account. This limits the effectiveness of any incentives to the grid operator. Accordingly, the incentives themselves must be tailored to the adaptable part of the technical losses in the respective time frame. Otherwise the incentives will produce inefficient results, which will not help grid users in the long term. Furthermore, incentive schemes must be fair in the sense that the underlying targets have to be achievable by the regulated entity. Rewards and penalties for out- or under-performing these targets should be balanced. Only in this case will the regulated entity exert the optimal level of effort to achieve the common target of lowering the purchasing cost of energy losses.

It is of utmost importance to remember that if the grid operator adheres to the procurement procedures set by the regulator, the price of the energy cannot be influenced. The only element that can be influenced by the grid operator is the quantity of the losses – and this only in the long term. The overall objective should be to have a global cost/quality optimisation. Nor are overly ambitious targets for reducing the cost of losses used to lower grid fees in general helpful for grid users, as they will also fail to set proper incentives for the grid operator to obtain an optimum configuration. Here a maximum degree of transparency will help to ensure that the mechanisms are tailored to the targets at hand. Keeping this in mind, the best way would be to install an incentive mechanism that promotes the overall optimum of grid operation instead of focussing on separate targets like the minimisation of losses at the expense of other objectives. It seems that various incentive mechanisms can exist in various Member States without any particularly harmful effect. In this case, the design of incentives can be left to Member States.

5.2. Which key elements should be considered when assessing different regulatory incentive mechanisms?

Incentive mechanisms to reduce losses should be designed to maximize social welfare. In order to be efficient, incentive mechanisms for losses reduction should:

- Aim at generating efficiencies where regulated companies do possess the ability to exert significant control
- Establish a link between reasonable estimated input (investment or operational costs) and reasonable targeted outputs (such as the intended loss reduction target) plus improvement of quality of supply
- Share the efficiency gains between the electricity industry and customers
- Be simple in their conception and easily understood by all parties concerned
- Be manageable in the sense that data collection and processing requirements should be minimal
- Minimize regulatory risk, taking into account the long useful life expectancy of the network assets and their impact on the overall long-term system efficiency
- Be coherent with the regulatory system in place, namely with other incentive mechanisms (quality of supply, CAPEX, OPEX, etc)
- Consider services that may offer value to customers on their own and may also broaden the level of influence of the network operators over losses
- Seize opportunities to renew network assets
- Take into consideration costs not yet internalised in market prices.

EURELECTRIC favours incentive mechanisms that broadly comply with the guidelines outlined above.

The incentive mechanisms must be extremely sensitive to the degree to which the grid operator can really influence the costs incurred by the compensation of losses. Accordingly, the regulator should set incentives to reduce technical losses very carefully and only with a medium-term target[7].

5.3. Are there advantages in setting separate mechanisms for technical and non-technical losses?

EURELECRIC considers that theoretically it would be preferable to put in place separate mechanisms for technical and non-technical losses because both the scope and the cost drivers to reduce each type of losses vary. But as mentioned in 2.2. and 3.2., referring to overall losses could be a better option.

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[7] Incentives for either TSO or DSO should not only focus on the reduction of the amount of losses, and not on the price at which the energy is procured. Instead the regulator should set transparent and market based procedures as outlined in the answer to question no. 4.2. If the grid operators adhere to these procedures, there should be neither a benchmark regarding the procurement price nor any other reductions in the costs incurred, as the procurement price cannot be influenced by the grid operators.

The design of incentive mechanisms should rely on a realistic estimation of what room for manoeuvre grid operators really have to influence the compensation costs of losses. The ability to influence costs depends on varying parameters when it comes to technical and non-technical losses. Accordingly, the incentive mechanisms should have a fundamentally different design as well. An even better alternative would be to have an incentive mechanism set for total losses with no distinction between the specific types of losses. However, as a large part of non-technical losses cannot be separated from technical losses, setting separate mechanisms may be difficult to apply.

