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Nuclear Power in the Competitive Nordic Electricity Market

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The Nordic countries – Denmark, Finland, Norway and Sweden – have a long tradition of cross-border co-operation in providing an efficient and reliable power supply. Each of the four countries has a different mix of power generation facilities. Norway's power is almost 100% from hydropower plants, Finland and Sweden have hydro, nuclear and other thermal plants, and Denmark has almost 100% thermal production.

The total power production capacity in the Nordic system is about 420 TWh per year, and normal annual production is 360 TWh. The main utilities in the four countries have informally co-operated for several decades in planning their power generation strategies. The Nordic countries are interconnected by several high voltage lines (both AC and DC), and several lines to other European countries are now being constructed or are planned.

During a normal year the net import/export exchange has been small between the four countries, but over shorter periods the exchange has been of great importance for many decades. During years with low precipitation and accordingly low hydropower generation, the net import/export exchange increases.

Electricity market competition was introduced in Norway by January 1991 and in Sweden by January 1996. During 1997 the last obstacles to a competitive power market in Finland were removed. Denmark is in practice part of the Nordic competitive power market, but formally the legislative changes there will follow the pace decided within the European Union (EU).

A power exchange has been in operation in Norway since 1991, and in 1996 Sweden joined this system. From late 1998 there will be a common power exchange covering the power markets in Norway, Sweden and Finland open for all sellers and buyers of electricity. Some utilities in Denmark are also members of the power exchange.

The power market in the Nordic countries is one of the biggest and most advanced competitive power markets in the world. About 25% of the total Nordic power supply is generated by nuclear power (30% in Finland and 50% in Sweden).

This paper contains a broad presentation of the Nordic electricity market and some experiences from its operation so far. With this background, a wide range of items related to nuclear power in a competitive power market are discussed, based on experience from Finland and Sweden (with emphasis on the Swedish situation). These include:

- operation strategies,
- modernisation of nuclear power plants,
- extension of plant life,
- power upgrading,
- decommissioning for political reasons,
- investments in new nuclear power plants.

The Nordic Power Supply System

Power Generation and Consumption

Norway and Sweden are among the countries with the highest electricity consumption per capita. In Norway consumption was more than 25 000 kWh/capita and in Sweden almost 16 000 kWh/capita during 1997. The average

Table 1. The power supply system in the Nordic countries as in 1997 (Source: Nordel Annual Report 1997).

	Denmark	Finland	Norway	Sweden	Nordic countries
Population (million)	5.3	5.1	4.4	8.9	23.7
Consumption (TWh)	34.5	73.5	111.4	140.1	359.5
Maximum load (GWe)	5.4	10.1	16.2	21.4	53.1
Total generation (TWh)	41.7	65.9	112.0	144.9	364.5
Hydropower	-	18%	99%	47%	53%
Nuclear power	-	30%	-	46%	23%
Other thermal power	95%	52%	1%	7%	23%
Other renewable power	5%	-	-	-	1%

consumption in all the Nordic countries (excluding Iceland) was 15 000 kWh per capita. A breakdown of the power supply system in 1997 is shown in Table 1.

This shows that the power supply system is dominated by hydropower, which accounts for roughly 50% of the total output of electricity. However, the percentage accounted for by hydropower varies from year to year, depending on the fall of rain and snow. Nuclear power accounts for about 25% of the total output, and provides a stable baseload power generation. The remaining 25% is generated by means of coal, oil and natural gas in co-generation plants or in condensing plants. In years when there is not much rain and snow, or when there are problems at some nuclear power plants, the extra demand is largely met by fossil-fuelled power plants.

From the environmental perspective, the power supply system in the Nordic countries is markedly better than the system that exists elsewhere in the EU, at least with respect to the conventionally recorded emissions of CO_2, SO_2 and NO_X (see Figure 1). A breakdown of the consumption of electricity in the four Nordic countries is shown in Table 2.

The High Voltage Distribution System

The hydropower plants are normally situated far from the areas with high power consumption. This is especially true in Sweden. The world's first 400 kV line was developed and constructed in Sweden and such lines are now by far the most common high voltage lines in the four Nordic countries. Also, the world's first high voltage DC cable (HVDC) was developed and constructed in Sweden. There are now several HVDCs in the Nordic power distribution system.

There are also several high voltage lines and cables connecting the Nordic system with other countries, for example between Denmark and Germany, Sweden and Germany, and Finland and Russia. Several new HVDCs are now planned between Scandinavia and the European power system (see Figure 2).

