FINLAND

FINLAND

1. GENERAL INFORMATION

1.1. General Overview

Finland (in Finnish Suomi) is a republic in northern Europe, bounded on the north by Norway, on the east by Russia, on the south by the Gulf of Finland and Estonia, on the south-west by the Baltic Sea and on the west by the Gulf of Bothnia and Sweden. Nearly one third of the country lies north of the Arctic Circle. The area of Finland, including 31 557 km^2 of inland water, totals 338 000 km^2. The terrain is generally level, hilly areas are more prominent in the north and mountains are found only in the extreme north-west.

The average July temperature in the capital Helsinki on the southern coast is 17 °C. The February average in Helsinki is about -5.7 °C. The corresponding figures at Sodankylä (Lapland) in the northern Finland are 14.1 °C and -13.6 °C. Precipitation (snow and rain) averages about 460 mm in the north and 710 mm in the south. Snow covers the ground for four to five months a year in the south, and about seven months in the north.

Finland has a population of 5.167 million (estimate July 2000) and an average population density of 17 per km^2 of land. Historical population data is shown in Table 1. The predicted annual population growth rate between the years 1998 and 2010 is 0.21 %. More than two thirds of the population reside in the southern third of the country.

In Finland the total primary energy consumption[1] per capita was about 60 % higher than the European Union average (according to 1996 statistics) and about 35 % higher than the OECD average. This is mainly due to the weather, which demands space heating for most of the time, and the structure of the industry, which is energy intensive processing industry (wood, especially paper, heavy metal and chemical). A third factor is relatively high transportation requirements per capita caused by the low population density.

TABLE 1. POPULATION INFORMATION

											Growth rate (%)
	1960	1970	1980	1990	1995	1996	1997	1998	1999	2000	1980 to 2000
Population (millions)	4.4	4.6	4.8	5.0	5.11	5.12	5.14	5.15	5.17	5.17	0.4
Pop. density (inh./km^2)	13.1	13.6	14.1	14.7	15.11	15.16	15.21	15.24	15.28	15.3	
Urban pop. (% of total)					64.4	65.0	65.6	66.1	66.7	N/A	
Area (1000 km^2)	338.1										

Sources: IAEA Energy and Economic Data Base

1.2. Economic Indicators

The Gross Domestic Product (GDP) in 1999 was US$ 130 billion. The historical GDP data are given in Table 2.

1.3. Energy Situation

Finland's energy mix is diverse and well balanced, and many of its power plants can be optimised for up to three different fuels. About 40 per cent of all Finnish homes are connected to district heating networks. In 2000, about 75 per cent of all district heat was produced in combined heat and power plants.

[1] Using the definition adopted by the IEA and the CEC (nuclear power is converted into primary energy with a 33 % gross efficiency, and hydro and wind power as well as imported electricity with 100 % efficiency).

TABLE 2. GROSS DOMESTIC PRODUCT (GDP)

									Growth rate (%)
	1970	1980	1990	1995	1996	1997	1998	1999	1980 to 1999
GDP (billions of current US$)	10.8	51.3	135	129	128	122	129	130	5.1
GDP per capita (current US$/cap)	2,300	10,700	27,000	25,300	25,000	23,700	25,000	25,200	4.7
GDP by sector (%):									
Agriculture				4.19	3.77	3.69	3.28	3.19	
Industry				28.79	27.61	27.92	28.81	28.36	
Services				67.03	68.62	68.38	67.92	68.45	

Sources: IAEA Energy and Economic Data Base; Finland in Figures 1999 (Statistics Finland); Data & Statistics/The World Bank.

Finland is highly dependent on foreign energy supplies. Crude oil and oil products constitute a major part of imported energy. Other main fuels imported to Finland are coal and natural gas. During the last years the imports of gas have had the fastest growth rate. Discussions on the possibility to expand the use of natural gas by adding a redundant source primarily from the Norwegian offshore deposits have continued, but are unlikely to lead to solution increasing the gas import to Finland during the next decade. Also alternative routes to gas supply sources in Russia are under investigation.

The primary indigenous energy resources in Finland are hydro power, wood, wood waste, pulping liqueurs and peat. The peat resources are about 800-1000 Mtoe and reserves are estimated at 280 Mtoe. These could be exploited with an annual rate of 4-4.7 Mtoe for about 60 years. The use of wood and wood based fuels in 2000 was 6.13 Mtoe corresponding to 20 % of the total primary energy consumption. Unexploited hydropower reserves are estimated to correspond to an annual production of the order of 7-8.5 TW·h. However, most of the unharnessed river areas are either nature reserves or frontier rivers or tiny waterfalls.

Indigenous fuels and hydropower cover about 30% of the energy demand. Finland imports all of its oil, natural gas, coal and uranium. Total demand for primary energy in 2000 was 30.8 Mtoe (1.29 EJ) and the different energy sources used are given in Table 3. The long-term trend of energy supply from 1970 onwards is depicted in Figure 1. The 2000 energy use in per cent is given in Table 4.

TABLE 3. PRIMARY ENERGY SOURCES IN 2000[a]

Energy Source	Mtoe	%
Oil	8.3	27
Coal	3.5	12
Natural gas	3.4	11
Indigenous fuels	7.8	25
Hydro power	1.2	4
Nuclear power	5.6	18
Net electricity imports	1.0	3
Total	30.8	100

[a] Using the definition adopted by the IEA and the CEC (nuclear power is converted into primary energy with a 33 % gross efficiency, and hydro and wind power as well as imported electricity with 100 % efficiency). This definition has been applied in Finland since 1997.

High proportion of energy-intensive processing industries and high requirements for space heating and long transportation distances make the total energy consumption per capita in Finland one of the highest in the OECD area. In 2000, the primary energy consumption per capita in Finland was 6.0 toe. The historical energy statistics are given in Tables 5 and 6.

TABLE 4. 2000 ENERGY USE

Sector	%
Industry	50
Heating	21
Traffic	17
Others	12

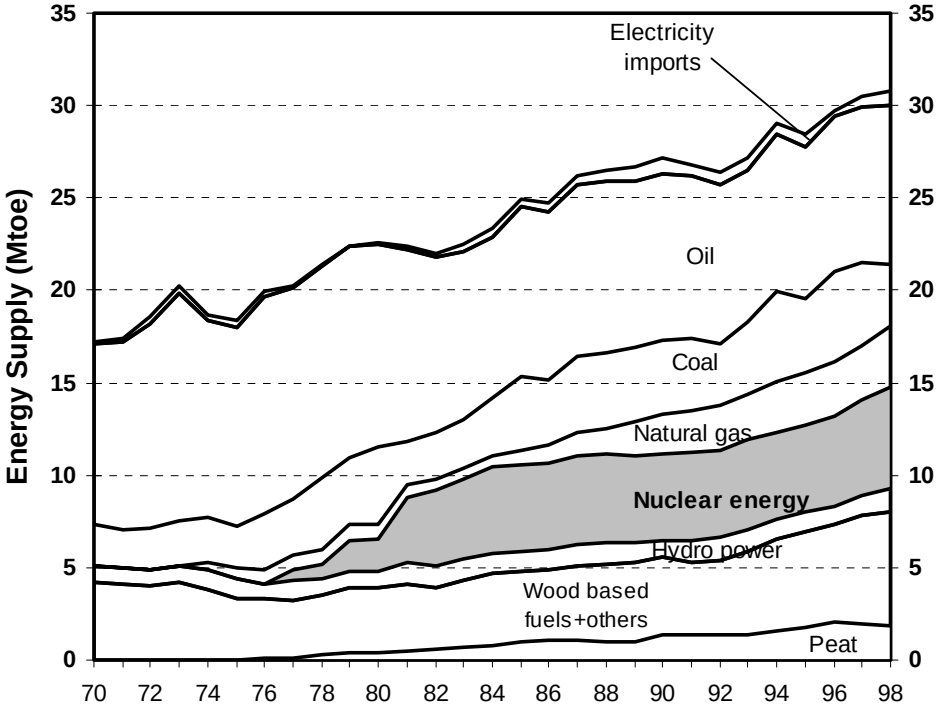

FIG. 1. Energy Supplies in Finland

TABLE 5. PRIMARY ENERGY SOURCES

Mtoe

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Oil	9.20	9.13	9.35	9.22	8.96	8.97	8.73	8.59	8.22	8.55	8.25	8.47	8.40	8.62
	(36.9%)	*(36.9%)*	*(35.7%)*	*(34.8%)*	*(33.6%)*	*(33.0%)*	*(32.6%)*	*(32.5%)*	*(30.3%)*	*(29.5%)*	*(29.0%)*	*(28.4%)*	*(27.5%)*	*(28.0%)*
Coal	4.01	3.52	4.02	4.12	4.06	3.98	3.91	3.38	3.91	4.89	3.98	4.89	4.52	3.38
	(16.1%)	*(14.2%)*	*(15.3%)*	*(15.5%)*	*(15.2%)*	*(14.6%)*	*(14.6%)*	*(12.8%)*	*(14.4%)*	*(16.8%)*	*(14.0%)*	*(16.4%)*	*(14.8%)*	*(11.0%)*
Natural Gas	0.82	0.99	1.31	1.40	1.84	2.17	2.29	2.37	2.45	2.70	2.80	2.93	2.87	3.30
	(3.3%)	*(4.0%)*	*(5.0%)*	*(5.3%)*	*(6.9%)*	*(8.0%)*	*(8.5%)*	*(9.0%)*	*(9.0%)*	*(9.3%)*	*(9.8%)*	*(9.8%)*	*(9.4%)*	*(10.7%)*
Nuclear Energy	**4.69**	**4.69**	**4.83**	**4.81**	**4.69**	**4.72**	**4.80**	**4.73**	**4.90**	**4.78**	**4.72**	**4.87**	**5.22**	**5.47**
	(18.8%)	*(19.0%)*	*(18.4%)*	*(18.1%)*	*(17.6%)*	*(17.4%)*	*(17.9%)*	*(17.9%)*	*(18.0%)*	*(16.5%)*	*(16.6%)*	*(16.4%)*	*(17.1%)*	*(17.7%)*
Hydro Power	1.05	1.06	1.17	1.14	1.11	0.92	1.12	1.29	1.15	1.00	1.10	1.01	1.02	1.26
	(4.2%)	*(4.3%)*	*(4.5%)*	*(4.3%)*	*(4.2%)*	*(3.4%)*	*(4.2%)*	*(4.9%)*	*(4.2%)*	*(3.5%)*	*(3.9%)*	*(3.4%)*	*(3.3%)*	*(4.1%)*
Peat	0.98	1.04	1.08	0.99	0.94	1.34	1.35	1.32	1.39	1.59	1.78	2.02	1.99	1.90
	(3.9%)	*(4.2%)*	*(4.1%)*	*(3.7%)*	*(3.5%)*	*(4.9%)*	*(5.0%)*	*(5.0%)*	*(5.1%)*	*(5.5%)*	*(6.2%)*	*(6.8%)*	*(6.5%)*	*(6.2%)*
Wood based fuels+other	3.80	3.83	3.96	4.20	4.31	4.19	3.97	4.04	4.48	4.99	5.13	5.27	5.88	6.12
	(15.2%)	*(15.5%)*	*(15.1%)*	*(15.9%)*	*(16.2%)*	*(15.4%)*	*(14.8%)*	*(15.3%)*	*(16.5%)*	*(17.2%)*	*(18.0%)*	*(17.7%)*	*(19.2%)*	*(19.8%)*
Electricity Imports	0.41	0.50	0.48	0.64	0.76	0.92	0.62	0.71	0.65	0.52	0.72	0.32	0.66	0.80
	(1.6%)	*(2.0%)*	*(1.8%)*	*(2.4%)*	*(2.9%)*	*(3.4%)*	*(2.3%)*	*(2.7%)*	*(2.4%)*	*(1.8%)*	*(2.5%)*	*(1.1%)*	*(2.2%)*	*(2.6%)*
Total	24.95	24.75	26.21	26.51	26.68	27.22	26.77	26.43	27.15	29.01	28.48	29.76	30.55	30.84

