SWEDEN

2012

1. GENERAL INFORMATION

1.1. Country overview

1.1.1. Governmental System

All legislative power in Sweden sits with the Parliament (Riksdagen). The Government has the executive power and also the initiative to propose changes in legislation. In addition, European Union membership has significant impact on rules and regulations in certain matters within the energy sector, as the Commission and the Council have the power to decide on European regulations. Directives, however, are implemented into Swedish legislation through decisions by the Parliament or the Government.

The Ministry of Enterprise, Energy and Communications is responsible for energy policy, and the Ministry for the Environment is responsible for climate policy, the built environment and also for nuclear safety and radiation protection. A special characteristic of the Swedish government is that ministries are quite small, and so day-to-day execution of policy is delegated to a wide array of national authorities. Energy authorities include the Swedish Energy Agency, the Energy Markets Inspectorate and the transmission system operator Svenska Kraftnät. Nuclear safety and radiation protection are responsibilities of the Swedish Radiation Safety Authority and climate policy is handled by the Swedish Environmental Protection Agency (and, in parts, by the Swedish Energy Agency).

1.1.2. Geography and Climate

Sweden is a long, narrow country in northern Europe, bounded by Norway in the west, Finland in the northeast and the Baltic Sea in the south and east, as shown in Figure 1. The total length from north to south is 1,600 kilometres, and the land area is 410,932 square kilometres. After France and Spain, it is the largest territory in Western Europe, almost twice the size of Great Britain. The northwest part of Sweden consists of mountains, and many rivers and lakes are scattered all over the country. Sweden’s coast line is more than 2,000 kilometres long.

FIGURE 1: GENERAL OVERVIEW

The northern boundary is located about 250 kilometres north of the Arctic Circle, but because of the Gulf Stream coming from west, the climate is not of a polar type. The average yearly temperature varies between -1.5 °C in the north and 7.8 °C in the south.

1.1.3. Population

The population data in Table 1 shows a slow increase in population. The population currently exceeds 9.4 million inhabitants. The population density is 22.9 persons per square kilometre, although the northern part of Sweden is sparsely populated, with less than 20% of inhabitants living in the northern half of the country.

TABLE 1. POPULATION INFORMATION

							Average annual growth rate (%)
Year	**1970**	**1980**	**1990**	**2000**	**2005**	**2010***	**2000 to 2010***
Population (millions)	8.08	8.32	8.59	8.88	9.05	9.42	0.60
Population density (inhabitants/km²)	19.67	20.24	20.91	21.62	22.02	22.91	0.60
Urban Population as % of total							
Area (1000 km²)	411	411	411	411	411	411	

* Latest available data

Source: Statistics Sweden

1.1.4. Economic Data

TABLE 2. GROSS DOMESTIC PRODUCT (GDP)

							Average annual growth rate (%)
	1970	**1980**	**1990**	**2000**	**2005**	**2010****	**2000 to 2010****
GDP (millions of current US$)	35 322	131 879	244 459	247 259	370 580	462 098	8.7
GDP (millions of constant 2005 US$)	174 915	212 357	263 882	324 508	370 580	400 030	2.3
GDP per capita (PPP* US$/capita)	4 570	10 552	19 301	27 948	32 701	39 326	4.1
GDP per capita (current US$/capita)	4 392	15 870	28 562	27 870	41 039	49 275	7.7

* PPP: Purchasing Power Parity

** Latest available data
Source: OECD

1.2. Energy Information

Sweden's energy requirements are covered both by domestic energy, in the form of hydropower, wind power, ambient heat for heat pumps and wood fuels including municipal waste and residues from the forestry industry (wood chips, bark and black liquor), and by imported energy, primarily oil, nuclear fuel, coal and natural gas (see Table 4). Originally, all energy supply was domestic, primarily through wood and hydropower. However, during the 19th century, coal began to be imported. Coal came to play an important role up until World War II, when oil and hydropower together became the base of the energy supply. The first oil crisis in 1973 demonstrated the risk of being dependent upon oil.

In the 1960s, the decision was made to invest in nuclear power, but it would take until the mid-1970s before nuclear energy had a significant impact on the energy system. Through the 1980s and onwards, nuclear power and domestic fuels (biomass) were the primary sources of energy in Sweden's oil-substitution programme, in addition to energy efficiency measures. Since 1973, the share of oil used in the energy supply has decreased from 71% to 31% in 2010. During the same period, the use of nuclear power (fuel input as share of total energy supply) increased from 1% to 28%.

Total energy supply varies from one year to another due to a number of factors, including variations in temperature and precipitation. Years that are warmer than the "average year" result in a reduced need for energy supplies, while colder years increase the need.

In comparison with the international situation as a whole, Sweden obtains a relatively large proportion of its energy supplies from renewable energy sources, in the form of biofuels, hydropower and wind power. In 2010, 48% of the total energy used came from renewable energy sources, according to the calculation method of the renewables directive (2009/28/EC).