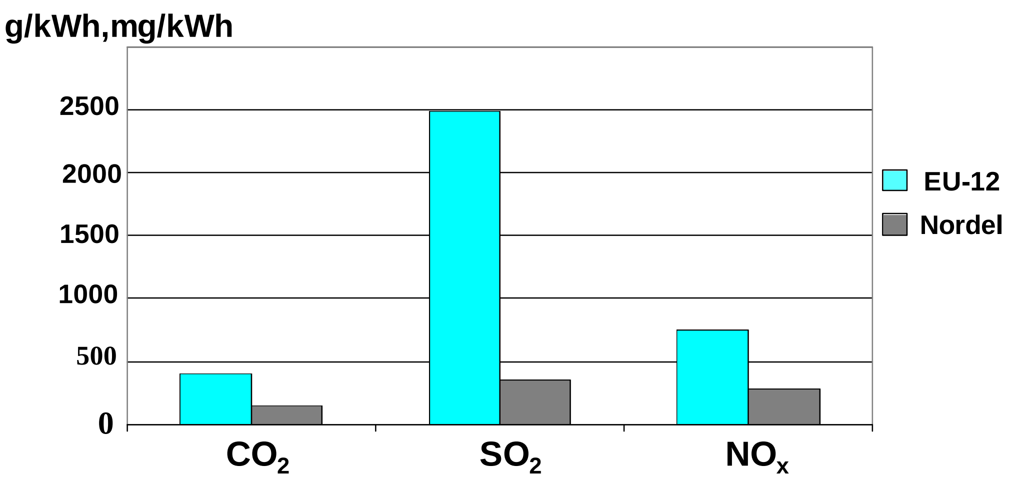

Figure 1. Emissions from Nordic and EU power production (CO_2 in g/kWh, SO_2 and NO_X in mg/kWh) (Source: Nordel Annual Report 1997).

Table 2. Electricity consumption in 1997 in the Nordic countries (GWh).

	Denmark	Finland	Norway	Sweden	Nordic countries
Gross consumption	34 492	73 467	111 415	140 119	364 735
Losses	2 352	2 801	10 685	9 719	25 910
Net consumption	32 140	70 666	100 730	130 400	338 825
– housing	9 710	17 404	35 250	39 500	102 444
– industry	9 810	40 798	43 940	53 300	151 271
– trade and services	9 330	11 094	19 940	34 200	75 088
– other	3 290	1 370	1 600	3 400	10 022

The Competitive Nordic Electricity Market

The Liberalisation Process

The issue of a more open power market in Europe became topical in the late 1980s. The objective was to improve efficiency in the power sector by, for example, increasing power trading on the European internal market. The first proposal for the EU's Internal Energy Market (IEM) Directive was presented in 1992. After a number of changes, the Directive was approved in December 1996 and came into force at the beginning of 1997. The power market will successively be opened up, but it will take at least five more years before there is a free internal power market within the EU.

Deregulation of the power market has been considerably more rapid in the Nordic countries than in EU as a whole. In the early 1990s, the individual Nordic countries discussed reorganisation of their national electricity supply systems, and the Nordic Council of Ministers recommended the establishment of a deregulated Nordic market.

In 1991, Norway passed a new Energy Act, which required power companies to divide their operations between a grid sector and a production sector. Similar electricity legislation was drafted in Sweden and Finland a few years later. Transmission fees between Norway and Sweden were abolished at the beginning of 1996, and a joint electricity exchange – NordPool – began operations in the region covered by the new market.

With respect to legislation, Denmark has opted for a concept that follows the outlines drawn up within the EU. Apart from that, measures have been taken in the electricity sector to promote more rapid development.

The Composition of Electricity Prices

The starting point for the electricity market legislation in the Nordic countries is that grid operations are conducted as a natural monopoly,