Source: Ministry of Trade and Industry (Finland), Energy Review 1/99. The definitions of the CEC are employed for conversion of nuclear, hydro, wind and imported (net) electricity into primary energy.

TABLE 6. ENERGY STATISTICS

Exajoule

							Average annual growth rate (%)	
	1960	1970	1980	1990	1999	2000	1970 to 1980	1980 to 2000
Energy consumption								
Total [1]	0.24	0.71	1.00	1.15	1.24	1.27	7.44	1.19
Solids [2]	0.08	0.17	0.26	0.28	0.23	0.21	6.10	-0.97
Liquids	0.10	0.44	0.53	0.39	0.38	0.40	8.50	-1.35
Gases			0.04	0.11	0.16	0.17		8.05
Primary electricity [3]	0.05	0.10	0.17	0.38	0.46	0.48	5.92	5.22
Energy production								
Total	0.05	0.17	0.23	0.38	0.42	0.42	7.83	2.95
Solids		0.08	0.07	0.10	0.05	0.04	24.33	-2.38
Liquids								
Gases								
Primary electricity [3]	0.05	0.09	0.16	0.28	0.37	0.37	5.95	4.28
Net import (export-import)								
Total	0.20	0.63	0.77	0.72	0.68	0.70	7.07	-0.43
Solids	0.08	0.11	0.16	0.18	0.12	0.12	3.17	-1.46
Liquids	0.11	0.52	0.57	0.43	0.40	0.42	8.55	-1.58
Gases			0.04	0.11	0.16	0.17		8.05

(1) Energy consumption = Primary energy consumption + Net import (Import – Export) of secondary energy.
(2) Solid fuels include coal, lignite, peat and commercial wood & black liquor.
(3) Primary electricity = Hydro + Geothermal + Nuclear + Wind (CEC definitions)
Source: IAEA Energy and Economic Data Base

1.4. Energy Policy

The objectives of Finnish energy policy are: security of supply; effective energy markets and economy; environmental acceptability and safety. In Finland, energy supply decisions on energy systems take place at a fairly decentralised level. A substantial proportion of energy is imported and produced by private enterprises. The state-owned energy companies are also run on a purely commercial basis. The latest Finnish government's report on energy policy was approved by Parliament in autumn 1997 (Energy Strategy, 1997). The report specifies Finland's energy strategy, which contains the energy scenarios that were drawn up in the preparation of the strategy. The objectives of energy policy, as outlined in the energy strategy, and the measures connected with them are:

- working on the energy production infrastructure to achieve an energy balance with a lower carbon content;
- promoting the energy markets;
- promoting energy conservation and energy efficiency;
- furthering the use of bioenergy and other forms of domestic energy;
- maintaining the high standard of energy technology;
- ensuring that there is enough capacity to procure sufficiently diverse and affordable forms of energy;
- maintaining an emergency supply capability in the energy sector;
- energy taxation.

In 1994, Finland ratified the Framework Convention on Climatic Change. For the reference year (1990) of the convention, the total CO_2-emissions in Finland were 54 million tons. In the Kyoto Protocol to the Framework Convention on Climatic Change the EU commitment is to reduce greenhouse gas (GHG) emissions, calculated as an average of the emissions between 2008 and 2012, by 8% from the 1990 level. According to the burden sharing between the EU countries, Finland’s commitment is to return the emissions to the 1990 level. The government is presently preparing a national action plan to reduce GHG emissions. The Finnish strategy emphasises, besides the reduction of emissions, the strengthening of sinks for carbon dioxide in forests. Also, intensified conservation and more efficient use of energy are called for. However, one of the important indigenous fuels, peat,

is considered by the decisions of the CEC not to be renewable and thus the emissions from peat-fired plants should be included in the carbon dioxide emission balance. Meeting the emission limits - especially those of carbon dioxide - seems to be a challenging task to be accomplished without expanded use of nuclear power or significant increase of electricity import. In 2000, the CO_2 emissions decreased to 54 Mt from the previous year's levels of around 60 Mt. The main reasons for the drop were major increases in hydropower production and in net electricity import as well as the power uprating in the connection of plant modernisation projects in nuclear energy production.

It is a generally accepted view that Finland should have an average annual economic growth of at least 2.5% for the next 30 years, in order to be able to reduce further the unemployment rate and, at the same time, reduce the foreign debt. Within this time frame, the growth of primary energy use is expected to slow down and even cease. The need for electricity, however, is expected to grow from the 2000 level of 79.1 TW·h to 90 TW·h in 2010. This requires some 2500 MW(e) additional power plant capacity and maintaining the net electricity imports at the present level. By the year 2025, electricity consumption is expected to grow by some 40% from the current level in the business-as-usual scenario.

2. ELECTRICITY SECTOR

2.1. Structure of the Electricity Sector

Energy supply in Finland is highly competitive and both the state-owned, municipality-owned and private sector energy and electricity supply utilities operate essentially on the same commercial basis as the industry in general. The Finnish power system is widely decentralised and has a diverse organisation. The main types of ownership are: (i) partly privatised, state-controlled power companies; (ii) industrial companies, and (iii) municipal and other distribution companies.

There are approximately 120 firms producing electricity in Finland at the moment. There are about 400 power plants in the country and about half of these are hydroelectric. Fortum Power and Heat Oy (previously Imatran Voima Oy; IVO) produces almost 40 % of Finland´s electricity. Industry and its electricity producing firms have a share of approximately the same size. The share of the local and regional energy companies is about 15 %. In addition, Finland imports electricity from Russia and the Nordic electricity markets to satisfy its remaining energy requirements.

Fortum is an international energy group formed through the combination of the earlier IVO Group (power and heat production) and Neste Group (oil and gas business). The principal divisions of Fortum are (1) Oil and Gas and (2) Power and Heat. Fortum Power and Heat (FPH) masters all aspects of energy services related to electricity and heat. The business operations of the company include generation, sales, and transmission of power and heat. The company owns several power and heating plants as well as shares in power plants. It also operates the Loviisa nuclear power plant. Additionally, electricity is purchased from other Finnish and foreign companies and through the Nordic electricity exchange.

Teollisuuden Voima Oy was founded in 1969 by a number of Finnish industrial companies with the purpose of building and operating large power plants. The company supplies electricity to its shareholders at production cost price. The company has public sector and private sector shareholders (Table 7).

The Finnish power system (Figure 2) consists of power plants, the main grid, regional networks, distribution networks and end-users of electricity. The system is a part of the interconnected Nordic power system together with the systems in Sweden, Norway and eastern Denmark. Moreover, there is a direct current connection from Russia to Finland, enabling connection between the systems, which apply different principles, and also enabling power trading across the border. There is also a DC connection to Sweden under the Gulf of Bothnia and a link to Estonia is under planning.

TABLE 7. PUBLIC AND PRIVATE SECTOR SHAREHOLDERS OF TVO

	%
Public sector	**43.1**
Etelä-Pohjanmaan Voima Oy	6.5
Fortum Power and Heat Oy (previously IVO; Imatran Voima Oy)	26.6
Kemira Oyj	1.9
Oy Mankala Ab	8.1
Private sector	**56.9**
Graninge Energia Oy	0.1
Pohjolan Voima Oy	56.8
Total	**100.00**

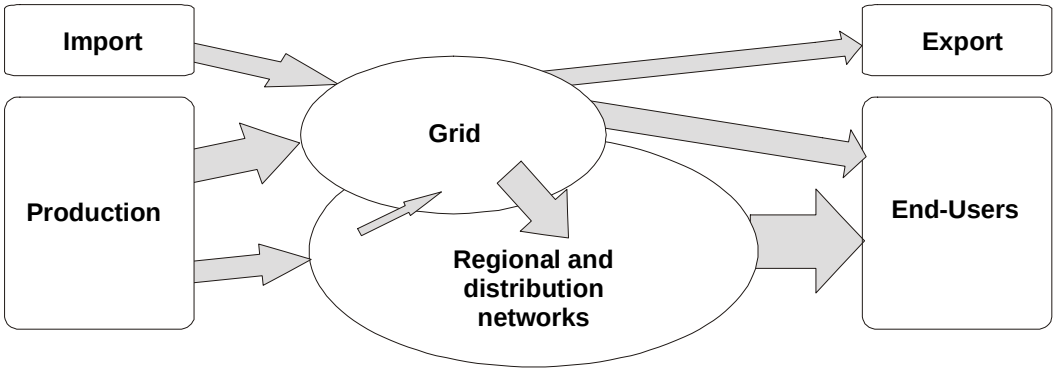

FIG. 2. The Finnish power system

Regional and distribution network activities are the responsibility of the electric utilities, which are licensed to operate the grid by the State Authority. Electricity transmission is priced using a so-called point-tariff system (postage stamp). The user can procure electricity from anywhere in the country without restriction. The user pays one grid transmission fee at his grid connection point, which covers the transmission costs for the use of the entire grid, without any additional fees. The producer can feed power into the network using the same payment principle. The grid operator is responsible for operating, maintaining and developing the network. In the present situation there is a need to improve the monitoring of power grid operations because of their monopolistic nature. To accomplish this, a separate monitoring authority was set up, the Energy Market Authority. The transmission of electricity over the national grid as well as the boundary interconnections with Sweden, Norway and Russia are managed by a system responsible grid company Fingrid Plc., which is owned by the two major producers (Fortum and PVO), Finnish government and institutional investors.