Non-technical losses may still be treated separately. However, the reduction of these costs is only rarely the sole responsibility of the DSO. Political targets and country-specific regulatory configurations contribute to the situation. For these reasons, incentives to reduce non-technical losses are to a large extent dependent on the situation in the individual Member State and are sometimes difficult to harmonise.

5.4 Are there advantages in setting mechanisms for transmission and distribution losses?

Transmission and Distribution are legally separate businesses. There are therefore advantages in setting separate mechanisms for transmission and distribution.

Moreover, transmission and distribution businesses are characterised by different planning and operational issues and are subject to different constraints.

Metering accuracy and metering estimations, for instance, are an issue that typically impacts on lower voltage distribution systems. Also, standard marginal nodal pricing techniques may not be equivalently applied as a losses cost signal for both transmission and distribution networks.

TSOs and DSOs face different challenges in limiting the costs for the compensation of losses. For this reason, the incentive mechanisms should be designed with the respective problems of TSOs and DSOs in mind. In particular TSOs normally have no or only very limited non-technical losses. Technical losses at the TSO level are extremely dependent on the load flows, which might change fundamentally from year to year and are heavily influenced by external factors such as absence or presence of wind energy, cross border flows, etc. As the amount of losses can only be influenced in the medium to long-term, any incentive mechanism faces the challenge of isolating the dominant effects of year-to-year changes from the longer-term effects generated by the actions of the TSO. In consequence, designing an incentive mechanism for TSOs can raise difficulties.

As far as DSOs are concerned, it should be kept in mind that an increase in decentralised generation and changing load patterns resulting from mostly industrial customers being connected or disconnected also contribute to significant changes in load flows from year to year. These changes will in most cases be larger than any influence the DSO has on losses, which can only be reduced in the long term. This makes it rather difficult both to isolate the effects of loss reduction in the responsibility of the DSO and to design a mechanism that provides the proper incentives.

6. Final Remarks

Europe has always enjoyed a high level of quality of supply and the electricity industry is keen to identify the best ways to increase the energy efficiency of the entire electricity supply chain. EURELECTRIC is pleased to note that ERGEG has identified and recognised the current need to improve the treatment of network losses and implement adequate incentives. This can help both TSOs and DSOs to increase their performance and their efficiency with regard to the top priority given to energy efficiency improvements in general and to the reduction of electricity network losses in particular.

It is generally accepted that electricity network losses exist and are unavoidable. The electricity industry has made continuous efforts in the past and is currently working to improve the present treatment of losses in order to reduce them to their minimum possible, on cost-based analysis, and to increase the efficiency of the entire electricity supply chain for the benefit of all customers and our environment.

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EURELECTRIC is currently engaged in further work on “Treatment of Losses by Network Operators” and would welcome opportunities to pursue the debate on aspects of reducing T&D power losses with the regulators.

ANNEX 1

LOSSES IN THE ELECTRICITY DISTRIBUTION GRIDS EURELECTRIC VIEWS

1. Introduction

EURELECTRIC's Working Group on Distribution collected information on the operating environment of European electricity distribution companies, including data on electricity network losses. The result of this selected work is presented in this Annex 1.

In principle the participation of European countries was open to everybody. Contributions on electricity network losses from the following countries have been given and included as annex in this document: Austria, Belgium, Czech Republic, Denmark, Finland, Germany, Hungary, Ireland, Italy, Luxembourg, Netherlands, Poland, Romania, Portugal, Spain, Slovakia, Sweden and United Kingdom (excluding Northern Ireland).

The tables and figures bellow are based on the answers received from the questionnaire sent out in 2002 and collected data relate to 2001 and 2002.

Losses in an electrical grid are in general calculated by taking the difference of the energy measured by input meters and the energy measured by consumption meters. Due to this some conclusions are possible:

- there are inaccuracies in the result when data collection time of input meters differs from data collection time of consumption meters
- own consumption of technical installations that are metered becomes part of the OPEX
- theft of electricity becomes part of losses

In order to compensate losses by an equivalent amount of energy bought from the electricity market the above mentioned loss energy has to be transformed into a load profile (on an hourly or a quarter- hour basis).