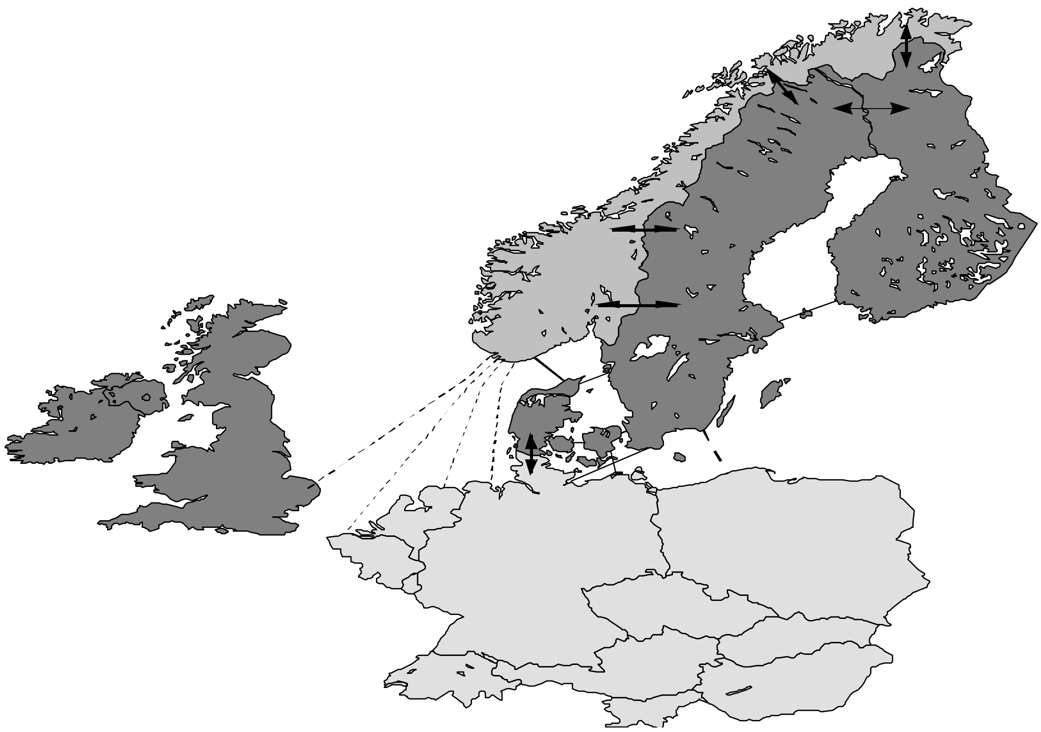

Figure 2. Status for existing and planned connections between the Nordic countries and between these countries and other countries in Europe (Source: 'Liberalisation of the Energy Sector in the Nordic Countries', World Energy Council, 1998).

and that grid operators are required to transmit power at reasonable costs and on equal terms. But electricity generation and electricity sales are subject to competition to a greater extent than before. These two types of operations are legally required to be separate, mainly to prevent cross subsidies.

The price paid by a consumer in the competitive Nordic electricity market can in principle be divided into three parts:

- The price for the generation and sale of electricity in an open competitive market. This price should include environmental fees applied to the generation of power (this is the situation in Sweden but not in Denmark, where environmental fees are applied to the consumption of power).
- Transmission fees, which are pre-calculated, transparent and based on a point-of-connection principle.
- Fiscal taxes applied on the consumption of electricity (for example energy taxes and VAT).

In Sweden the price paid by small private customers (without electric domestic heating) is divided into these three parts in the proportions of 20%, 40% and 40%. For a large, intensive industrial power consumer (for example, a steel or a paper mill) the total price is distributed in the proportions 95%, 5% and 0%. In an ideal competitive market the first part of the price per kWh should be about the same for these two types of customers, which represent the extremes.

Overall Responsibility for the Power Supply System

For practical reasons it is not possible to arrange a competitive electricity trade for shorter periods than one hour. For shorter periods and in real time a central actor is needed, responsible for the stability of the frequency and voltage on the total grid system (i.e. for the balance between production and consumption in real time). This responsibility is carried out by the grid operators.

The publicly owned national grid operators are also responsible for grid balancing services in Norway and Sweden. In Finland the national grid is operated by Fingrid, a company which is owned by the power producers. Fingrid also has responsibility for balancing services. The situation in Denmark is for the time being somewhat more complex. There are many reasons for having only one system operator for all the Nordic countries, and hopefully this goal will be achieved in the near future.

The balancing service is looked upon as a collective good. It is therefore paid for outside the competitive electricity market as part of the net tariff.

The Net Pricing Tariff

The pricing of transmission services in the whole network is based on a point-of-connection tariff system, which means that the choice of power supplier does not affect the costs payable by the customer for the grid services. This means that the consumption part of the transmission tariff depends only on the point where the customer is connected, and the feeding part of the transmission tariff depends of the point where the power supplier is connected.

It also means that a transmission tariff offered to a local consumer has to cover both local, regional and main grid transportation. The local grid owner is responsible for including the transportation cost of the regional and the main grid in his local grid tariff. This type of general Third Party Access (TPA) together with the tariff system has opened up the grid for effective competitive trade. Each customer is in this way connected to whole Nordic competitive electricity market and is free to choose their own supplier or suppliers. This system promotes a liberal power market and gives the customer more opportunities to choose the power supplier on terms determined by the market.

The system described above would, in an ideal competitive electricity market without any bottlenecks, result in an electricity price per kWh which is levelled out, being the same for all customers independent of size.

