THE FUTURE OF NUCLEAR ENERGY

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1 Introduction

The debate in Europe about the future of nuclear electricity supply is presently dominated by two items:

* the liberalisation of the electricity market
* the decision of some European countries to phase out nuclear energy.

From this debate one could draw the conclusion that nuclear power has no future at all.

FORATOM, which represents the interests of the European nuclear industry in Brussels, is convinced that nuclear energy does have a future because, according to our judgement, it has to. There are compelling economic and environmental reasons for maintaining and expanding the use of nuclear energy in Europe. Nuclear just makes good sense.

Globally, nuclear **must** have a future,

* **if** we are to meet the world's growing demand for energy,
* **if** we are to maintain current standards of living – if not improve them
* **if** we humans are to preserve this planet in a healthy and habitable form for future generations.

Let me now give our view of where nuclear energy stands in the European Union.

Western Europe has more than 140 power reactors in operation, producing about 35% of all the electricity consumed in the European Union.

The nuclear industry, with an annual turnover of €45 billion, provides over 400,000 highly skilled jobs. The nuclear power plants have a total capital value of about €350 billion, at today's costs.

The industry is well regulated and enjoys an excellent safety record – something the plant operators are determined to maintain. Safety remains the industry's top priority, despite the pressures of power market liberalisation and industry restructuring.

The plants produce electricity reliably, safely and at competitive prices. They are environmentally friendly, as they emit practically no greenhouse or acid rain gases.

Let me now comment on the two central items of today's discussions, which I mentioned earlier: liberalisation and phase-out.

Liberalisation, in several European countries has not only eliminated former supply monopolies. At the same time the monopoly of (national) energy policies has disappeared. Our future energy mix will be increasingly influenced by

technological and international market developments like the continuing "dash for gas". Despite the well-known fact that utilities in some countries are still confronted with government plans to phase-out nuclear energy, I believe that the viability of nuclear energy in the long run will rather depend on the competitiveness of nuclear energy compared to other options of electricity generation than on (changing) political tendencies in our respective countries.

2 Current Competitiveness of Nuclear Energy

What is the role of nuclear energy in the liberalised markets of today?

In Germany, as an example, almost two years of competition have shown that nuclear continues to be the most important pillar of electricity generation, despite the radically changed conditions of an electricity market that was 100% liberalised overnight without any intervening deadlines.

Recent figures, published only two weeks ago, indicate that German NPPs in fact increased their electricity production by 5% in 1999 (169 TWh in 1999, compared to 161 TWh in 1998). The share of nuclear energy in public electricity supply amounted to 34% in 1999, compared to 33% in 1998.

Obviously, the prophecies of the opponents of nuclear power were wrong. A market driven phase-out of nuclear is currently not feasible. On the contrary, the liberalisation of electricity markets seems to increase the use of NPPs, if you look at countries like the US or Great Britain.

What makes **existing NPPs** so profitable and therefore competitive?

The key factor is certainly the amount and structure of their costs. About three-quarters of the entire costs fall in fixed capital investment and only one quarter in variable costs, which primarily means fuel expenditures. If you look at gas-fired plants, this ratio is exactly the reverse. However, the important thing is that fixed costs do not affect the competitiveness of existing plants once the capital investments have been amortised.

In other words, power generation costs arise largely from low variable costs, which give Germany's nuclear power plants an excellent market position – even compared to modern "combined-cycle" power plants.

To give some details:

High availability rates allow for large electricity generation at low expenditure. Since the early 1980s, Germany's nuclear power plants have regularly led the IAEA 'top ten' list of NPPs with the highest power generation and availability rates in the world. (In 1998, the Grohnde NPP topped the list at 11.8 billion kWh,

followed, from third to sixth place, by Isar-2, Emsland, Neckar-2 and Philippsburg-2).

Based on annual utilisation periods from 6,000 to 8,000 hours, the average power generation costs of our **existing** NPPs (investments in them already paid off) lie between 1.9 and 1.5 € cents per kWh, taking into account all back-end expenses, including reprocessing of spent fuel rods, final storage of radioactive waste, and plant decommissioning and dismantling. Electricity generation in **new** gas-fired base-load plants costs 2.6 € cents per kWh at 6,000 h/a and 2.5 € cents per kWh at 8,000 h/a.

In other words, nuclear energy is about 0.8 € cents per kWh cheaper than power from modern gas plants – a saving of some 50%.

Obviously, there is no need to worry about the economic viability of most existing NPPs. If we look at possible **new** NPPs, however, the situation is different. With respect to the future construction of new NPPs, there are two issues that I would like to look at a bit closer.

The competitive edge of most existing NPPs derives from low and long-term calculable generation costs. However, as long as NPPs are not amortised, high capital costs and long construction times are a disadvantage compared to other generation options, particularly the gas-fired "combined cycle" plants, which I have mentioned already.

