SOME BRIEF REMARKS ON SECURITY OF ELECTRICITY SUPPLY

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Initial remarks

Some days ago, oil prices almost reached 50 USD per barrel. One year ago, North America and Europe were surprised by large-scale black-outs. Influenced by these events, security of electricity supply was the obvious choice for the main topic of this year's CIGRE conference. Although the choice of the subject might seem trivial, and in spite of the many articles and TV programmes on security of supply recently produced by the mass media, I believe the subject in itself is far from being trivial.

One of the aspects that most strikes me in the current public debate about security of electricity supply is the huge imbalance between a very limited number of arguments addressing the problem from a quantitative point of view and a very large number of qualitative, sometimes almost metaphysical, opinions. If the debate is not properly framed, it will be more difficult to design and to implement the necessary measures to ensure the appropriate level of security of supply. In my presentation, I will introduce some brief remarks that may be helpful in: a) defining the problem of security of electricity supply in quantitative terms; b) identifying workable approaches to the problem and c) illustrating some regulatory aspects involved. The views I will express are my own and do not commit the institutions I have the honour to chair.

On the multiple dimensions of the problem and the need for an informed debate

Before going into the technical discussion, however, I believe it is worth reflecting about the importance of some non-technical aspects of the problem.

Why do so many people who would not dare to discuss, for instance, technologies of electricity generation, engineering of transmission networks or the economics of energy derivative markets feel authorised to discuss security of electricity supply ? Why do high-level political decision-makers feel obliged to react immediately after large-scale black-outs even if the diagnostics and the therapy they communicate do not always match the underlying physical and economic reality ? How did “security of supply” become part of the standard media vocabulary ?

I believe the main reason why security of electricity supply got a prominent place in the political agenda is that electricity is essential for the functioning of our societies. Developing countries need electricity in order to build their industrial infra-structure. As the recent example of China clearly shows, non-availability of electricity can be a major obstacle to economic development. Developed countries, on the other hand, increasingly rely less on industry and more on services; however, services are increasingly based on electricity consuming internet-based “information trade”. Therefore, availability of reliable and affordable electricity is crucial for the functioning of the modern society and of the global economy. In this sense, security of electricity supply is a very sensitive political problem and an issue for debate in the public space.

Moreover, security of electricity supply depends, among other factors, upon the availability of primary energy. However, fossil energy sources are not evenly distributed throughout the globe, which has led to several economic and political conflicts. On the other hand, the use of endogenous energy sources, fossil or renewable, also has strong social, economic and environmental implications. The relatively short history of nuclear energy is, in fact, a long chain of political reactions. In brief, the choice of primary energy sources for electricity generation is a very sensitive political problem, both at local level (i.e. where the power plants are located) and at global level (i.e. in geo-political terms).

The security of electricity supply problem has political dimensions, as well as technical dimensions. I believe it is in the general interest to distinguish between these different aspects of the problem. Political choices and responsibilities should be as clearly

defined as the responsibilities of the operators in charge of managing the electricity system and of delivering the appropriate levels of reliability and quality of service; the responsibilities of producers, suppliers, traders and other market agents should also be clearly defined. In my view, it is the duty of energy regulators to contribute to a better understanding of the different roles and responsibilities, also explaining to consumers the major interactions between the various dimensions of the problem. Electricity consumers expect from independent regulatory authorities objective assessments, objective monitoring reports and objective explanations.

Between the democratic legitimacy of those who were elected to make political choices and the technical and scientific legitimacy of those who manage electricity systems according to best practices, regulators find themselves in a difficult position. However, this regulatory "bridge" between two different sets of legitimate principles and procedures is an essential balancing element in a modern, democratic and technical society that is committed to overcoming its internal conflicts and sometimes contradictory objectives through rational, transparent and argumentative decision-making processes.