The biggest bulk sellers of electricity in Finland are Fortum Power and Heat, Teollisuuden Sähkönmyynti (TSM)[2] and Vattenfall. They sell electricity directly to large, business-to-business customers and electricity retailers. Electricity retail is carried out mainly by the local and regional electrical companies. There are currently about 100 of these players in Finland. After the deregulation, no special permits are required to sell electricity, so the industry is open to new competitors as well. The electricity trade system in Finland is illustrated by Figure 3.

[2] The British Eastern Group became in September 1999 TSM's largest shareholder with an 81 % shareholding. The PVO Group has retained its 19% shareholding in TSM.

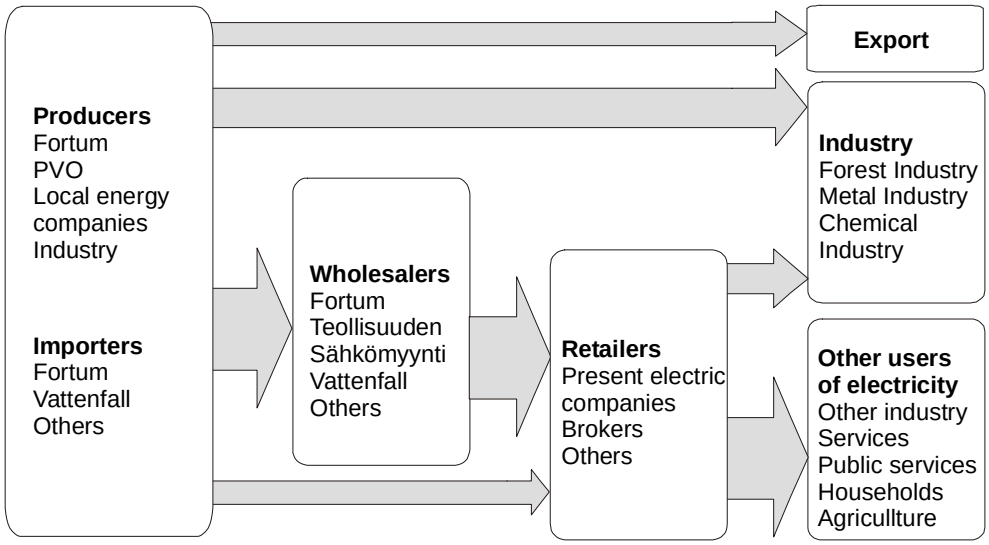

FIG. 3. Electricity Trade System

2.2. Decision-Making Process

Industrial and domestic consumers are free to use the energy they prefer. The power industry is covered by the same laws as other commercial activities. Companies are fully responsible for their economic operations. The main government influence on energy decisions is through taxes and some minor subsidies. Anyone has the right to construct a power station or a transmission line. License for construction of power plants is needed only for nuclear and hydropower plants. All new power plant projects and high-voltage transmission lines (> 110 kV) need to undergo environmental impact assessment procedure. The construction of a transmission line requires a license from the Energy Market Authority. The license of electricity imports has been abolished. This deregulation has made it possible for Finnish electricity consumers to co-operate directly with foreign power producers and traders. The state gives some investment subsidies or other forms of support for promoting the use of renewable energy and conservation measures.

The decision-making process for building nuclear facilities is rather complex and requires (besides the normal environmental impact assessment procedure necessary for all power plant projects) ultimately also the approval of the decision-in-principle by the Parliament (cf. Section 5.1). The Nuclear Energy Act of 1988 defines the procedures required for new nuclear power plants irrespective of private or state ownership. The same is true what comes to other nuclear facilities, such as the waste management and decommissioning.

2.3. Main Indicators

The historical electricity production and the installed capacities are given in Table 8 and the related energy ratios in Table 9. The total domestic electricity production in 1998 was 67.2 TW·h and the total consumption of electricity was 76.5 TW·h (Table 10). The primary energy sources in electricity supply and electric energy consumption in 1998 are given in Table 11.

Power in Finland is mostly generated by thermal and hydropower plants. So far only a very small volume of electricity is produced by wind power, although the relative increase of wind power capacity has recently been quite rapid. Finland's total power production capacity totals approximately 16 500 MW broken down as follows (Source: Nordel Annual report 1998):

- Hydro power 2 937 MW
- Nuclear power 2 656 MW
- Condensing power 3 903 MW
- Thermal power backpressure 3 606 MW
- Industrial backpressure 2 477 MW
- Gas turbines 878 MW
- Wind power 17 MW

TABLE 8. ELECTRICITY PRODUCTION AND INSTALLED CAPACITY

	1960	1970	1980	1990	1999	2000	Average annual growth rate (%) 1960 to 1980	Average annual growth rate (%) 1980 to 2000
Electricity production (TW·h)								
- Total [(1)]	8.63	21.19	38.71	54.38	71.41	73.46	7.79	3.25
- Thermal	3.36	11.83	21.96	25.39	33.22	34.73	9.84	2.32
- Hydro	5.27	9.35	10.12	10.86	16.09	17.09	3.32	2.65
- Nuclear			6.63	18.13	22.07	21.60		6.08
Capacity of electrical plants (GWe)								
- Total	2.83	4.31	10.42	13.22	15.10	15.25	6.73	1.92
- Thermal	1.28	2.35	6.47	7.94	9.31	9.38	8.46	1.87
- Hydro	1.56	1.96	1.75	2.62	2.94	3.01	0.58	2.75
- Nuclear			2.20	2.66	2.66	2.66		0.95
- Wind					0.19	0.20		

[(1)] Electricity losses are not deducted
Sources: IAEA Energy and Economic Data Base

TABLE 9. ENERGY RELATED RATIOS

	1960	1970	1980	1990	1999	2000
Energy consumption per capita (GJ/capita)	54	153	209	231	239	245
Electricity per capita (kW·h/capita)	2,042	4,714	8,352	12,481	15,255	15,826
Electricity production/Energy production (%)	161	123	160	129	158	164
Nuclear/Total electricity (%)			17	35	32	30
Ratio of external dependency (%) [(1)]	82	89	77	62	55	56
Load factor of electricity plants						
- Total (%)	35	56	42	47	54	55
- Thermal	30	58	39	36	41	42
- Hydro	39	54	66	47	62	65
- Nuclear			34	78	95	93

[(1)] Net import / Total energy consumption
Sources: IAEA Energy and Economic Data Base

TABLE 10. ELECTRICITY SUPPLY (INCL. NET IMPORTS) BY PLANT TYPES IN 1997 AND 1998.

	1997			1998	
	Exajoule [1]	TW·h (e)	%	TW·h (e)	%
Nuclear power	0.218	20.05	27.2	21.0	27.4
Conventional condensing power	0.111	10.86	14.7	6.5	8.5
Hydropower	0.0425	11.80	16.0	14.6	19.1
Wind power	0.0006	0.017	0.02	0.024	0.03
Cogeneration, district heating	0.0546	12.23	16.6	13.1	17.1
Cogeneration, industry	0.0535	10.98	14.9	12.0	15.8
Gas turbines	0.00025	0.017	0.02	0.014	0.02
Net imports	0.0275	7.65	10.4	9.3	12.2
Total electricity supply	0.509	73.6	100	76.5	100
Total primary energy consumption	1.279				
Share of electricity supply in primary energy consumption	39.8 %				

[1] Primary energy; the definition of CEC used in conversion of electricity production into primary energy. In the cogeneration the actual efficiency achieved is taken into account.
Sources: Finnish Energy Statistics; Ministry of Trade and Industry (Finland), Energy Review 1/99

TABLE 11. PRIMARY ENERGY SOURCES IN ELECTRICITY SUPPLY AND ELECTRIC ENERGY CONSUMPTION IN 1998

	TW·h	%
Primary energy sources		
• nuclear power	21.0	27
• coal	7.6	10
• hydropower	14.5	19
• other domestic renewables	7.6	10
• net imports	9.2	12
• natural gas	9.2	12
• peat	6.0	8
• oil	1.4	2
Electric energy consumption		
• industry	42.0	55
• household	16.1	21
• agriculture	2.3	3
• service	8.4	11
• public	4.6	6
• losses	3.1	4
Total	76.5	100

Source: Country information.

In addition, electricity is imported from Russia and the Nordic electricity market. During 1998 about 610 MW of new capacity was connected to the grid. The upgrading of nuclear power plant capacity covered 240 MW (the total NPP upgrading in 1997 - 1998 was altogether 350 MW). Most part of the new conventional capacity will comprise combined heat and power production. The total production capacity will be reduced considerably during the first half of next decade due to the gradual expiration of the present electricity import contracts.

The per capita electricity consumption in 1998 was about 14 800 kW·h. Electricity now represents about 40 per cent of the primary energy consumption. The share is expected to further rise by the end of the century. In the industry sector electricity is the main source of energy. In 1998, the Finnish industry consumed 41.5 TW·h of the electricity. As compared to the previous year the consumption of electricity by the industry went up 4 % (1.5 TW·h). The most important branch is pulp and paper production, which in 1997 consumed 59 % of the total electricity needs of the industry and 68 % of the total heat energy needs of the industry. Other significant branches are the metal and chemical industries.

In the Energy Strategy of Finland (KTM 1997) different scenarios were presented for the development of electricity consumption up to 2025. Similar results have been presented in the forecasts made in 1997 (Figures 4 and 5) by the Finnish Energy Industries Federation (Finergy). Electricity consumption was expected to increase to 78 TW·h in the year 2000 and to 92 TW·h in 2010. As the consumption in 2000 was 79.1 TW·h, this forecast seems to have slightly underestimated the growth in electricity consumption. Consumption would increase most in industry, while services and domestic sectors would show a slower rate of increase than the rise experienced in 1980's.