Within a liberalised market, any new generation of reactors has to ensure absolute profitability in comparison with conventional power plants. The challenge is to reduce capital costs considerably.

The European Pressurised Water Reactor, the EPR, follows this path. With a capacity of 1756 MWe, the EPR would reduce specific investment costs to less than € 1,380/kW. This would be a reduction of about one third compared to those NPPs that were built in the late 1980s. The EPR could produce electricity at generation costs of about 2.6 € cents, making the reactor competitive with all other base-load options, including gas-fired "combined cycle" power plants.

The nuclear industry, therefore, makes a valuable contribution towards achieving Western Europe's economic, energy supply and environmental objectives.

3 Phase-out Policies

My second item, you will recall, is the current talk in certain quarters of a nuclear phase-out. In any debate about such a course of action, the economic and environmental effects of plant closures must be given full and careful consideration.

The discussion should be based on fact, rather than emotion, and should take into account current public opinion and the needs of future generations.

Phase-out policies have been adopted in certain West European countries for purely political reasons. The decisions involved have not been based on safety, environmental or economic arguments, and are – contrary to what many politicians often claim – out of line with public opinion, according to recent polls.

Phasing out nuclear will have a negative economic impact at different geographical levels – local, national, regional and global. Industrial competitiveness will suffer as well.

At local level, nuclear power plants perform a dual role. They not only produce power for the grid; they also serve as a powerhouse for the local economy concerned. In many places, they provide the main economic base for whole communities, communities that have grown around them right from the initial construction phase. The new plants have brought with them two important spin-offs – a boost for the local economy and other valuable benefits, such as better housing, schools and leisure facilities.

Take the plants away, and you undermine the foundations of those communities. You even run the risk of turning once-thriving localities into depressed 'ghost towns'. If plants close, people once employed there will move away to seek work elsewhere. The lucky ones will find alternative employment, but the less fortunate may be forced to stay where they are, without work and adding to the social and economic disintegration already triggered by the closure. In certain areas, the presence of nuclear power plants has actually managed to keep communities together, acting as an economic incentive for people to stay in their home districts rather than join the drift to the big cities in search of a better life.

It is a well-known fact that support for nuclear power is significantly higher in the vicinity of nuclear plants than in areas with no such installations. This shows that at least those people living closest to the plants are fully aware of the value of those installations.

At national level, it is important that countries have appropriate energy strategies that reflect both their natural resources and their energy needs. The reduced reliance on fossil fuels – offered by nuclear energy – means increased energy independence and greater diversity and stability in energy supply. With nuclear energy, countries are less likely to be affected by sudden rises in fossil fuel prices and fuel supply shortages.

Plant closures would cast a grim shadow not only at local and national level. At the European regional level, any future decline in the contribution of nuclear energy to Europe's energy supply will have serious implications for strategic energy policy and environmental targets. The EU currently depends on external sources for 50%

of its energy supply, and this figure is expected to rise to 70% by 2002. With reduced reliance on nuclear, that percentage would increase still further, and the EU would find it all the more difficult to meet its Kyoto commitments.

Events in Sweden and Germany have shown that a phase-out is no easy matter. There is the issue of compensation to be addressed, along with a range of legal and commercial questions previously unforeseen and unanswered.

Nuclear energy is the only large-scale non-fossil energy source capable of expansion. If it were to go into decline, what would be the feasible alternatives? The potential for expanding hydro is limited. The nuclear industry supports the use of renewables, but the amount of power these sources can provide is extremely limited, compared to nuclear energy.

The fossil resources of our earth are finite and should be conserved, as they have important industrial uses other than power generation. On the other hand, uranium, which is used as nuclear fuel, is available from a variety of sources world-wide. In general, it can only be used intelligently as the fuel needed for the production of nuclear electricity.

One of the key factors holding back the further development of nuclear power in Europe is today's abundant supply of gas at attractive prices. But these conditions will not prevail forever.

For the moment, gas is the preferred short-term option, but in the long-term, the winners in the energy game will be those who take the long-term view, those who see the long-term role of nuclear energy and its potential.

In October 1998, the Nuclear Energy Agency, NEA, and the International Energy Agency, IEA, of the OECD, issued some key predictions for the period 2005-2010. Their study forecast that nuclear would remain economically competitive with fossil fuel generation, except in areas where there was direct access to low-cost fossil fuels.

Let us now look at today's global energy supply situation and at what the future holds from an environmental viewpoint.

Today, more than 2 billion people have no access to electricity. This figure represents one-third of the world's population.

World energy demand will continue to grow as populations increase and countries undergo industrial development and expansion.