Depending on the amount of losses there may be incentives in the regulatory model with the aim to reduce losses.

2. Country Contributions

2.1 Austria

Losses are part of the overall power balancing process. Every DSO has to maintain a separate balancing group for the losses. The losses must be bought by the DSO on the energy market.

The costs for losses are covered by a surcharge to the network tariffs. The surcharge determined by the DSOs for each grid level and has to be approved by the regulator.

2.2 Belgium

The distribution and transformation losses have to be annually reported to the regulator, in order to allow him to compare the losses of different DSOs and to evaluate the quality of the distribution grid. In order to improve the allocation process, the DSOs have commonly established an harmonised methodology to estimate the losses in a distribution grid. At present, the total losses in the Belgian grid are estimated at 3.767,5 GWh; No separate figures are currently available for the distributor losses only.

2.3 Czech Republic

Energy losses are differences between purchased and sold energy, divided into technical losses, non technical losses and self consumption. Volume of technical and non-technical losses varies from one DSO to another. Losses are part of OPEX, accepted by the regulator and therefore paid in tariffs by customers.

2.4 Denmark

Losses in distribution network are calculated as the metered energy entering the network of the network company minus metered energy settled with the final consumers over the same period.

Network companies settle the energy entering the network from transmission companies with these companies at their individual tariffs. Electricity to specifically cover network losses are purchased in the free market – in practice often at your own obligation to supply the company which can deliver at current market price.

Costs of losses are outside the benchmarking of the income cap regulation. The costs are settled with the network customers as part of the network tariff.

The economic responsibility for balancing power on the consumption side is that of trading companies and obligation to supply companies. They cooperate in joint balancing-groups in order to minimise balancing costs. Costs of balancing power consequently are part of the energy price.

2.5 Finland

The losses are defined as the difference between the metered input to the network and the actual deliveries to the customers. The net operators normally purchased their losses from the sales company (or department) of their own concern (or company). There are no obligation to compete the purchasing. The loss percentage for Finnish DSOs is normal in the range 3-5 %.

2.6 Germany

Costs of losses are part of the use-of-system-charges. Therefore they have to be known for each voltage level. According to the new Electricity Bill, system operators are obliged to procure the corresponding amount of energy in a transparent, objective and non discriminatory manner.

2.7 Hungary

The total loss is estimated on the difference between the input and purchased energy. The purchased energy is segmented to monthly and yearly read customer consumption. Both are used for invoicing, but the yearly read customers' information contains deviation,. In this case this value of purchased energy can only be estimated.

The total loss is calculated and includes technical and non-technical loss. The technical loss built of technical parameter deviations, like loss of network, transformation and meter equipment elements faults exclude the meter stop which is sorted to non-technical loss. Therewith the non-technical loss contains the energy steeling, reading and billing inaccuracy.

The full (100%) technical loss is accredited, but the non technical loss is accredited only in 50 % by the Regulator.

2.8 Ireland

Losses are effectively paid for by the suppliers as part of their energy charges. Metered amounts for Independent Suppliers are grossed up by loss factors and the residual is allocated to the Public Electricity Supplier. In addition, there is an incentive/penalty mechanism incorporated in the price control in relation to losses. Under this arrangement, a target level of losses was set at 1,275GWh (approx. 7% of total units distributed). Losses were valued at €38,000/GWh. There was a cap on the maximum amount of the incentive/penalty set at 2% of allowed revenue for both this incentive and the continuity incentive.

2.9 The Netherlands

The distribution losses of a DNO are defined as the difference between the metered input to the network and the actual deliveries to the customers. The DNOs are obliged to purchase the corresponding volume of energy. The costs of losses are part of the use of system charge.

2.10 Norway

Losses are defined as the difference between the metered input to the network and the actual deliveries to the customers. The costs connected with network losses are included in the annual total costs and must be met within the permitted income.