2.4. Impact of Open Electricity Market in the Nuclear Sector

2.4.1. General Electricity Market Situation in Finland

The New Electricity Market Act (1994) came into force in 1995 and opened electricity market. According to the Act, transmission and distribution companies are licensed by the Electricity Market Authority. The licenses specify the franchised territory for the distribution companies. In Finland there is only one company (Fingrid Plc.) for transmission of high-voltage electricity. In their territories the distribution utilities are obligated to connect end-users and production sites to the distribution network against reasonable compensation.

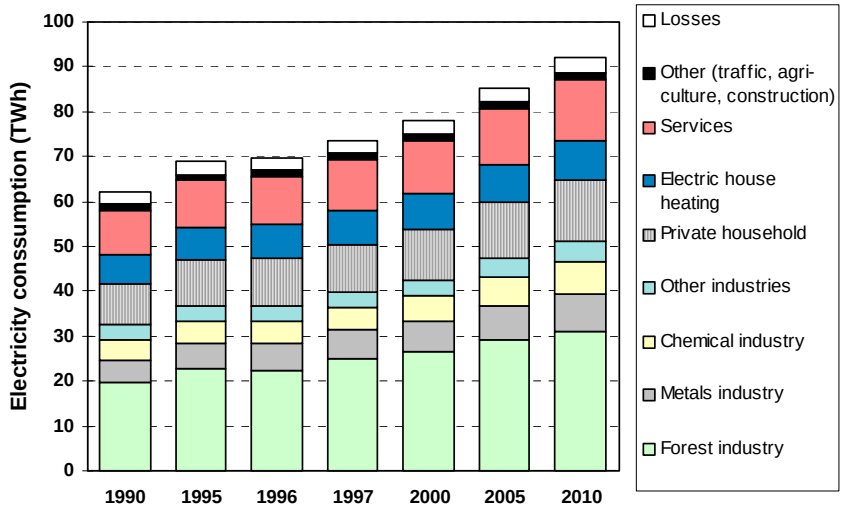

FIG. 4. Development and forecast of electricity consumption in main consuming sectors (1990 - 2010) (Source: Finergy Research Report 3/1997)

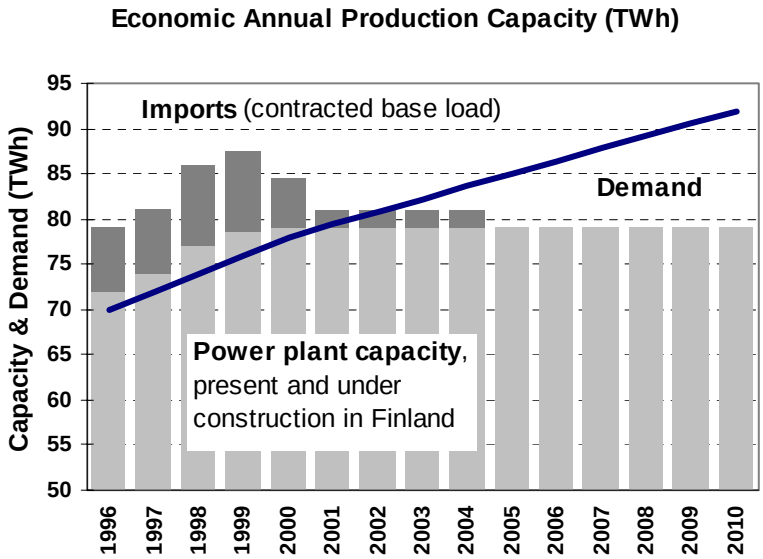

FIG. 5. Estimated electricity demand and economic annual production capacity in Finland up to 2010 (Source: Finergy Research Report 3/1997)

Transmission and distribution companies are obligated to transmit electricity in their networks if transmission capacity is available. Electricity retailers who have dominant market position in a distribution network have an obligation to offer electricity to small-scale customers at a reasonable public price. Customers can choose between this local offer and any other offers on the competitive market. Foreign ownership in electricity supply is also possible.

Generation and transmission investments are funded by loans from the domestic and international financial market, by self-financing and by equity capital. The state does not fund investments by the utilities and gives no guarantee for debts. The state is only involved as an equity investor in the state-owned companies and requires fair return on equity capital.

As of the beginning of 1997, all electricity users have been able to freely select their electricity suppliers. From 1 September 1998, also all households have in practice been able to select supplier as changing the supplier does not any more require new metering equipment.

The enforcement of legislation pertaining to Finnish electricity markets and the grid operators´ operations are overseen by Energy Market Authority in collaboration with the Finnish competition authorities.

The deregulation of Finnish electricity markets has had a significant role in the opening of Nordic markets. This was in the interest of both industry and domestic households. The Nordic Electricity Exchange will play an important role in the creation of a common market by bringing in new players and helping to develop new forms of commerce. The exchange started in 1998 and its operations are based on the present and future products and services of the Norwegian -Swedish NordPool and Finnish - Swedish El-Ex electricity exchange.

2.4.2. Impacts of Deregulation on Nuclear Power Sector in Finland

The existing nuclear power plants in Finland are operating as base load units and had most of the time an average annual load factor of more than 90 %. The electricity production costs are low for both Loviisa and Olkiluoto NPPs. The investment costs of the existing nuclear plants are to large extent already paid and the operating costs are low compared with conventional thermal power stations. Hence, the deregulation of electricity market does not have any significant impacts on the competitiveness of nuclear power. The present nuclear power plants will be even more competitive in case environmental fees, for example CO_2 taxes, would be introduced. In that case, a long lifetime for most of the existing nuclear power plants can be foreseen.

2.4.3. Energy Taxation Issues

In 1990, Finland became the first country to enact an energy tax based on the carbon content of energy products. However, after the deregulation of the electricity market in 1995, this taxation system was found to impair severely the Finnish electricity producers' competitiveness in Nordic markets. Therefore, several changes have been implemented to reform the energy taxation. Presently the taxes are imposed on the use of electricity (for industry about 4.2 euro/MW·h) and for other consumers (6.9 euro/MW·h). In heat generation, the tax that is levied continues to be based on the carbon content of the fuel and not on the consumption of heating energy (CHP or other). The taxes on heat generation are determined on equal terms for all consumers. For comparison the target values in the EC directive proposal for the electricity tax for industry and other consumption is 3 euro/MW·h and the minimum tax level 1 euro/MW·h. In the EC directive proposal the same tax rate is valid for heat produced by CHP.

3. NUCLEAR POWER SITUATION

3.1. Historical Development

The Technical Research Centre of Finland (VTT) has a research reactor in operation since 1962. The Loviisa Power Plant units, on the southern coast (cf. Figure 6), owned by Fortum Power and Heat Oy (Fortum), were ordered in 1969 and 1971 and started commercial operation in 1977 and 1981. The Olkiluoto Power Plant units, on the western coast, owned by Teollisuuden Voima Oy (TVO), were ordered in 1972 and 1974 and started commercial operation in 1979 and 1982. The Loviisa power plant has two Russian (Soviet) VVER (PWR) reactors and Olkiluoto power plant has two Swedish BWRs. At the start of the operation the nominal net capacity of the Loviisa units was 420 MW(e) each and the initial net rating of the Olkiluoto units was 660 MW(e) each. The power level (net) of the Olkiluoto units was raised to 710 MW(e) in 1984. In the connection of the latest operating licence renewal process and plant modernisation projects, the authorities approved in 1998 the uprating of the power production capacities (net) of the Loviisa and Olkiluoto plants up to 2×488 MW(e) and 2×840 MW(e).

3.2. Status and Trends of Nuclear Power

3.2.1. Nuclear Power Statistics and Survey of Operating Experience

Today, about 27 % of the total electricity supply in Finland is produced by nuclear power (Tables 10to 12). Finland's four nuclear power plant units have a total net capacity of 2 656 MW(e).

They have operated reliably and complied with existing safety and environmental protection standards. For years, the annual load factors of all the units have been around 90 %. Both companies have invested a lot to keep the annual outages as short as possible. During 1998, all the Finnish nuclear power units operated very reliably and produced more electricity than ever before.

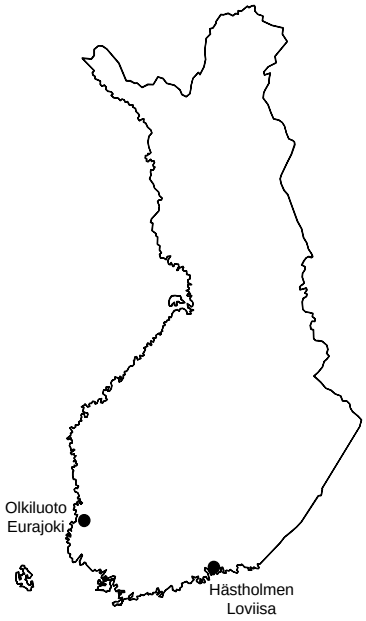

FIG. 6. Locations of the Finnish nuclear power plants

The historical trend of annual load factors of the Finnish nuclear power plants is shown in Figure 7. The development of annual occupational collective doses (manSv/a/reactor) of the Finnish nuclear power plants (both with 2 reactor units) are shown in Figure 8.

TABLE 12. STATUS OF NUCLEAR POWER PLANTS

Station	Type	Net Capacity	Status	Operator	Reactor Supplier
LOVIISA-1	WWER	488	Operational	FORTUMPH	AEE
LOVIISA-2	WWER	488	Operational	FORTUMPH	AEE
OLKILUOTO-1	BWR	840	Operational	TVO	ASEASTAL
OLKILUOTO-2	BWR	840	Operational	TVO	ASEASTAL

Station	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
LOVIISA-1	01-May-71	21-Jan-77	08-Feb-77	09-May-77	
LOVIISA-2	01-Aug-72	17-Oct-80	04-Nov-80	05-Jan-81	
OLKILUOTO-1	01-Feb-74	21-Jul-78	02-Sep-78	10-Oct-79	
OLKILUOTO-2	01-Aug-75	13-Oct-79	18-Feb-80	10-Jul-82	

Source: IAEA Power Reactor Information System (PRIS), 31 December 2000.

3.2.2. Modernisation of the Existing Plants

The previous operating licenses of all four Finnish power reactors were valid until the end of 1998. The applications for renewal of these permits were submitted for regulatory review in 1997. Major modernisation and power uprating actions were carried out in the connection of the licence renewal process. Several technical modifications at the plants and thorough updating of the Final Safety Analysis Reports were necessary.