The Electricity Markets

The trade of electricity is partly done on a bilateral basis and partly through organised markets (power exchanges or pools). The joint power exchange in the Nordic power market has two different markets. The trade of contracts for physical delivery the next day is served by the spot market. The power exchange also organises a financial futures market, which can be used for hedging up to three years ahead.

The power exchange has been operating in Norway since 1991 and in Sweden since 1996. The Finnish market was included in 1998. The power exchange is operated by NordPool, a company owned by the two national grid companies in Norway and Sweden. The number of actors in the exchange is now about 130. In addition, about 30 customers trading through brokers have been connected. The broker concept was introduced early in 1996.

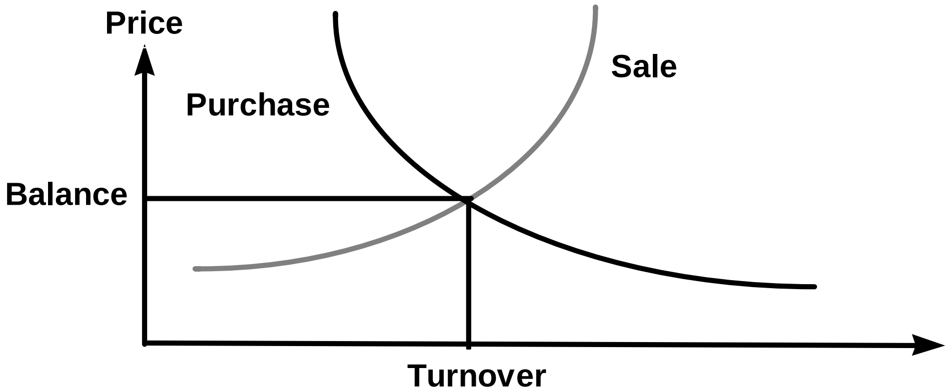

Figure 3. The principle of price calculation in the NordPool spot market (Source: 'Liberalisation of the Energy Sector in the Nordic Countries', World Energy Council, 1998).

In the spot market the actors can bid for purchase and sale. The actors make their bids in the form of quantities combined with prices within an allowed price interval. All the bids are fed into a computer and a line is drawn between the discrete price/quantity points. A typical bid will be to purchase for low prices, with reduced purchases at higher prices as the actor chooses to add its own production or use bilateral contracts. At higher prices the bid turns into an offer for sale. All the bids are to be delivered before noon.

The sum of all bids is used to generate curves for total purchases and total sales against price (see Figure 3). The system price will be calculated at the equilibrium point where purchases balance sales. The system calculates 24 prices, one for each hour for the next day from midnight to midnight. After the spot market prices have been fixed, the players get confirmation of their purchases and sales, and the actual prices, according to their bids.

NordPool is a counterpart in all contracts in the spot market, and all the trade remains anonymous. Following the delivery week, the players get invoices and credit notes from NordPool, and the financial transactions take place the next week.

NordPool has two types of contracts in the financial market, futures and forwards. The contracts on the futures market are all financial contracts and not contracts for physical delivery as on the spot market. Bilateral contracts are also now settled more and more often as financial contracts.

To reduce the number of contracts, they are traded as single week contracts for the first 4–7 weeks in advance, as blocks of 4 weeks for the rest of the first year, and as three different seasons consisting of a number of blocks for the following two years.

About one third of the electricity produced is traded through the organised markets. The remainder is traded through bilateral contracts of different kinds. The spot market prices have a strong influence on the bilateral contracts, and therefore the prices of long term contracts reflect in most cases the expected development of the spot price. The expected spot price is also decisive for production planning and for investments in new generation facilities. The spot market price represents the marginal value of one kWh in the market at a given moment.

The Development of the Electricity Price

In the old days the electricity price was set by the producer to cover all costs. This not the case any more in the Nordic power market. Instead the price is determined by the market, and varies according to supply and demand.

The total Nordic power production system, with capacity of about 420 TWh per year, is represented in Figure 4. The load forecast (which equals production in a normal year) is about 360 TWh/year, as indicated in the figure. The incremental operating costs (i.e. the variable costs) are shown on the Y-axis in Swedish öre per kWh (SKr 1 = 100 öre = US$0.125).

The capacity of the total hydropower system in a year with normal precipitation is about 200 TWh, as indicated in the figure. 1996 was an extremely dry year and therefore the hydropower capacity was reduced by about 25 TWh, while the load remained at the 360 TWh level. The resulting effect on the electricity spot market price can be illustrated by means of the figure. Removing 25 TWh from the hydropower block means that the arrow indicating load is no longer pointing into the coal condensing region, but instead into the oil condensing region with an increase in the incremental costs as a result. During most of the dry year 1996 the spot market price was increased from below 20 öre / kWh to between 25 and 30 öre / kWh. For part of the year the spot market price was above 30 öre / kWh.