2.11 Portugal

Distribution losses are defined as the difference between the metered input to the network and electricity deliveries to customers (binding and non-binding system). The Supplier has to purchase the difference between metered input to distribution network and actual deliveries to end use customers including standardised losses.

Allowed revenues include a term related to losses. Whenever losses exceed a given threshold, the company suffers a reduction in allowed revenue for that year, whereas an increase in allowed revenue occurs if losses are lower than such threshold.

2.12 Romania

The specific distribution tariffs in force include regulated losses. The price considered equals the average purchase price of the distribution/supply company.

Starting with 2005, for each control period, the regulator will establish by mutual consent with the distribution operators a program for cutting down losses, by levels of voltage, leaving the distribution operators the advantages resulting from a more efficient management of such losses.

In 2012, when establishing the distribution tariff the regulator will recognize for all distribution operators in Romania an average level of technological and commercial losses of maximum 9% .

When the schedule of capital expenditure is not approved by ANRE, the distribution operators have the right to request ANRE to revise the loss reduction targets, and ANRE will subsequently analyze and decide over the opportunity and the level of such revision.

At the end of each control period, the regulator will analyze the actual level of losses and will establish a new level for the following control period and for each year of the respective period.

The distributors will be allowed to keep all gains obtained by reducing losses beyond the level established by ANRE.

2.13 Spain

Losses are paid for by suppliers as part of their energy charges in the wholesale market. Network losses are standardised by voltage level and time of day period.

Distributors have to purchase the difference between metered input to their distribution network and the end user metered output including the standardised losses. If real losses are higher than those standardised, the distributor bears the excess of losses costs. On the other hand, if losses are lower, the distributor obtains a profit.

For the moment, there is no other specific mechanism to give incentives for the reduction of losses.

2.14 Slovak Republic

Losses defined as the difference between energy purchase and energy sale must be purchased by distribution companies. The components are as follows: technical losses, commercial losses (theft and measurement inaccuracy) and the separate category – the own consumption of electrical equipment that can be purchased by the distribution companies for the special price. Estimated value of losses as well as its allocation into voltage levels (HV, MV, LV) is different for every distribution company in the country. In the regulatory framework the losses are considered as legitimate costs and in the future there’s anticipation that losses will be the subject of more detailed investigation by the regulator.

2.15 Sweden

The losses are defined as the difference between the metered input to the network and the actual deliveries to the customers. The losses are normally purchased from the own group’s sales department, and the prices are official and scrutinized by the Regulator. The losses for the distribution companies’ networks 2001 were 4.84 TWh out of a total distribution of 103.8 TWh, which is 4.7 %.

2.16 United Kingdom

Distribution losses (excluding EHV losses) in the UK are defined in the Licence as the difference between metered input to the DNO network (as recorded at 132kV Bulk Supply Points) and the end user metered output. It is expressed as a percentage of metered output. The loss percentages for UK DNOs are in the range 5.4% to 9.1%.

From the definition it will be seen that there are a number of components:

- Technical losses
- Theft

- Data errors / anomalies in the Settlements System

Losses are effectively paid for by suppliers as part of their energy charges in proportion to their aggregated demand at Bulk Supply Points.

DNO ‘own consumption’ takes two forms – at all offices, and most major substations, supply is metered and the costs form part of overall cost base re-charged through the Distribution tariffs. For example, heating at minor substations is not metered and forms part of the losses described above.

Table 1. Distribution Network Losses.