On the general context of "security of electricity supply"

When discussing the problem of security of electricity supply it is useful to distinguish between two different scenarios:

1. In some regions, practically all citizens are physically connected to the network and are supplied either by the local distributor or by a supplier of their choice. Consumers may be more or less concerned about prices or quality of supply, but the problem of security of electricity supply is seen as a potential future problem, not as a problem of the present. It is perceived as a possibility of not being supplied, or being supplied under conditions which are too unsatisfactory, somewhere in the future; it may be a near future or a more remote future. The perceived potential risks may be grouped into three broad classes:

a) lack of primary energy for electricity generation;

b) lack of a reliable infrastructure (power plants, transmission or distribution networks), either as a result of poor maintenance or as a result of lack of investment in new facilities;

c) disorder of energy markets (oil, gas and coal markets; wholesale electricity markets or retail electricity markets).

2. In other regions, many citizens are not yet physically connected to the electricity system and those who are connected do not enjoy a high level of continuity of supply, being subject to frequent, planned or unplanned, disruptions of electricity supply. Very often, electricity prices do not reflect costs and, under these conditions, it becomes difficult to make the necessary investments to ensure appropriate levels of security of supply. In these regions, security of supply is a very real problem of today and tomorrow.

In the second case, security of electricity supply is mainly a political problem: it involves hard decisions that will shape the economic development of the country, influence the social evolution and strongly affect the distribution of wealth and welfare. The decisions taken can be translated into a plan for the development of the electricity system; together with the assumptions underlying the plan, the ability to implement such a plan will determine to a very large exten the future degree of security of supply.

In the first case, where the generalized and secure supply of electricity has already been achieved, the problem of security of electricity supply includes two outstanding issues: the political choice of primary energy mix and the procedural definition of security of electricity supply under new forms of organization of electricity markets.

The choice of primary energy mix is mainly aimed at reducing or diversifying the dependency on primary energy imports and at enabling the country to meet the environmental objectives internationally agreed, namely in terms of emissions. The related political decisions can and, in my view, should translate into an indicative plan illustrating the quantitative goals or the respective quantitative ranges for each source of primary energy and for a certain number of years in the future. This indicative plan is essential for potential investors in electricity generation to make their decisions and for transmission and distribution network operators to plan the expansion of the respective networks; it is also a necessary condition for calculating the future reliability and security of supply of the given system.

A procedural definition of security of supply under new forms of organization of electricity markets is needed, especially where liberalization and unbundling have been introduced. This definition should be technically sound and accepted by the stakeholders; it should lead to a set of quantitative measurements and to the publication of monitoring reports on a regular basis.

When discussing security of electricity supply, one should carefully examine the geographical boundaries of the region under study. In the past, security of electricity supply was considered within State borders, although in some cases infra-State regions were considered. In recent years, regional electricity markets have emerged; therefore, security of electricity supply has to be seen in this supra-national context. The best known example is the so-called internal electricity market of the European Union: it includes 25 Member States and more than 300 million consumers with a yearly consumption of almost 3,000 TWh. With each individual Member State applying its own definitions and without giving proper consideration to the use of interconnectors and to the functioning of the existing regional markets, it is not possible to consider security of electricity supply at EU level as the sum of 25 figures, not necessarily compatible and consistent among themselves. Defining security of electricity supply at regional, supra-national level, is a new challenge from the technical point of view and it may take some time before we reach an acceptable result; however, this technical challenge is a minor one as compared to the big political challenge that was establishing the principle of a single energy market and the common rules for its functioning.

In the remaining part of my presentation I intend to address some particular aspects of the security of electricity supply problem from a regulatory and technical point of view.

On the implications of different choices of primary energy sources for security of electricity supply

If supplying electricity to customers in a given country requires importing large amounts of primary energy, that country may wish to define some policy guidelines regarding the use of primary energy for electricity generation. Some examples of energy policy measures that have been applied include: subsidizing national fossil fuels, namely hard and brown coal; subsidizing the combined generation of heat and power

(cogeneration); subsidizing electricity generation from renewable energy sources, namely hydro, wind and photovoltaics; prohibiting the use of certain forms of primary energy – e.g. nuclear energy; limiting, permanently or temporarily, the authorized capacity of certain types of power plants, according to long-term energy plans; imposing on suppliers the obligation to procure a given percentage of the electricity they sell from power plants using certain sources of primary energy.