During 1997 and 1998 the hydropower capacity has been normal or above normal. The spot market price has therefore decreased to very low values. The average value for 1998 will probably be around 15 öre / kWh or less. In late July 1998 the spot price has sometimes even been below 5 öre per kWh. Also the price three years ahead on the futures market is now low, below 20 öre / kWh.

When the competitive electricity market expands to cover various other types of customers and / or expands geographically, the downward pressure on prices will be harder.

In debate in Sweden it has been said that the price will increase in the Swedish market when a competitive market has been established in the rest of Europe. The reason would be that the electricity price is now much higher in Germany than in Sweden. There would thus be an incentive for constructing several HVDC cables between Sweden and Germany for export of power from Sweden (and other Nordic countries). The result would be higher prices in the Nordic countries.

This is completely wrong. The reason is that in many countries in Europe, and also in different regions of Germany, the power supply system has been dimensioned to meet local demands for delivery security. The sum of these security margins adds up to a substantial overcapacity, which will be visible when the power market has been deregulated all over Europe. The competitive market price will therefore be forced down towards the incremental operating cost for coal condensing power. Coal condensing power in the total European power system will be at the intersection where demand and supply normally meet.

In the Nordic countries, where the electricity price varies depending on the supply of hydro-power, the opening of a competitive European electricity market will result in smaller price

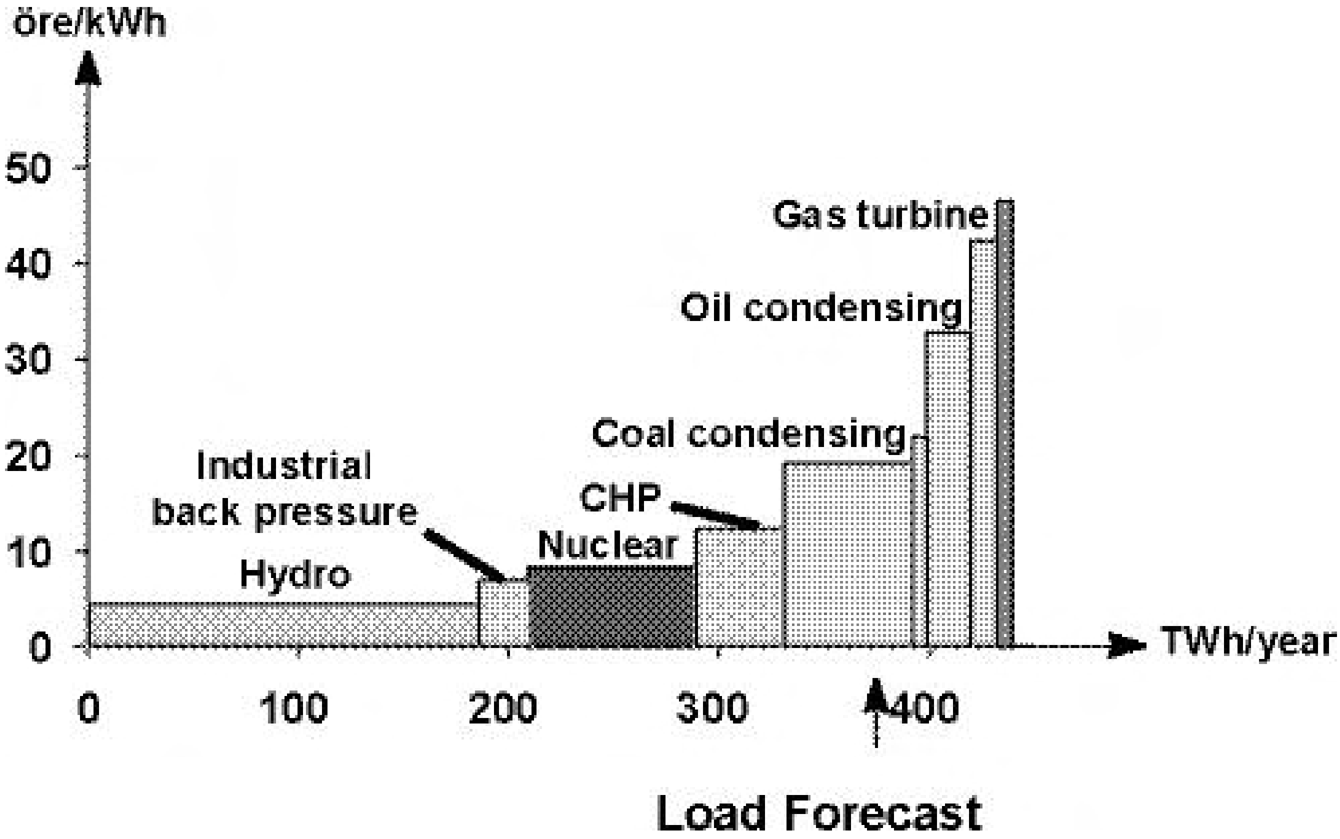

Figure 4. Incremental operating costs in the Nordic power production system.