COUNTRY	Is the distributor required to purchase losses?		Is there a level of average standardised or allowed?		Does the distributor bear additional costs of losses when exceeding the level?		Are improvements respect to the standardised level rewarded ?		Is there any other specific specific mechanism for the reduction of losses ?	
	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
AUSTRIA	*		*		*			*		*
BELGIUM	*			*						
DENMARK	*			*				*		*
FINLAND	*			*				*		*
FRANCE										
GERMANY	*			*						*
GREECE										
IRELAND		*	*		*		*			*
ITALY		*	*		*		*			*
LUXEMBOURG	*			*				*		*
NETHERLANDS	*			*						
NORWAY	*			*					Included in revenue	
PORTUGAL		*	*		*		*		term in revenue	
SPAIN		*	*		*		*			*
SWEDEN	*			*						*
UNITED KINGDOM		*		*		*		*	Reward/penalty [(2)]	
CZECH REPUBLIC	*		*			*		*		*
POLAND	*		*		*			*		*
HUNGARY	*		*		*		*			*
SLOVAK REPUBLIC	*		*		*			*		*

Note: **Source: Answers to the questionnaire on Operating Environment for Distribution Companies**
(2) In the UK, change in losses in any year from the rolling 10 year average is rewarded / penalised in the allowed revenue for the following year.

Table 2 (13). T&D Network Losses [TWh]

COUNTRY	Network Losses [TWh] 2001	Demand (incl. Losses) [TWh] 2001	Network Losses [% of demand] 2001
AUSTRIA	5.4	60.3	8.96%
BELGIUM	3.8	83.6	4.55%
DENMARK	2.3	35.6	6.46%
FINLAND	3	81.2	3.69%
FRANCE	31	452.5	6.85%
GERMANY	23	523.7	4.39%
GREECE	4.9	51.3	9.55%
IRELAND	1.9	23.4	8.12%
ITALY	19.3	304.8	6.33%
LUXEMBOURG	0.1	5.8	1.72%
NETHERLANDS	4.1	107.7	3.81%
PORTUGAL	4.1	44.6	9.19%
SPAIN	17.8	227	7.84%
SWEDEN	11.8	150.3	7.85%
UNITED KINGDOM	32.3	375.7	8.60%
NORWAY	9.8	127.8	7.67%
CZECH REPUBLIC	4.9	62.2	7.88%
HUNGARY	4.7	36.9	12.74%
POLAND	14.2	124	11.45%
ROMANIA	5.9	46.1	12.80%
SLOVAK REPUBLIC	2.0	25.7	7.78%