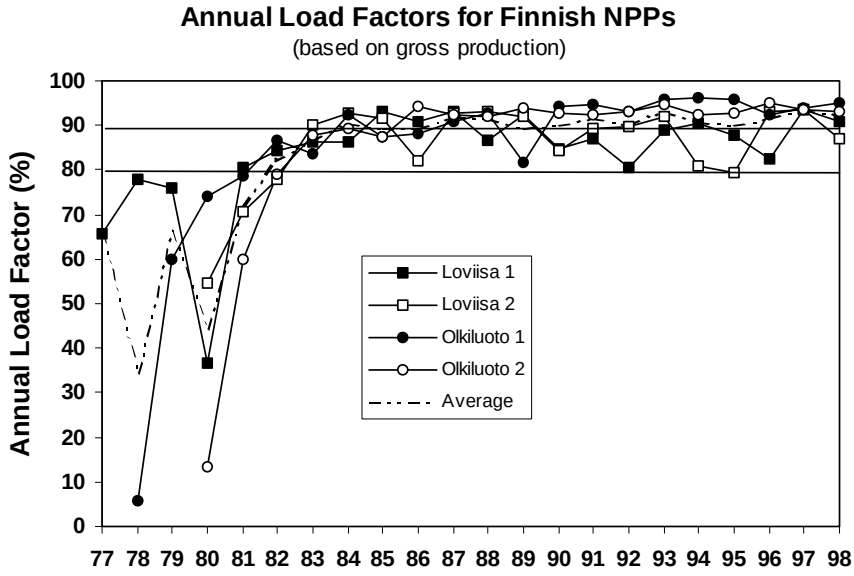

FIG. 7. The development of annual load factors of the Finnish nuclear power plants

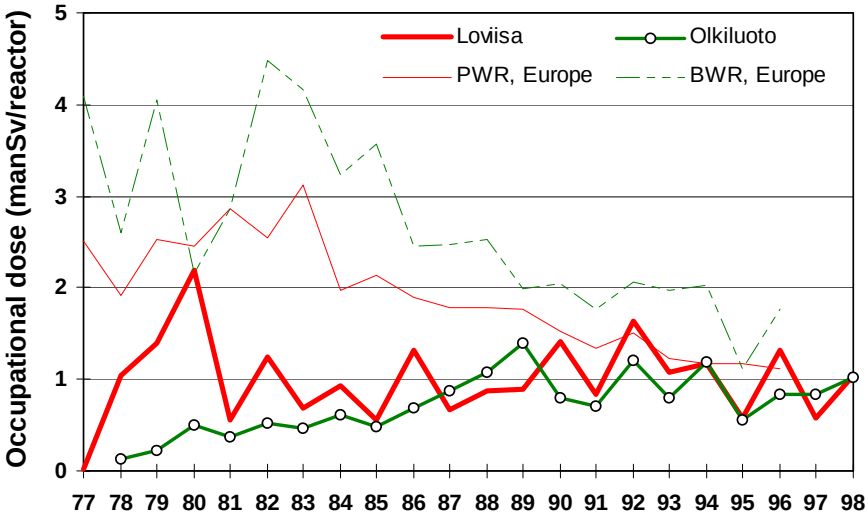

FIG. 8. The annual occupational doses to the personnel of the Finnish nuclear power plants as compared to the average European experience

The modernisation, power uprating and operating licence renewals of Loviisa and Olkiluoto nuclear power plants were the major topics of regulatory work in 1997 and during the first half of 1998. A thorough review of the completely revised safety analyses of both plants was carried out. The Radiation and Nuclear Safety Authority (STUK) prepared detailed safety evaluation reports for both plants. The stepwisely proceeding test operation programmes for the power uprating were carried out under the supervision of the safety authority.

In April 1998 the Government granted the licence to the Loviisa 1 and 2 plant units at the uprated power level. The licence is valid up to the end of 2007. It also covers the repository for low and medium level nuclear waste and interim storages for spent fuel including the necessary expansion of these facilities. The licence for the operational waste repository is valid until the end of 2055. The thermal power of both Loviisa units was uprated to 109 % from the rated power specified in the former operating licence.

The application of new operating licence of Olkiluoto NPP was for uprated 115.7 % reactor power. The final plant modifications needed for the upratings were carried out during the refuelling outages in May and June of 1998, and the final test operations were started after the outages. The Government granted the licence to Olkiluoto 1 and 2 units in August 1998 at the uprated power level. The licences are valid for both units up to the end of 2018. By the end of 2008, the utility must submit to STUK a comprehensive periodic safety review report, after which STUK makes its own safety assessment.

3.3. Current Policy Issues

3.3.1. Plans for New Nuclear Facilities

According to the Nuclear Energy Act, the licensing process for a new nuclear facility commences with the so-called decision-in-principle. At this step the Government considers whether "the construction project is in line with the overall good of society". In particular, the Government pays attention to the need of the facility with respect to country's energy supply and to the suitability of the proposed site of the nuclear facility and its effects on the environment. For the decision, the Radiation and Nuclear Safety Authority (STUK) has to make a preliminary statement on the safety of the facility and the host municipality must state its acceptance of siting the facility. A positive decision can only be made by the Government, if the municipality's statement is positive and no safety or other reasons have been presented that would show that there are not sufficient prerequisites to fulfil the requirements of the Nuclear Energy Act. Finally, a positive decision still has to be endorsed by the Parliament.

As preparatory actions before filing of an application for the decision-in-principle of Government and Parliament for a new nuclear power plant unit, the nuclear power companies Fortum and TVO carried trough the Environmental Impact Assessment procedure for new NPPs at either Olkiluoto or Loviisa sites. The environmental impact assessment reports for both locations were submitted in August 1999 for review to the contact authority, Ministry of Trade and Industry. The Ministry gave its final statements February 2000.

On 15 November 2000, TVO submitted an application for a decision-in-principle to the Government on the construction of a new nuclear power plant unit. The application for a decision-in-principle proposes that the unit be constructed either in Eurajoki, Olkiluoto, or in Loviisa, Hästholmen, near the already operational power plants. The nuclear power plant unit is to be equipped with a light water reactor, either a boiling water or pressurised water reactor with an electrical output of 1000 - 1600 MW. Each of the municipalities of the alternative sites has accepted the construction of a new nuclear power unit. TVO will make its choice based on an economic assessment before applying the construction licence.

The amendment to the Nuclear Energy Act in 1994 halted Loviisa NPP's spent fuel shipments to Russia (Chelyabinsk). Fortum and TVO agreed on co-operation in nuclear waste management concerning spent fuel treatment and disposal. The two companies founded in 1995 a joint company, Posiva Oy, of which TVO owns 60 % and Fortum 40 %. However, the final responsibility for nuclear waste management stays with the company who produced the waste.

In May 1999, Posiva Oy completed the Enviromental Impact Assessment-reporting on construction of the final disposal facility for spent nuclear fuel. The report covered four alternative locations. At the same time Posiva Oy submitted an application for the decision-in-principle to the Council of State based on one site; i.e. the Olkiluoto NPP site. The municipality of Eurajoki accepted the construction of the facility in Olkiluoto. On 21 December, the Government made a decision in principle and in May 2001 the Parliament endorsed the decision of the Government with a 159 - 3 majority of votes.

The decision applies to the spent nuclear fuel from the existing power plants. In accordance with the decision, the maximum amount of the fuel to be disposed of in the final repository is 4000 tons, which is the amount generated by the existing nuclear power plants during 60 years of operation. The

construction licence for the facility should be applied before 2015. The operation is planned to start around 2020. The final disposal of the spent fuel generated by the potential new nuclear power plant unit, which is currently under consideration, will be handled in parallel with the decision proceedings of the new power plant.

3.3.2. Public Acceptability of Nuclear Power

An independent university group has conducted public opinion surveys on energy alternatives since 1983. Figure 9 indicates how the attitudes towards nuclear power have evolved through the years. It can be seen that the public attitude was rather favourable towards nuclear power before the Chernobyl disaster. The survey taken immediately after the accident showed a drastic change in opinions. At that time only 14 % were in favour of increasing nuclear capacity. The confidence lost in 1986 quickly returned by 1988 and the trend has been slowly improving since that. The latest poll of 1999 showed that 34 % favoured expanded use of nuclear, while 36 % were opposed. The most popular energy source was natural gas, while coal scored the lowest.

The biggest uncertainty seems to concern nuclear waste. A question put in the most recent opinion poll in spring 1999 concerned especially the opinion of the inhabitants living in those municipalities that were the candidate host communities for a spent fuel repository in Finland. The results show that a clear majority of the people in Loviisa and Eurajoki would agree that a spent fuel repository is sited in their home community, provided that studies can show that the encapsulation and disposal facility is safe.

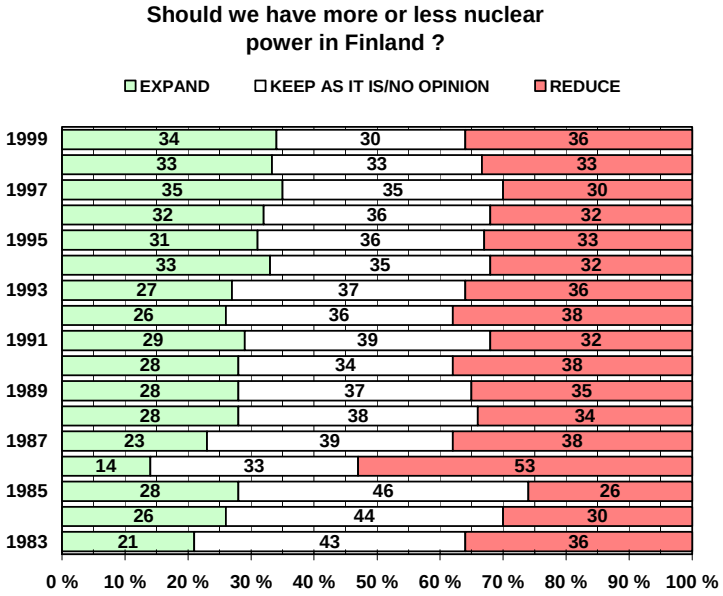

FIG. 9. Attitudes in Finland towards the use of nuclear power

3.3.3. Financial Provisions for Nuclear Waste Management

Power companies in Finland pay annual contributions to the State Nuclear Waste Management Fund, which operates under the auspices of the Ministry of Trade and Industry. This provision covers all future measures: treatment, storage and final disposal of spent fuel and radioactive waste, as well as decommissioning of the plants. The power companies contributing to the fund are entitled to borrow back 75% of the contributions against securities.