variations. The average price of electricity in the Nordic market will remain below 20 öre / kWh, corresponding to the incremental production cost for coal condensing power, even after a change in the European power market. The situation would be different both in the Nordic countries and in the rest of Europe if the demand for power rises, or if CO_2 taxes are applied to coal condensing power generation.

Environmental Taxes and Fees

The environmental taxes in the power sector are very different in the four Nordic countries. Denmark has both a CO_2 tax and an SO_2 tax, applied on consumption of electricity rather than on generation. In Sweden, fuel used in electricity generation is subject to an SO_2 tax and a limited CO_2 tax. An environmental fee on NO_X emissions is also levied. Taxes are levied on the production of electricity from nuclear plants at the rate of 2.2 öre per kWh. A fiscal tax (property tax) is levied on hydropower, at about 2.2% of the value of the real estate. In Finland, there are no environmental taxes, but fiscal taxes are applied on the real estate. In Norway, relying only on hydropower, there are no environmental taxes, but instead several fiscal taxes are applied on production. There is a political debate in Norway about the introduction of CO_2 taxes.

Different types and levels of taxes in different countries involved in the same electricity market are often a severe distortion of the natural market forces, without any logical structure. In some extreme cases the disharmony of environmental taxes in the Nordic countries has resulted in worse environmental conditions. The Danish power producers can, for example, export power at low cost generated in old coal condensing plants without flue gas scrubbing systems. The price level in the Nordic electricity market in a year with low and normal capacity of hydropower is determined by the incremental cost of producing power in the Danish coal condensing plants, about 15 öre / kWh. This means that modern fossil fuelled plants in Sweden with flue gas scrubbing systems cannot compete due to high production costs.

It is of great importance to harmonise the environmental taxation systems in the different Nordic countries, and also in other parts of Europe, as soon as possible.

Restructuring of the Electricity Supply Industry

During the first years of the reform of electricity markets a heavy fight has been fought between a number of Swedish and foreign investors over the ownership of the Swedish power producers available on the stock market. At the same time, the Swedish companies are establishing themselves in neighbouring countries. This means that the electricity supply industry that used to be essentially a domestic industry is now becoming international.

The result to date is that the third largest Swedish generator, Gullspång, ownership of which used to be dominated by Swedish municipalities, is now totally controlled by Imatran Voima of Finland. Similarly, the seventh largest generator, Graninge, formerly controlled by a Swedish private family, is now controlled by Electricité de France (which owns 30% but in accordance with a special agreement controls the majority of votes). The second largest generator, Sydkraft, which used to be fully controlled by Swedish municipalities, is now to a large extent owned by PreussenElektra and Hamburgische Elektrizitätswerke of Germany, and Statkraft of Norway. The foreign and Swedish owners of Sydkraft are at the moment of roughly equal strength. Stockholm Energi, until recently fully owned by the City of Stockholm, has been merged with Gullspång, and the new company is owned 50% by IVO of Finland and 50% by the City of Stockholm.

Nuclear Power in Sweden and Finland

The first commercial nuclear power plant in Sweden, Oskarshamn-1, started operation in 1972, and the last in a series of twelve was brought on line in 1985. In Finland, there are four nuclear units in operation. The total capacity is 10 000 MWe in Swedish nuclear power plants and 2300 MWe in the Finnish plants. The normal net production per year is 72 TWh and 20 TWh, respectively. The 16 nuclear units in operation in the Nordic countries are presented in Table 3.

In Sweden there has been a political debate for many years about the phasing out of nuclear power. On 4 February 1997, an inter-party agreement between the Social Democrats, the Centre Party and the Left Party was presented. In this, the three political parties agreed on a number of measures to reduce electricity consumption and to develop new methods of electricity production during the next few years. They also agreed to start a new, long term transformation programme to develop a so-called "ecologically sustainable" energy system.