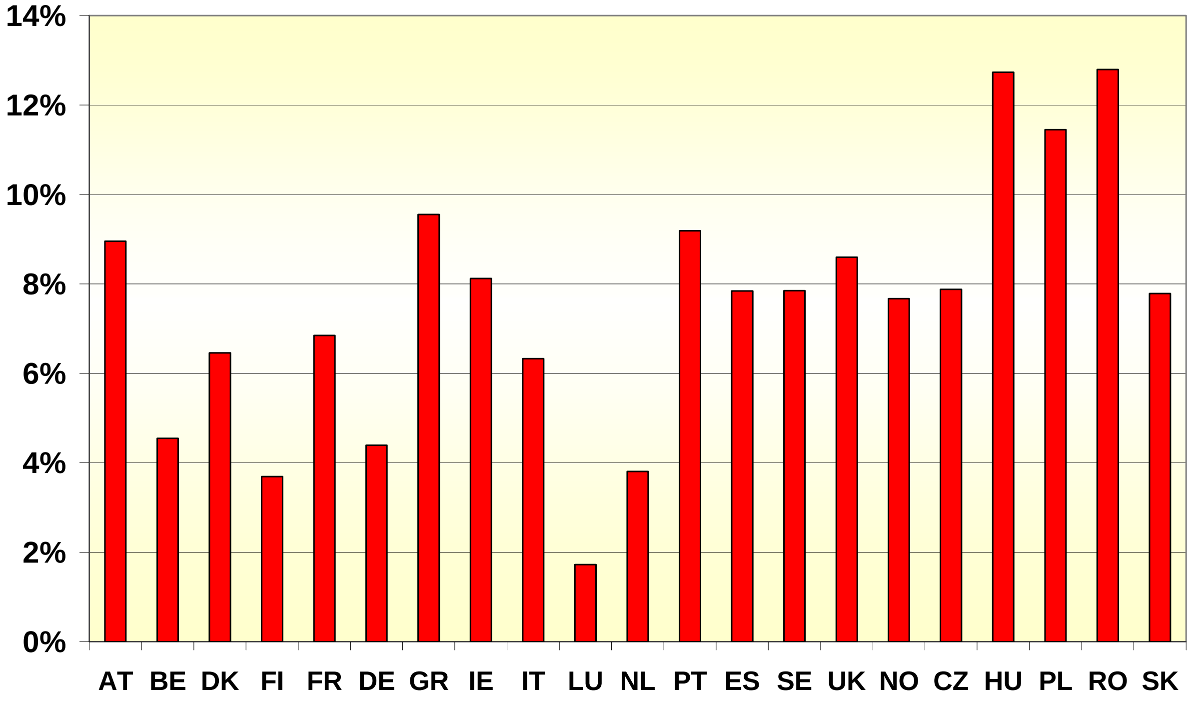

Figure 1. Network Losses (T&D).

Source: EURELECTRIC Report EURPROG 2003

Note: The total grid losses for all voltage levels in Slovak Republic in 2002 was 2,005 GWh (Source: SSE)

3. Summary

The values for losses indicated in table 2 and shown in figure 1 include both distribution and transmission losses. It can be observed from figure 1, that the percentage of losses in the different countries varies significantly. In Luxembourg, the level achieved is 1.72%, compared to the levels in Hungary and Romania of 12.74% and 12.80% respectively. The average level is around 6-7%.

It is difficult to draw precise conclusions for the differences, but the reasons are likely to include:

- Precise definition of losses
- Level and security of coverage of customer metering
- Inherent design of networks

ANNEX 2

REACTIVE POWER MANAGEMENT
CURRENT PRACTICE IN SOME EUROPEAN DSOS

1. Introduction

Reactive power is created in alternating current systems and it is a part of the energy that is transported in the electrical system. Reactive power and effect is not perceived as "useful" energy. This means that reactive effect is only reducing the total power capacity and increasing transportation losses. An additional disadvantage with reactive effect is that this delivers a somewhat bad quality of electricity – especially overtones.

Some components or devices that are connected to the grid have a need for reactive energy. The optimal solution to this is to meet this need by installing "compensation" elements, through compensators, as close to the consumption devices as possible.

The reduction of reactive effect is a problem that must be solved by manufacturers of power networks devices as well as by electricity generation companies and electricity distribution companies.

Electricity transmission and distribution equipments suppliers are encouraged to take actions and produce "self-compensating"devices regarding the reactive effect. Enforcement of the CN-norms is required.

Generally speaking the electricity TSOs and DSOs customers should have the right to a certain socket of reactive effect. Socket exceeding this level should be met by a demand to reduce this level. This will possibly create a need for reactive metering and reactive deduction which could be introduced within a reasonable time frame.

2. EURELECTRIC investigation on the Management of the Reactive Power

EURELECTRIC WG Distribution made some investigations on how is the **Management of the Reactive Power** addressed in some European DSOs. The following questions have been addressed:

1. What are the **principles** (in line with existing national regulations and norms) applied for the management of the reactive power along the whole chain generation, transmission, distribution, supply, end customer?

2. Are there **specific regulations** dealing with the management of reactive power in your company/country?

3. Is the concept of **trading reactive power** to customers realistic? If yes, on what is it based (meter reading, calculation of an average power factor, etc?

Information related to the issue of managing the reactive power was very much apperciated. The following countries contributed to this valuable exercise: Austria, Portugal, Slovakia (two DSOs) and Spain.

3. Country Contributions

3.1. AUSTRIA

In general generators have to feed more than 50 % reactive power in relation to active power into the grid (cos phi < 0,9). Exeption: due to reasons of power quality at the connection point DSO can set differing requirements if necessary.

Every grid operator (DSO and TSO) has to take care for a sufficient extent of reactive power on his own (additional agreements with generators), TSO provides balancing.

Houshold-Customers do not have to pay for the use of reactive power.