The co-operation between Fortum Power and Heat and TVO (cf. section 3.3.1) does not cover medium and low-level operation wastes, nor the decommissioning of the nuclear power plants and the management of the thereby arising wastes. The first medium- and low-level waste repository located in Olkiluoto was commissioned in 1992. The operation licence was granted in 1998 for the first phase of the second repository for low-level maintenance wastes at the Loviisa NPP site in Hästholmen. IVO and TVO are independently responsible for funding despite their spent fuel management co-operation.

To ensure that the financial liability is covered, the utilities must each year present cost estimates for the future management of nuclear wastes, including decommissioning of NPPs. The latest cost estimates, based on waste quantities at the end of 2000 and decommissioning of NPPs, arise to about € 1 112 million for TVO and Fortum together, with no discounting.

The administrative procedures are described in detail in the nuclear energy legislation. The past and expected future development of the total fund holdings and unfunded liabilities are depicted in Figure 10. As of beginning of 2001, the fund capital amounts to 96 % of the liability. The peak of the liability curve in 1994 is due to the termination of Loviisa spent fuel returns to Russia and the subsequent decrease is due to the spent fuel management co-operation agreement between Fortum and TVO. In rough terms, the cost for radioactive waste management, including plant decommissioning, is 0.23 ECU/MW·h (with no discounting), representing about 10 % of the total power production cost.

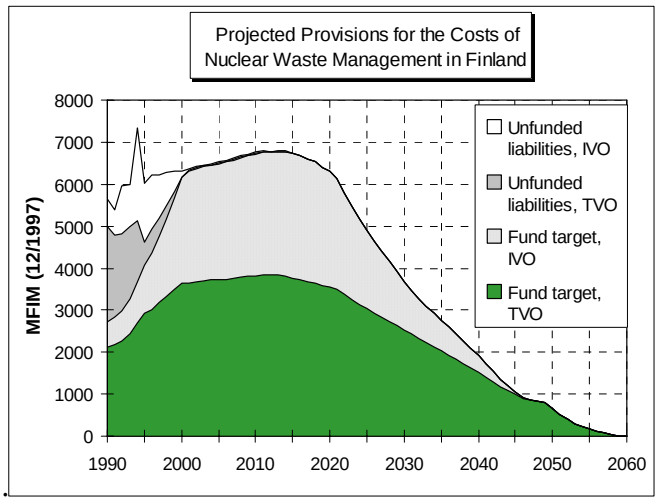

FIG. 10. Fund holdings in the Nuclear Waste Management Fund and unfunded liabilities covered by securities (1 FIM = 0.17 euro)

4. NUCLEAR POWER INDUSTRY

4.1. Supply of Nuclear Power Plants

The nuclear steam supply system (NSSS) and twin turbine generators for Loviisa nuclear power plant were supplied by V/0 Atomenergoexport of the former USSR. IVO acted as its own architect engineer and co-ordinated the design and supply of equipment from several countries. This included the integration of West German instrumentation and, under Westinghouse license, an ice condenser containment system. After the completion of the recent modernisation project (cf. Section 3.3.2) the authorities approved in 1998 the raising of the power capacity of the Loviisa reactor units from 445 MW(e) to 488 MW(e).

The Olkiluoto units were ordered on turnkey contracts from Asea-Atom (now Westinghouse Atom) in 1972 and 1974. TVO had the responsibility for the second unit's civil engineering systems. In 1993, the containment buildings were retrofitted with Siemens filtered venting system. The Olkiluoto units were upgraded in 1984 from 660 MW(e) to 710 MW(e) (net capacity). After the completion of the recent modernisation project (cf. Section 3.3.2) the authorities approved in 1998 the raising of the power capacity of the Olkiluoto reactor units from 710 MW(e) to 840 MW(e).

Collaboration with foreign vendors provided Finnish companies with experience in supplying certain mechanical equipment to nuclear power stations. Domestic capabilities have also been developed for simulators, fuel handling, storage equipment, radiation dosimeters and monitoring equipment. The design, deliveries and installation works in the connection of the modernisation projects were carried out by domestic and foreign companies.

4.2. Operation of Nuclear Power Plants

The operation, maintenance, and training at Loviisa are carried out by Fortum Power and Heat Oy. TVO takes care of the operation and maintenance and the operator training for Olkiluoto.

4.3. Fuel Cycle and Waste Management Service Supply

After joining the European Union the requirements of Euratom have been adopted in nuclear fuel supply to the Finnish NPPs.

Fortum Power and Heat, the operator of the Loviisa NPP, has continued the efforts for acquiring an optional fuel supplier from western sources besides the present Russian fuel supplier. Together with the Hungarian Paks utility, test fuel assemblies have been bought from the BNFL. Five lead assemblies from BNFL were loaded in Loviisa in 1998.

Uranium for TVO 1 and TVO 2 comes (or has come) from Canada, Austria, Niger, China and Russia. Most of the enrichment has taken place in Russia, the rest in Western Europe. Fuel elements delivered to Olkiluoto have been manufactured by ABB Atom in Sweden, Siemens in Germany and GENUSA in Spain.

Spent fuel from the reactors is stored for a few years in the fuel pools at the reactor buildings. Thereafter, they are transferred to interim spent fuel storage at the power plant sites. Fortum Power and Heat and TVO are responsible for both the acquisition of fuel and the management of spent fuel.

Repositories for medium- and low-level wastes are already in use at Olkiluoto and Loviisa sites. Spent fuel management plans and the financial provision for nuclear waste management in general have been discussed in sections 3.3.1 and 3.3.3. A specialised company, Posiva, is taking care of the necessary R&D activities, design and implementation of the spent fuel disposal project in Finland. In the future Posiva also aims to supply similar services for the needs of other countries.

4.4. Research and Development Activities

Finland has no institutes dedicated solely for nuclear research. Most research takes place at the Technical Research Centre of Finland (VTT). Other major research institutes include the universities of technology in Helsinki and Lappeenranta (TKK, LTKK), the Geological Survey of Finland (GTK), the Finnish Meteorological Institute and the universities of Helsinki, Kuopio, Tampere and Jyväskylä. In addition, the Radiation and Nuclear Safety Authority (STUK) and the power companies Fortum Power and Heat and TVO carry out internal research or finance research in the research institutes or universities.

The focus of nuclear R&D is on the safety and operational performance of the power plants and on the management and disposal of wastes. Publicly funded nuclear energy research provides impartial expertise for the regulation of nuclear energy. The public sector's research also plays a major role in ensuring the necessary personnel and equipment resources for research and development, as well as in establishing the framework for international collaboration.

To make publicly funded nuclear energy research result-oriented and efficient, to strengthen the basic and advanced education of experts, and to facilitate international co-operation, most of the research was organised as national research programmes in 1989. The Advisory Committee on Nuclear Energy (YEN) assists the Ministry of Trade and Industry (KTM) in directing the publicly funded nuclear energy research. KTM has appointed steering and review groups to supervise and direct publicly funded research. Currently, the third generation of programmes is under way. The programmes now in progress are:

- Nuclear Power Plant Safety (FINNUS), 1999 – 2002;
- Public Sector’s Research Programme on Nuclear Waste Management (JYT2001), 1997-2001;
- Advanced Light Water Reactors (ALWR), 1998 - 2001 (with strong industry support);

- Component Life Management (XVO), 1999 - 2002 (with strong industry support);
- Finnish Fusion Programme (FFUSION2) 1999 - 2002.

The total volume for the four research programmes on nuclear fission energy is about 65 person-years annually. Nuclear fusion research comprises about 25 person-years. At present, the total annual volume of all nuclear energy research in Finland is estimated to be some 200 person-years.

4.5. International Cooperation in the Field of Nuclear Power Development and Implementation

Finland participates in IAEA work on all programme areas. The main emphasis is on nuclear safety and safeguards programmes. Finland also supports the IAEA's work through voluntary contributions. Finland is a party to all IAEA conventions.

When Finland joined the European Union together with Austria and Sweden in early 1995, it also became a member of the European Atomic Energy Community, Euratom. In March 1995, Finland made the first contract of association with the European Commission to participate in research on controlled thermonuclear fusion. Through this contract, Finland is also involved with the global International Thermonuclear Experimental Reactor (ITER) project. The contract has been renewed in early 1999.

As a member of the European Union, IAEA, OECD/NEA and Nordic Council of Ministers, Finland participates in most nuclear research and development activities conducted by intergovernmental organisations. Multilateral co-operation is supplemented by several bilateral projects and co-operation agreements that the Finnish research institutes, safety authorities and industrial enterprises have with foreign organisations.

The importance of international co-operation in reactor safety and nuclear waste management research and development is most evident in experimental research and development of large computer codes where large manpower and financial resources are involved.

Finnish research institutes and companies have been well presented in the Euratom research programme. Finnish institutes and companies have been involved in altogether 47 research projects and networks of the 5th framework programme of the Euratom.

Finnish nuclear safety authorities and nuclear research institutes take part in committees and expert groups established in OECD/NEA. Finland has been a member of the OECD Halden reactor project since its beginning in the late 1950's.

The five Nordic countries have carried out joint research programmes since 1977. The goal is to maintain a high level competence in the field of reactor safety, waste management and emergency preparedness as well as promoting a unified view on safety issues. The current fifth programme covers the years 1998-2001.

Finland's bilateral assistance in the field of nuclear safety and other sectors of nuclear technology is mainly directed to the neighbouring areas in Russia and the Baltic states and to Ukraine. In Russia, work is focused on the Kola and Leningrad nuclear power plants. By the end of 2000, Finland's total financial commitments in regard to Russia and CEECs for nuclear safety amounted to about 25million €.

5. REGULATORY FRAMEWORK

5.1. Safety Authority and the Licensing Process

General safety regulations are issued by the Council of State. Detailed regulations and regulatory guides are issued by the Radiation and Nuclear Safety Authority (STUK). The licensing of nuclear installations in Finland (construction permit and operation license) is the responsibility of the

Council of State. A major nuclear facility also needs a positive decision-in-principle by the Council of State, subject to ratification by the Parliament. However, licenses for small nuclear facilities (e.g., research reactors with thermal power below 50 MW(e)) are granted by the Ministry of Trade and Industry, which has overall responsibility for control of nuclear energy in Finland.