The government introduced to parliament a bill (number 1996 / 97:84), entitled "A sustainable energy supply", based on the inter-party agreement. The bill was adopted in the Swedish Parliament

Table 3. Nuclear power plants in Sweden and Finland.

Power plant	Reactor type, vendor	Net output (MWe)	Net production 1997 (TWh)	Year of commercial operation
Sweden				
Barsebäck-1	BWR, ABB Atom	600	3.7	1975
Barsebäck-2	BWR, ABB Atom	600	3.9	1977
Forsmark-1	BWR, ABB Atom	968	5.4	1980
Forsmark-2	BWR, ABB Atom	969	7.3	1981
Forsmark-3	BWR, ABB Atom	1 158	9.0	1985
Oskarshamn-1	BWR, ABB Atom	445	2.6	1972
Oskarshamn-2	BWR, ABB Atom	605	4.4	1975
Oskarshamn-3	BWR, ABB Atom	1 160	9.0	1985
Ringhals-1	BWR, ABB Atom	830	2.2	1976
Ringhals-2	PWR, Westinghouse	875	6.2	1975
Ringhals-3	PWR, Westinghouse	915	6.6	1981
Ringhals-4	PWR, Westinghouse	915	6.4	1983
Finland				
Loviisa-1	VVER	465	4.0	1977
Loviisa-2	VVER	465	4.0	1981
Olkiluoto-1	BWR, ABB Atom	710	6.4	1979
Olkiluoto-2	BWR, ABB Atom	710	6.1	1982

on 10 June 1997. The resulting energy policy programme will give rise to state expenditure of SKr 9 billion (US$1.1 billion) over a seven-year period. This energy policy programme and the closure of two nuclear reactors will form the basis for future political decisions.

According to the guidelines adopted by parliament, the two nuclear reactors at Barsebäck were to be taken out of service, the first before 1 July 1998 and the second before 1 July 2001. One condition for the closure of the second reactor is that the loss of electricity production must be compensated for by new production and decreases in electricity consumption. According to the parliamentary decision, no final date is set out for the closing down of the remaining nuclear reactors in Sweden. This means that the previously-set deadline of 2010 is now removed.

In December 1997 the parliament passed additional legislation on the decommissioning of the two nuclear plants (Law 1997:1320). Referring to the new law, the government decided on 5 February 1998 to withdraw permission to operate Barsebäck-1 after the end of June 1998. The owner of Barsebäck (Sydkraft) appealed to the Swedish Supreme Administrative Court to set aside the decision of the government, and asked also for an interim order. On 14 May the Supreme Administrative Court decided that the government decision should not have effect before the court had tried the case finally.

Barsebäck-1 can thus continue to operate until pending legal matters are settled. In the meantime, the government continues negotiations with Sydkraft about compensation for closing the Sydkraft plant. Sydkraft has also complained to the European Commission that the government decision has the effect of reducing competition. In September a general election will take place. According to opinion polls, public support for phasing out Barsebäck is very small at present.

The political attitude to nuclear power is quite different in Finland. The industry in Finland suggested some years ago building a fifth reactor. The government was positive but the proposal was defeated by a small margin in the Finnish Parliament in 1995. The power industry is still interested in a new reactor project, and the case might be brought to a second political test in the parliament after the general election in 1999.

Competitiveness of Nuclear in a Free Market

Nuclear Plants Already in Operation

As long as the operating and maintenance (O&M) costs, plus production taxes, of an existing nuclear power plant are lower than the estimated long term average electricity price on the spot market there is an economic incentive to continue the operation of the plant.

The attitude among the Swedish and Finnish utilities is that all the 16 nuclear power units now in operation have an expected lifetime of at least