For Business-Customers reactive power is metered separately. If Business-Customers use more than 50 % reactive power in relation to active power (cos phi >0,9) the use exceeding will be billed. Due to regulations this revenues shall cover only the expenses of the grid operator related to reactive power.

3.2. PORTUGAL

In Portugal is considered that the reactive power should be compensated at consumer level as transmission of reactive power leads to an increase in thermal losses, a decrease in supply voltage and a need for network reinforcement.

In this context, an incentive for a reduction of demand for reactive power is set up in the tariff of access to the grids:

- The reactive power supplied to the network (capacitive) during off-peak hours (night and week end) is invoiced
- On the other hand, outside off-peak period, reactive power consumed (inductive) in excess of 40% of active power is invoiced. Monthly values for active and reactive power are taken into account for this invoicing.

The current prices are as follows (c€/kvarh):

	Inductive	Capacitive
Consumers at Very High Voltage	1.52	1.13
Consumers at High Voltage	1.55	1.16
Consumers at Medium Voltage	1.69	1.27
Consumers at Low Voltage with a subscribed demand > 41,4kVA	1.97	1.50

Despite these prices being higher than the costs for supplying reactive power, leading to a pay back time of less than one year for an investment to compensate reactive power, a significant number of customers currently pay reactive power.

As many customers do not compensate reactive power, the distribution network operator (DNO) proceeds to the compensation. This compensation should take place as near as possible of customer's installations, at MV/LV stations. However, it would lead to a disperse compensation with difficulties on the corresponding control and maintenance. Hence, the DNO is proceeding to the compensation in HV/MV substations.

There has been some discussion on the threshold of 40% and it seems that, if a change occurs, it will be towards a lower value, being more demanding.

For customers at low voltage with a subscribed demand less than 41,4kVA there is no explicit invoice of reactive power. In fact, these customers are paying apparent total demand (in kVA and not in kW) as they have a demand control by a circuit breaker.

In what concerns producers, namely from renewable, cogeneration and so on, the active power supplied to the grid has to be accompanied by reactive power in the amount of 40% of the active power. The reactive power in deficit is invoiced.

Our experience shows that such a blind rule for producers may lead to an excess of reactive power in some circumstances. In those cases, a different threshold is agreed with producers.

We are just starting a process of having distributed small generators at low voltage. Hence, we do not have yet experience for the impact of this generation.

3.3. SLOVAKIA – DSO 1

Reactive power flow is managed (reduced) by means of price list approved by the regulator. Customers (HV, MV and wholesale LV customers, not households, nor small firms) as well as distributed generators must have **power factor (cos Phi) from 0,95 to 1 inductive** (lagging power factor). If they do not comply with this requirement, there is a penalty to the price of electricity according to the price list approved by regulator.

- Determination of power factor is as follows: There are **monthly** meter readings (remote) in due customers (and distributed generators): active and reactive energy per month. From these two values the **month average** power factor is calculated and checked if it is in the range 0,95 - 1 lagging.

In those customers who have a four quadrant meters also over-compensation is checked and penalised.

- **No direct** limits as for VAr power are applied.

- On the side of TSO, in the supply points TSO - DSO, the excessive inductive reactive power is compensated in coils connected to the terciar winding (10,5 or 22 kV) of VHV/HV transformers.

There is not a case of legal selling reactive power in Slovakia; it is only via penalties according to the price list.

3.4. SLOVAKIA – DSO 2

Question 1

The basic principle of the reactive power regulation is:

- Providing of technical reliability of the electricity system operation at all levels

- Optimization (reduction) of losses in the electric energy transmission and distribution (caused by reactive power)
- From the legislation point of view (methodology, regulations, norms) we proceed according to the EU regulations and principles of UCTE.

Technically it is a regulation of the voltage and of reactive power in the electricity system (ES) at various voltage levels (surplus of reactive power leads to voltage increase, the lack of it to voltage decrease):

- Transmission grid (400 kV, 220 kV)

The objective is to maintain the voltage level in the standardized ranges under the condition of optimal losses and acceptable reserve of reactive power. This fundamental task is done by Slovenský energetický dispečing (Slovak Energy Dispatching) with a software support (method of the so called „pilot nodes“).