In Finland, the overall management and supervision of nuclear matters is the responsibility of the Ministry of Trade and Industry (KTM). The Ministry also carries out the preparation of the policies and licensing procedures for adaptation by the Council of State (Government). Preparation of legislation drafts and implementation of international agreements, supervision of nuclear waste management, and administration of the state's nuclear waste fund are the duties of the Ministry's Energy Department. The Ministry is assisted by the Advisory Committee on Nuclear Energy for the preparation of the most important matters related to nuclear energy.

The Radiation and Nuclear Safety Authority (STUK) works to ensure that radiation equipment, radioactive materials, nuclear energy and the nuclear materials are used safely. STUK is also responsible for the control of handling of radioactive materials and radiation exposure in workplaces, at home and in the environment. STUK operates under the auspices of the Ministry of Social Affairs and Health. The safety authority maintains close contacts with the Ministry of Trade and Industry, other government bodies, research institutes, universities and power companies. STUK is assisted by the Advisory Committee on Nuclear Safety (YTN) in major nuclear safety issues. Licensing of nuclear power plants includes three stages: the decision-in-principle, the construction license and the operating license. The safety aspects of the license applications are assessed by STUK. All use of nuclear energy must meet the following prerequisites:

i. it shall be generally beneficial for society;

ii. it shall be safe and it shall not cause any detriment to human beings, the environment and property;

iii. physical security, emergency preparedness and other arrangements shall be sufficient to mitigate nuclear accidents and to protect the use of nuclear energy against illegal actions; and

iv. the import of nuclear explosives or the manufacture, possession or exploding of such explosives in Finland is prohibited.

The application for the Council of State's (Government's) decision-in-principle (see Figure 11) may concern one or more alternative nuclear installation projects. Before the decision is made, an overall description of the installation including environmental effects and safety plans are made available to the public. Public and local authorities are given the opportunity to present their opinions in a public hearing. If the general prerequisites are met and if the municipal council of the site in question is in favour (municipal right of binding veto) of the construction of the installation, the Council of State may make the decision-in-principle. The decision is submitted to parliament, which either confirms or rejects it (political consideration).

The Council of State enforces regulations on nuclear safety, security and emergency preparedness drafted by STUK. The Ministry of Interior is responsible for regulating public rescue services.

The application for a construction license is more detailed and includes safety analysis reports and security plans.

The application for an operating license must be accompanied with detailed construction information of the facility and cover the facility's operation plans. The license can be granted only for a fixed period.

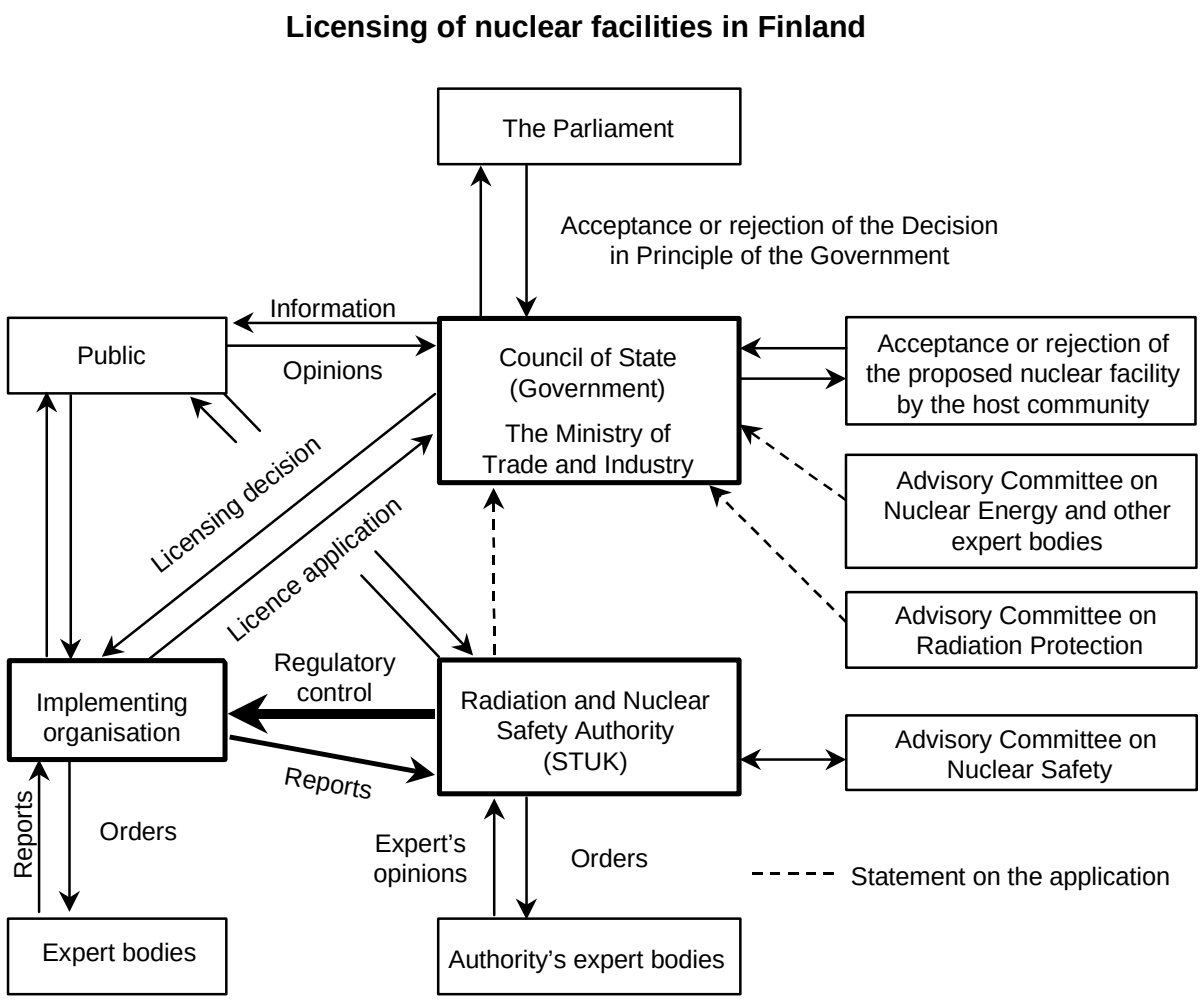

FIG. 15. Licensing of nuclear facilities in Finland
(e.g. nuclear power plants and waste management facilities)

During the operation, a nuclear power plant is subjected to three types of regulatory inspections: periodic inspections; inspections that the operating organisation must pass in order to continue operation; and, continuous re-evaluation of the safety level of the operating plant. Operating licenses are granted for a limited period. When renewing a license, an overall evaluation of the safety of the plant is carried out by STUK.

5.2. Main National Laws and Regulations

The Nuclear Energy Act 990/1987 (Ydinenergialaki) and Decree No. 161/1988 (Ydinenergia-asetus) give parliament the final authorisation for building new major nuclear installations including waste disposal facilities. The Act and Decree also define the licensing procedure (e.g. handling of construction and operation licence applications), the conditions for the use of nuclear energy as well as waste management (including the scheme to ensure that sufficient funds are collected for future waste management). Furthermore, they define the role and tasks of the different parties involved in the regulation, licensing and operation of nuclear facilities, such as the responsibilities and authority of STUK.

The Radiation Act 592/1991(Säteilylaki) establishes the conditions to prevent and limit harmful radiation effects to health.

Nuclear Liability Act 484/1972 & 588/1994 (Ydinvastuulaki) implements the Paris Convention on the Third Party Liability in the Field of Nuclear Energy and the Brussels Supplementary Convention. The amendment of 1994 adopts Joint Protocol bridging Paris and Vienna Conventions.

The Electricity Market Act 386/1995 (Sähkömarkkinalaki) opened access to the distribution networks and allowed foreign ownership of electricity supply. The Competition Act 480/1992 (Laki kilpailunrajoituksista) is compatible with EC directives on competition. Cartels and abuse of dominating position are prohibited by the act. Several other laws also cover electricity sector, including nuclear facilities:

- Law on Environmental Impact Assessment sets EIA compulsory for nuclear facilities (The EIA report is required as one enclosure for the application to obtain the decision in principle to construct a nuclear facility);
- Law on Construction and Land Use Planning requires a site permit for a power plants and major nuclear facilities;
- Law on Water Resources requires special permits of water courts for the use of cooling water in the power plants;
- Law on Air Protection includes the government decision on limits for non-radioactive atmospheric emissions;
- Law on emergency preparedness.

The requirements presented in the Nuclear Energy Act and Decree are specified in several general regulations laid down by Decisions of the Council of State (Government). These decisions (VNp) cover the following topic areas:

- General safety regulations for nuclear power plants (VNp 395/1991);
- General regulations concerning the physical security of nuclear power plants (VNp 396/1991);
- General regulations concerning emergency preparedness for nuclear power plants (VNp 397/1991);
- General safety regulations for the final disposal facility for low and intermediate level radioactive wastes from nuclear power plants (VNp 398/1991); and
- General safety regulations for the final disposal of spent nuclear fuel (VNp 478/1999);

Furthermore, the detailed Finnish licensing requirements for nuclear installations are outlined in the STUK regulatory guides YVL guides). The YVL guides now include about 60 directives in the following eight series: general guides, systems, pressure vessels, civil engineering, equipment and components, nuclear materials, radiation protection and radioactive waste management.

5.3. International, Multilateral and Bilateral Agreements[3]

AGREEMENTS WITH THE IAEA

• Statute of the International Atomic Energy Agency [FTS 2/58, 37/63, 18/76, 13/90]	Entry into force:	7 January 1958
• Amendments of Article VI & XIV.A of the IAEA Statute	Ratified:	14 June 2000
• Agreement on privileges and immunities of the IAEA; INFCIRC/9 [FTS 27/60]	Entry into force:	29 July 1960
• Application of safeguards in connection with the NPT; INFCIRC/155 [FTS 2/72]	Entry into force: Suspended:	9 February 1972 1 October 1995
• The Agency's assistance to Finland in establishing a research reactor project; INFCIRC/24	Entry into force:	23 December 1960

[3] Note: If the text has been published as an IAEA Information Document the corresponding code of this document (INFCIRC/xxx) is given. The code [FTS xx/xx) refers to the number used in the official publication "Finnish Treaty Series".