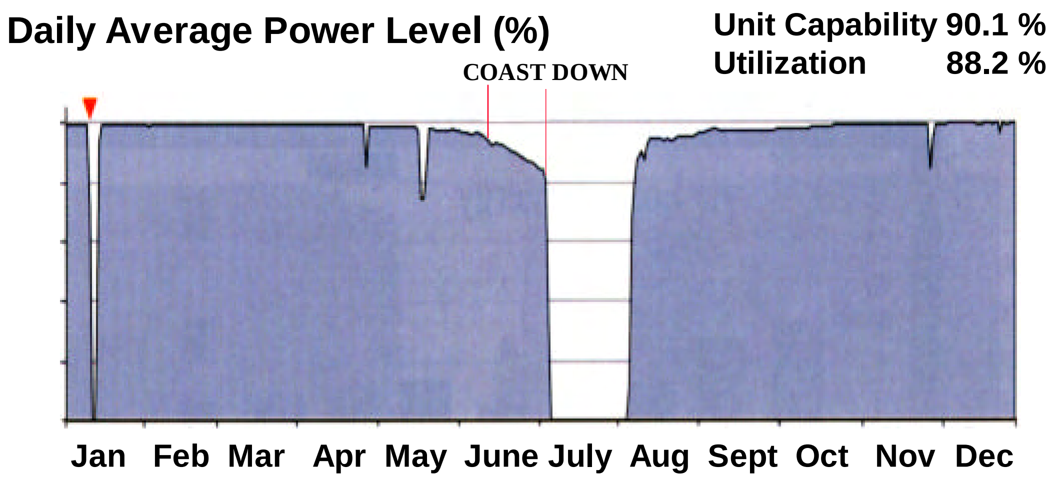

Figure 5. Operation chart for Forsmark-3 in 1997 (Source: 'Operating Experiences from Swedish Nuclear Power Plants, 1997', Annual Report issued by the Swedish Nuclear Training and Safety Centre).

40 years in the competitive Nordic power market, in most cases probably much longer. (The oldest unit, Oskarshamn-1, will reach 40 years in 2012.)

The Nordic nuclear power plants are normally used for baseload generation. However, when spring floods occur during the April–June period there is normally an excess of cheap hydropower on the market. Therefore the reactors are normally fuelled in such a way that coast-down operation occurs during springtime. Some load-following operations may also take place during weekends in the summer, because of low load demand (no electricity is needed for domestic heating). A typical annual operation chart is shown in Figure 5.

Less than half of the O&M costs for nuclear power generation (fuel costs, waste fees and production taxes) are proportional to the actual production. Therefore, there is an economic incentive to keep the load factor as high as possible (except for coast-down and load-following operation in certain periods, as mentioned above). Well planned, short outages for refuelling and necessary maintenance are therefore an important goal for the management of a nuclear power plant in a competitive power market.

The Nordic utilities have long been aware of the fact that nuclear power plants need to be continuously modernised, partly for safety reasons but also to keep the availability as high as possible. There are presently modernisation programmes at the Swedish nuclear power plants with investments of the order of SKr 200 million (US$25 million) per unit per year for the next few years. Similar programmes are also in progress at the Finnish reactors. Investments at this level are judged to be necessary to keep the nuclear power plants competitive in the Nordic power market. The goal is to keep the load factor well above 85%.

The modernisation programme also has the aim of extending plant lifetime. This is already economically sound in the existing market situation. In the longer perspective (10 years or more) plant life extension has a greater economic impact. The reason is that it is likely that the market price will increase to reach the level of the total cost for power production from new plants. This will probably mean a doubling of the actual average market price in the Nordic countries. In this perspective, investments for the extension of plant life are very attractive.

There is also an economic incentive for power upgrading of existing nuclear power plants. Some upgrading of the power capacity has already been performed at Barsebäck, Forsmark and units 1 and 2 at Ringhals. In a study it has been shown that there is the technical potential for an increase in the power output of Swedish reactors of the order of 10 TWh per year (an increase of about 15%). Some of these upgrades would not be economic in the existing market situation, but an increase of the order of about 5% could probably be justified at present. In Finland, due to the different political situation, power upgrades at the four units of the order of 300 MWe in total have been decided on, and part of programme has already been realised.

Does the deregulation of the power market make any difference when it comes to politically motivated phasing-out of nuclear power plants? The experience in Sweden is that the competitive power market makes the real cost of the premature closure of plants more evident. This fact might influence the political decisions. The other experience is that it can clearly be seen that some of the new energy sources, for example bio-energy, have high fixed and variable costs so that they cannot compete with the existing market price. This can, however, be counteracted by political decisions either to increase the taxes on existing power sources or to subsidise the new energy sources.

Conclusions

All the nuclear power plants in Sweden and Finland are already competitive in the open electricity market. Existing nuclear power plants will be even more competitive if environmental fees, for example CO_2 taxes, are introduced. In that case, a long lifetime for most of the existing nuclear power plants can be foreseen. The investment cost of the existing nuclear plants must be considered as sunk, and the operating costs are low compared with conventional thermal power stations.

On the other hand, there is no risk that owners will invest more than economically feasible when the reactors are getting older. In a competitive electricity market the price is no longer based only on costs, but rather is determined as a result of supply and demand. This means that the owners will be very careful to invest only as much money as will allow the capacity to remain competitive.

In an open and competitive electricity market investors will wait to invest in new capacity until the price has stabilised at a level that covers the total cost of new capacity. It is likely that investments in new capacity will mainly be made in flexible power plants with low capital costs per kWe, even if the operating costs are high. For the time being, this means combined cycle natural gas fired power plants.