To meet these increasing demands, and to improve living standards for future generations, there will need to be large increases in electricity generation. Such

increases must be achieved in a sustainable way that has the lowest possible environmental impact.

4 Environmental Impact

Another important issue is the possibility of man-made climate change, caused by the emission of greenhouse gases. The Kyoto Protocol calls for the promotion of CO_2 avoidance technology and of advanced, innovative and environmentally sound technologies. Nuclear energy is one of those technologies, generating about 16% of the world's electricity and thereby avoiding each year the release of some 1.8 billion tonnes of CO_2 world-wide.

In Europe alone, climate-friendly nuclear electricity saves the emission of about 800 million tonnes of CO_2 a year. To make an equivalent saving, 200 million cars would have to be taken off the roads, which represents practically the whole private fleet of motor cars.

CO_2 emissions can be further avoided by adding new nuclear capacity, upgrading existing nuclear plants and extending their operating lives.

Proposals for energy taxes, hitting every form of electricity generation, represent a missed opportunity. Any such tax should focus primarily on cutting CO_2 emissions, not reducing energy use. Unlike power plants that burn fossil fuels, nuclear stations do not pollute the atmosphere. What comes from the cooling towers of nuclear power plants is simply steam. Therefore, there is no logical reason to impose a tax designed for environmental protection on power generation sources that do not damage the atmosphere. It makes no sense at all to discriminate against an energy source that is actually helping to curb CO_2 emissions. Indeed, the reverse should be the case. The clean air benefits of nuclear, and other sources, should be properly recognised, and this should be reflected in any new taxation structure.

Nuclear energy is a competitive solution especially when the global costs to society are taken into account. In a world increasingly concerned about global warming, nuclear energy remains one viable and economic option. All forms of energy and all technologies are necessary for global sustainable development. All forms of energy are required for mankind to continue to advance economically, and all options must be used so that mankind can start making this world a better place to live in.

Still looking ahead, many of Europe's nuclear plants -- still only halfway through their operating lives -- will need to be replaced in the next 20 years. In view of this, the nuclear energy option should be kept open and nuclear expertise should be maintained, in order to:

* achieve a rational and sustainable energy mix
* help cut CO_2 emissions

* promote economic development
* protect jobs and ensure the industry's continued success on global markets.

Cost comparisons usually ignore the impact on the environment. If "external costs" – defined by the adverse impact on climate and human health and based on lifecycle analyses – were taken into account, the competitive edge of nuclear would of course be very obvious. A research study carried within the framework of the European Commission's "ExternE Project" comes to the following conclusions:

* The experts calculate the costs of a modern **hard-coal power plant,** with a nominal performance capacity of 600 MW and a utilisation period of 6,500 h/a, at 1.0 to 5.2 € cents per kWh.
* For a **lignite power plant** (800 MW, 6,500 h/a), the costs lie between 1.1 and 6.4 € cents per kWh.
* For a **gas-fired combined-cycle power plant** (800 MW, 6,500 h/a), the figures lie between 0.4 and 1.9 € cents per kWh.
* The external costs for **nuclear power plants** are noticeably lower than those for conventional thermal plants, ranging between 0.1 and 0.7 € cents per kWh. The external costs of NPPs thus lie within the range of costs for power plants based on renewable energy resources like solar and wind.

The most promising way to internalise environmental and health costs, or capitalise on the environmental benefits of nuclear, would be to integrate nuclear power within the Flexible Mechanisms of the Kyoto Protocol, Emissions Trading, Joint Implementation and the Clean Development Mechanism, CDM.

* Within the concept of emissions trading, both new NPPs as well as upgrades of existing NPPs should be given emissions reduction credits.
* Additional nuclear capacities should be eligible within the concepts of Joint Implementation and Emissions Trading.

5 Conclusion

Europe is one of the world leaders in nuclear technology advancement. The development of spent fuel reprocessing is but one example of this. This process continues today with the development by France and Germany of the European Pressurised-Water Reactor. Nuclear research and development work is continuing in Europe, and must be continued in the future, if Europe is to retain its world leadership position in the technological field and on the commercial front.

If we look at the benefits, which nuclear energy has to offer, in economic and environmental terms, I support the view that nuclear is an energy source *whose time has come again*. This is not some fanciful notion or wishful thinking. There is clear evidence of greater long-term reliance on nuclear energy. Perhaps we do not see

new nuclear plants springing up in Europe, but we do see ambitious nuclear power development programmes underway in places like China, Japan and Korea. Closer to home, Finland is seriously considering the construction of a new nuclear unit. Elsewhere, in Europe and the US, we see a growing trend towards nuclear plant life extension and plant upgrades geared towards higher production capacity.

These are all signs that nuclear will be around for a long time to come and that nuclear will indeed have a future.