All above mentioned energy policy measures expose electricity consumers to the risks associated with the preferred primary energy sources and, therefore, they have an impact on security of electricity supply; moreover, all these measures have direct and indirect impacts on electricity prices.

Once the primary energy mix is defined in quantitative terms, assessing security of electricity supply still requires some generation related assumptions. For instance, it is necessary to estimate the availability of power plants – this is not trivial given the introduction of new technologies and new products from different manufacturers, as well as the existence of different maintenance and operation strategies of producers competing in the wholesale market. It is also necessary to estimate the expected output of power plants – again, this is not a trivial task, since it is necessary to define the set of statistical data used to compute the output of hydro, wind or solar power stations and different stakeholders may have different views about the required level of data robustness, according to their own capacity mix. The estimated energy outputs will also have an obvious impact upon the necessary reserve margins and system costs; this fact reinforces the probability of stakeholders adopting very different views on the appropriate selection of statistical data.

Moreover, some primary energy choices – e.g. decentralized generation – may have a considerable impact upon network planning and operation strategies. Transmission and distribution networks must be constructed in such a way that electricity can flow efficiently from points of generation to points of consumption; the size, type and location of power plants clearly influence the grid topology and the associated necessary investments. The impact of the chosen primary energy mix upon network costs requires a neutral, objective assessment of costs and benefits; it is hard to believe that producers and network operators, having contradictory interests, will provide the most suitable analytical work.

In order to have a constructive debate about the implications of primary energy choices upon security of electricity supply, it is necessary, in my view:

1) Where applicable, to publish all relevant qualitative and quantitative information about the preferred – politically determined – sources of electricity generation for a given time period. Where integration into a supra-national market has been decided, time horizons should obviously be harmonized.

2) To conduct a transparent and public debate with all stakeholders in order to agree on a set of generation-related technical assumptions and statistical data to be used for computation of system reliability and security of supply indexes.

3) To monitor generation projects and market reactions, in particular, where applicable, to the published energy mix policy, and to compare actual capacity additions to the established goals, as well as the actual technical characteristics of the new power plants to those initially assumed.

4) To assess the impact of the preferred primary energy mix upon transmission and distribution networks (cost/benefit analysis, identification of possible bottlenecks, etc.), as well as upon system services (reserve margins, etc.).

On new methodologies for network planning

In liberalized markets where network operators are independent from any interests in generation, trade or supply of electricity, networks must support efficient electricity trade. This means that enough transmission and distribution capacity should be available at all nodes and branches of the network, bottlenecks should not exist or should be kept to a minimum and network losses should be as low as possible. However, the fulfilment of these objectives may increase network costs by an amount that would offset the benefits consumers would obtain from efficient electricity trade. Therefore, a trade-off is necessary between different, contradictory interests.

In liberalized markets, network planning must be a transparent, co-operative process. Network operators and network users should keep a permanent dialogue and the resulting outcome should be submitted to regulatory scrutiny and supervision in order to

ensure a proper balance among all stakeholders' interests and to safeguard public interest.

As previously described, networks may also have to support the political choice of primary energy mix. In this case, network planning must take into account, not only market preferences, but also politically determined generation profiles and connecting capacities.

Within the new, competitive and unbundled legal framework, network operators must adopt a different approach to network reliability as they did in the old days of vertically-integrated monopolies. Probabilistic methods play an increasingly important role and new mathematical tools are being introduced. Planning methodologies must be fully transparent to network users and regulators.

The reliability standards of each network operator must be clearly identified and published. Where integration into a supra-national market has been decided, a certain degree of harmonization is needed. For instance, if the very simple and well-known "n-1" criterion is interpreted and applied in different ways in different areas, it becomes impossible to establish any meaningful comparisons and to compute any aggregated values.

In supra-national markets, the pressure upon network operators to reduce costs also increases as a result of "yardstick competition". However, blind cost reductions may affect reliability and quality of supply. Therefore, benchmarking of network operators under regulatory supervision is crucial for the development of a more efficient and reliable interconnected network.

In order to have a constructive debate about the implications of network operator choices upon security of electricity supply, it is necessary, in my view:

1) To describe and publish all relevant reliability criteria and standards applied by each network operator for planning and operational purposes.