The technical means (in the sequence of their use) – generator exciting of the power plants – change of ratio of regulating transformers 400/220kV and 400/110 kV – use of compensation means (choke coils, compensation operation of the generators of the selected pumped storage power stations) – switch off of the recommended 400 kV lines.

- HV grid 110 kV

The objective is to keep the determined voltage levels in the 110 kV grids.

The technical means (in the sequence of their use) – generator exciting of the power plants connected to the 110 kV grid – change of the ratio of regulating transformers 400/220kV and 400/110 kV – use of compensation means (compensation operation of the generators of the selected pumped storage power stations, capacitor batteries),

- MV grid 22 kV

On the electric grid side

The objective is to meet the voltage values for all customers determined by a technical norm. The necessary measures are provided by the dispatching and the operation departments of the territorial respective distribution company.

The technical means - change of the ratio of regulating transformers110/22 kV – adjusting the taps of the distribution transformers 22/0,4 kV.

On the consumption side

In the distribution grid MV and LV the measures for the regulation of the reactive power are based on the economic aspects - costs for distributing the reactive part of electric energy. There has been defined a so called neutral valued of the power factor in the range 0,95 – 1 for this reason. If the neutral value is not met, the customer pays according to the electricity distribution pricelist a surcharge to the price for electric energy distribution. The power factor is calculated from the proportion of the reactive and active energy metered for the same period. The loss reduction caused by the reactive part of electric energy and the related costs is a effective motivation for implementation of technical measures on the consumption side (as well as on the distributor side) – implementing electrical machines with a low portion of reactive consumption – compensation of the reactive consumption, from the use of static capacitors up to highly sophisticated control systems. The mentioned measures do not apply to the customers of the category “households”.

The necessary technical measures are implemented as a rule by respective departments concerning the technical as well as business issues.

Question 2

As already mentioned at the beginning of the answer to the first question, we deal with the issue of reactive power control in compliance with the EU regulations and principles of UCTE, therefore we do not see the way of handling this issue at our company as well as in Slovakia somehow specifically. In this area we use also theoretical as well as technical background of the CIRED platform.

Question 3

The answer to this question is given as one of the measures for reactive power control on the customer side and thus by means of a power factor, the neutral values of which is defined in the range of 0,95 – 1. The power factor is calculated from the ratio of reactive and active power metered by electric meter (invoicing metering device) for the same period.

3.5. SPAIN

3.5.1. Principle for the management of reactive power

The main principle for the management of reactive power is based on the compliance of a given cosφ by the different agents. If an agent can improve this requirement in terms of cosφ, he can receive an extra remuneration or a bonus. If he does not comply with the cos φ is penalised.

Suppliers are not involved in this matter.

3.5.2. Specific regulations dealing with the management of reactive power

There are two kinds of regulations where the management of reactive power is dealt with. Grid codes and network tariff regulations

- Grid code (P.O. 7.4) for the management of voltage control in the transmission grid. This grid code sets the cos φ requirements for the different agents connected to the transmission network:

Generation: $\cos\varphi = 0.989$ for both in-take/off-take reactive power.

Transmission: according to the TSO orders.

Distribution: peak hours: $\cos\varphi \geq 0.95$; night hours: $\cos\varphi < 1$; off-peak hours (except night hours): $0.95 \leq \cos\varphi < 1$

End consumer: the same as distribution

- Network tariff regulation

This regulation sets the penalties for end consumers in case of non-compliance with a $\cos\varphi \geq 0.95$.

3.5.3. Concept of trading reactive power to customers

This concept is not realistic. What has sense is the concept of billing reactive power. The concept of sale implies a customer will of buying something, but this is not the case in the electricity supply. Reactive power is billed because the consumption of reactive power in peak hours may produce problems of voltage control.