• The Agency's assistance to Finland in establishing a sub-critical assemblies project; INFCIRC/53	Entry into force:	30 July 1963
• Nordic mutual emergency assistance agreement in connection with radiation accidents; INFCIRC/49 [FTS 39-40/65]	Entry into force:	23 June 1965
• Agreement between the non-nuclear weapon States of the European Community, the European Atomic Energy Community and the IAEA in connection with the NPT; INFCIRC/193	Entry into force:	1 October 1995
• Additional Protocol to the Agreement between the non-nuclear weapon States of the European Community, the European Atomic Energy Community and the IAEA in connection with the NPT (GOV/1998/28)	Signed:	22 September 1998
• Improved procedures for designation of safeguards inspectors	Accepted on:	25 April 1989

OTHER RELEVANT INTERNATIONAL TREATIES

• Treaty on the non-proliferation of nuclear weapons; INFCIRC/140 [FTS 10-11/70)	Entry into force:	5 March 1970
• Convention on physical protection of nuclear material; INFCIRC/274 [FTS 72/89]	Entry into force:	22 October 1989
• Convention on early notification of a nuclear accident; INFCIRC/335 [FTS 98/86]	Entry into force:	11 January 1987
• Convention on assistance in the case of a nuclear accident or radiological emergency; INFCIRC/336 [FTS 82-83/90]	Entry into force:	28 December 1990
• Convention on nuclear safety; INFCIRC/449 [FTS 74/1996]	Entry into force:	24 October 1996
• Vienna convention on civil liability for nuclear damage		Non-Party
• Paris convention on civil liability for nuclear damage on 29 July 1960 [FTS 20/72, 1/90]	Entry into force:	16 June 1972
• Protocol to amend the Vienna convention on civil liability for nuclear damage		Not signed
• Convention on supplementary compensation for nuclear damage		Not signed
• Joint protocol relating to the application of the Vienna and Paris conventions; INFCIRC/402 [FTS 98/1994]	Entry into force:	3 January 1995
• Supplementary convention to the Paris convention of 29 July 1960 on third party liability in the field of nuclear energy, Brussels and Paris [FTS 4/77, 85/91]	Entry into force:	14 April 1977

• Convention relating to civil liability in the field of maritime, carriage of nuclear material in Brussels [FTS 62/91].	Entry into force:	4 September 1991
• Joint convention on the safety of spent fuel management and on the safety of radioactive waste management; INFCIRC/546	Entry into force:	18 June 2001
• Zangger Committee; Communication received from Members regarding the export of nuclear material and of certain categories of equipment and other material; INFCIRC 209.	Dated:	22 August 1974
• Nuclear Suppliers Group, NSG; Communication received from Member States regarding the export of nuclear material, equipment or technology; INFCIRC/254 /Part I INFCIRC/254 /Part 2.	Dated: Dated:	March 1980 July 1992
• Communication received on behalf of the European Community regarding transfers of nuclear material, equipment and technology; INFCIRC 322.	Dated:	21 December 1995
• Statements on full-scope safeguards adopted by the adherents to nuclear suppliers guidelines; INFCIRC/405.	Adopted:	3 April 1992
• Communication received from the Member States of the European Community regarding the provision of certain additional information; INFCIRC/415.	Dated:	8 February 1996
• Acceptance of NUSS Codes	Summary: Codes are considered to be useful guidance. Finnish regulations are in general consistent with revised codes. (Letter of 18 May 1990)	
• Agreement on common Nordic guidelines on communication concerning the siting of nuclear installations in border areas, [FTS 19/1977].	Entry into force:	15 November 1976
• The Statute of the OECD Nuclear Energy Agency (NEA), subsequently amended (FTS 24/1976)	Entry into force	1 January 1976

BILATERAL AGREEMENTS

- As of 1 January 1995, Finland has been a member of the European Atomic Energy Community (EAEC or Euratom). Consequently, e.g. the following agreements are applied in Finland:
  - Agreement between the European Atomic Energy Community and the Government of Canada for cooperation in the peaceful uses of atomic energy, 6 October 1959
  - Agreement between the Government of Australia and the European Atomic Energy Community concerning transfers of nuclear material from Australia to the European Atomic Energy Community; 21 September 1981
  - Agreement for cooperation in the peaceful uses of nuclear energy between the European Atomic Energy Community and the United States of America, 12 April 1996.

  - Agreement for cooperation in the peaceful uses of nuclear energy between the European Atomic Energy Community and the Republic of Argentina, 29 October 1997**.**

- Agreement between the Government of Republic of Finland and the USSR concerning cooperation in peaceful uses of atomic energy, 14 May 1969 [FTS 38-39/69].
- Agreement for cooperation between the Government of Finland and the Government of Sweden concerning peaceful uses of atomic energy, 15 October 1968 [FTS 40-41/70].
- Agreement between Finland and Sweden on the guidelines to be followed while exporting nuclear material, technology or equipment, 4 March 1983 [FTS 20/83].
- Agreement between Finland and Denmark on the Exchange of Information and Reporting Relative to Nuclear Plants and Nuclear Events in Finland and Denmark, 25 February 1987 [FTS 27/87].
- Agreement between Finland and Sweden on the Exchange of Information and Reporting Relative to Nuclear Plants and Nuclear Events in Finland and Sweden, 25 February 1987 [FTS 28/87].
- Agreement between Finland and Norway on the Exchange of Information and Reporting Relative to Nuclear Plants ad Nuclear Events in Finland and Norway, 25 February 1987 [FTS 46/87].
- Agreement between the Government of the Republic of Germany and the Republic of Finland concerning the Early Notification of a Nuclear Accident and the Exchange of Information and Experience Relative to Nuclear Safety and Protection Against Radiation, 21 December 1992 [FTS 35/93].
- Agreement between the Government of Finland and the Government of the Russian Federation on the Rapid Reporting on Nuclear Accidents and the Exchange of Information Relative to Nuclear Plants, 19 January 1995 [FTS 38/96].
- Agreement between the Government of the Republic of Finland and the Government of Ukraine on Early Notification of Nuclear Accidents and on Exchange of Information and Experience in the Field of Nuclear Safety and Radiation Protection, 8 February 1996 [FTS 66/1997].

REFERENCES

[1] The Ministry of Trade and Industry, Energy Review 1/2001.
[2] Statistics of Finland, 1999.
[3] Finnish Energy Statistics.
[4] Finergy 1997, Electricity markets in 2010-Scenarios for the development of electricity use and supply, The Finnish Energy Industries Federation (Finergy), Research Report 3/1997, (In Finnish).
[5] The Finnish Energy Strategy - The Council of State's Report on Energy Policy. 1997. Helsinki: Ministry of Trade and Industry, Publications 11/1997.
[6] IAEA Energy and Economic Data Base (EEDB).
[7] Energy in Europe, 1998 - Annual Energy Review, DG XVII, European Commission.
[8] The Ministry of Foreign Affairs, Treaty Register.
[9] Data & Statistics/The World Bank, www.worldbank.org/data.
[10] IAEA, Power Reactor Information System (PRIS).

Appendix

DIRECTORY OF THE MAIN ORGANIZATIONS, INSTITUTES AND COMPANIES INVOLVED IN NUCLEAR POWER RELATED ACTIVITIES

NATIONAL ATOMIC ENERGY AUTHORITIES

Ministry of Trade and Industry (KTM) Energy Department Nuclear Energy Division P.O. Box 32 FIN-00023 GOVERNMENT	Tel.: +358 9 1601 Fax: +358 9 160 2695 http://www.vn.fi/ktm/eng/paasivu.htm
Radiation and Nuclear Safety Authority (STUK) P.O. Box 14 FIN-00881 HELSINKI	Tel.: +358 9 759 881 Fax: +358 9 7598 8500 http://www.stuk.fi/english/

NUCLEAR ADVISORY BODIES

Advisory Committee on Nuclear Energy (YEN) c/o Ministry of Trade and Industry (KTM) P.O.Box 32 FIN-00023 GOVERNMENT	Tel.: +358 9 1601 Fax: +358 9 160 2695
Advisory Committee on Nuclear Safety (YTN) c/o Radiation and Nuclear Safety Authority (STUK) P.O. Box 14 FIN-00881 HELSINKI	Tel.: +358 9 759 881 Fax: +358 9 7598 8500

OTHER NATIONAL AUTHORITIES

Ministry of Foreign Affairs (Non-proliferation of nuclear weapons and international agreements)	http://virtual.finland.fi/ministry/formin.html
Ministry of Social Affairs and Health (Administrative authority for the use of radiation)	http://www.vn.fi/stm/english/
Ministry of the Environment (Protection of the environment in normal and in accident situations)	http://www.vyh.fi/
Ministry of the Interior (Protection of population in emergency conditions)	http://www.intermin.fi/paasive.html

NUCLEAR UTILITY COMPANIES

Fortum Power and Heat Oy P.O. Box 40 FIN-00048 FORTUM	Tel.: +358 10 4511 Fax: +358 10 4536790 http://www.fortum.com/
Imatran Voima Oy (Operator of Loviissa NPP)	http://www.ivo.fi/
Teollisuuden Voima Oy (Operator of Olkiluoto NPP) FIN-27160 OLKILUOTO	Tel. +358 2 83811 Fax +358 2 8381 2109 http://www.tvo.fi/eng/index.html

RESEARCH INSTITUTES

Technical Research Centre of Finland (VTT)
P.O. Box 1000
02044 VTT

Tel.: +358 9 4561
Fax: +358 9 456 7000
http://www.vtt.fi/

Geological Survey of Finland (GTK)
Betonimiehenkuja 4
FIN-02150 ESPOO

Tel.: +358 205 5020
Fax: +358 205 5012
http://www.gsf.fi/

Finnish Meteorological Institute
P.O. Box 503
FIN-00101 HELSINKI

Tel.: +358 9 192 91
Fax: +358 9 179 581
http://www.fmi.fi/en

OTHER NUCLEAR ORGANISATIONS

Posiva Oy
(Finish Radwaste Management Company)
Töölönkatu 4
FIN-00100 HELSINKI

Tel. +358 9 228 030
Fax. 358 9 2280 3719
http://www.posiva.fi/englanti
http://www.posiva.fi/eng/1/1.html

Finnish Energy Industries Federation

http://www.energia.fi/finergy/

Finnish Nuclear Forum

http://www.energia.fi/

Finnish Nuclear Society

http://www.eu.vtt.fi/ene/eneydi/ats/index.html

UNIVERSITIES

Lappeenranta University of Technology (LTKK)
P.O. Box 20
FIN-53851 LAPPEENRANTA

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http://www.lut.fi/english

Helsinki University of Technology (TKK)
P.O.Box 1000
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University of Kuopio
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