2) To describe and publish the methods used by network operators for planning and operational purposes.

3) To publish, on a regular basis, expansion plans indicating the expected available capacity at each node of the network and the time schedule of all major construction and reinforcement projects.

4) To monitor reliability of all networks and to publish reports on their performance on a regular basis. Where integration into a supra-national market has been decided, a certain degree of harmonization of the methods and data used is necessary and benchmarking should be carried out under regulatory supervision.

On the implications of regional markets for network operation and security of electricity supply

Regional markets offer the potential to increase economic efficiency, energy efficiency and reliability. However, these benefits will not be automatically achieved. As regards security of supply, an effort is needed in order to ensure the adoption, by all involved interconnected system operators, of appropriate planning and operational rules.

In the past, system operators were part of vertically-integrated companies with interests in generation. They had, at least, a de facto monopoly of all interconnectors. The planning and operational rules developed under the previous framework are clearly not appropriate within a liberalized framework, particularly when a parallel process of supra-national integration of energy markets takes place. Full vertical separation of system operators from generators, traders and suppliers and closer horizontal co-operation among system operators is a crucial pre-condition for the efficient, fair and secure expansion and operation of interconnected systems.

If an interconnected system has to support the development of an integrated market, co-ordination is necessary in several fields, such as: long-term planning of interconnectors and other transmission facilities, short-term planning of operation, emergency procedures, restoration procedures, protection strategies and settings, balancing and settlement.

The development of a new set of rules, enabling the more efficient, reliable and secure operation of the interconnected system and supporting the development of an integrated and efficient wholesale electricity market, requires the will and ability of all system operators, the active participation of all network users and close regulatory supervision. Although very important steps have been already undertaken in Europe, progress in this area is still urgently needed.

On privatisation, regulation and security of electricity supply

Sometimes, the view is expressed that liberalization and privatization of the energy sector are incompatible with security of electricity supply. The idea that only public ownership can deliver common goods such as security of electricity supply is indeed a very old one. I would like to point out that the opposite idea, i.e., the conviction that private ownership of monopolies subject to suitable regulation can deliver the desired results to society is also an old one. Ninety-nine years ago, addressing the US Congress in a plea to reinforce the powers of the authority in charge of railway regulation, President Theodore Roosevelt described this idea in the following, extraordinarily crude and clear terms:

" It is because, in my judgement, public ownership of railroads is highly undesirable and would probably in this country entail far-reaching disaster, that I wish to see such supervision and regulation of them in the interest of the public as will make it evident that there is no need for public ownership. The opponents of government regulation dwell upon the difficulties to be encountered and the intricate and involved nature of the problem. Their contention is true. It is a complicated and delicate problem, and all kinds of difficulties are sure to arise in connection with any plan of solution, while no plan will bring all the benefits hoped for by its more optimistic adherents. Moreover, under any healthy plan the benefits will develop gradually and not rapidly. Finally, we must clearly understand that the public servants who are to do this particularly responsible and delicate work must themselves be of the highest type both as regards integrity and efficiency. They must be well paid, for otherwise able men cannot in the long run be secured; and they must possess a lofty probity which will revolt as quickly at the thought of pandering to any gust of popular prejudice against rich man as at the thought of anything even remotely resembling subserviency to rich men. But while I fully admit the difficulties in the way, I do not for a moment admit that these difficulties warrant us in stopping in our effort to secure a wise and just system."

Final remarks

I believe that the clear definition of roles and responsibilities, the adoption of a transparent and rational process leading to the definition of security of electricity supply indexes, reliability standards and operational rules for interconnected systems, permanent monitoring and reporting under regulatory supervision and a firm

commitment from transmission system operators, distribution operators, market operators and industry in general can “secure a wise and just [electricity] system” .

The challenges we all face, and in particular transmission and distribution operators, are significant. It is our common duty to explain to electricity consumers and to all citizens the size and importance of the required transformations in order to ensure that the electricity industry will remain, in the 21st century, as reliable as it was in the past. It is my deepest personal conviction not only that future electricity systems will be secure, but also that system operators are and will remain reliable partners determined to innovate, to excel technically and to serve electricity consumers.