1.2.1. Estimated available energy

The two main domestic energy sources exploited are hydropower and bioenergy. Wind power is rapidly expanding, heat pumps capture significant amounts of free heat from the environment (ground, air and water) and peat provides another domestic source of energy.

Sweden possesses large amounts of low-grade uranium. However, the uranium content in the ore is low or very low. According to OECD/NEA and IAEA statistics Sweden's share of the world's total quantity of uranium that can be extracted is less than 1%. The economic incentives to exploit such low grade uranium ores have not sufficed, and so no uranium mines are operated in Sweden. All nuclear fuel is therefore imported.

Most hydro power is located in the north of the country, and the electricity is transported to the south by several large 400 kV lines. All the nuclear power plants are in the southern part of Sweden. Because of the abundance of rivers and lakes, all thermal power plants (nuclear or conventional) are cooled by sea, lake or river water.

TABLE 3. ESTIMATED AVAILABLE ENERGY SOURCES

	Estimated available energy sources					
	Fossil Fuels			Nuclear	Renewables	
	Solid	Liquid	Gas	Uranium	Hydro	Other Renewable
Total amount in specific units*				4000[1)]	130[2)]	
Total amount in exajoule (EJ)				N/A	N/A	

* Solid, Liquid: Million tons; Gas: Billion m3; Uranium: Metric tons; Hydro, Renewable: TW
1) Reasonably Assured Resources (RAR) under < USD 130/kgU
2) TWh/year, estimated technically exploitable capability.
Source: Uranium 2007: Resources, Production and demand. OECD/NEA & IAEA 2008; Survey of Energy Resources 2010, World Energy Council.

1.2.2. Energy Statistics

TABLE 4. ENERGY STATISTICS

	1970	1980	1990	2000	2005	2010*	Average annual growth rate (%) 2000 to 2010*
Energy consumption**							
- Total	1.589	1.707	2.002	1.987	2.184	2.095	0.54
- Solids***	0.080	0.070	0.107	0.108	0.110	0.108	0.00
- Liquids	1.223	0.969	0.673	0.559	0.623	0.552	-0.13
- Gases	0.000	0.000	0.018	0.029	0.035	0.063	11.62
- Nuclear	0.000	0.289	0.716	0.625	0.790	0.599	-0.41
- Hydro	0.149	0.212	0.258	0.284	0.262	0.241	-1.54
- Other renewables	0.122	0.165	0.232	0.350	0380	0.506	4.47
Heat	0.000	0.000	0.000	0.015	0.012	0.019	2.38
Electricity (net import)	0.015	0.002	-0.002	0.017	-0.027	0.007	-5.78
Energy production							
- Total	0.272	0.667	1.206	1.285	1.456	1.368	0.65
- Solids***	0.000	0.000	0.000	0.010	0.013	0.008	-1.74
- Liquids	0.000	0.001	0.000	0.000	0.000	0.000	
- Gases	0.000	0.000	0.000	0.000	0.000	0.000	
- Nuclear	0.000	0.289	0.716	0.625	0.790	0.599	-0.41
- Hydro	0.149	0.212	0.258	0.284	0.262	0.241	-1.54
- Other renewables	0.122	0.165	0.232	0.350	0.380	0.506	4.47
Heat	0.000	0.000	0.000	0.015	0.012	0.014	-0.86
Net import (Import - Export)							
- Total	1.32	1.04	0.80	0.70	0.73	0.73	0.34

* Latest available data
** Energy consumption = Primary energy consumption + Net import (Import - Export) of secondary energy.
*** Solid fuels include coal, lignite
1) Between 1970 and 1990 including peat, waste etc.
Source: IEA, Swedish Energy Agency

1.2.3. Energy policy

In both the long and the short term, the objective of Swedish energy policy is to ensure reliable supplies of electricity and other forms of energy to carriers at prices that are competitive with those of other countries. It is intended to create the right conditions for cost-efficient Swedish energy supply and efficient energy use, with minimum adverse effects on health, the environment or the climate. The Swedish government also promotes the concept of an eco-efficient economy, strongly advocating energy efficiency, green energy and low carbon technologies as positive drivers, not costs, for welfare and growth.

In the spring of 2009, the Swedish government presented a new and comprehensive energy and climate policy, which was approved by Parliament in June 2009. This integrated energy and climate policy is strongly influenced by the common European Union policies in those same areas. In several instances, the Swedish policies are more ambitious than the targets set by the EU.

Targets for 2020 include a 40% reduction (compared to 1990 levels) of climate gas emissions in the non-ETS sector (which is more ambitious than the EU target for Sweden, of a decrease of 17% compared to 2005 levels), 50% renewable energy (EU obligation: 49%), 20% higher energy efficiency, and 10% renewable energy in the transport sector (common binding EU target). In addition, the European Union has called for the ETS sector to reduce its emissions by 21% by 2020. The overall European Union target for climate gas emission reductions is 20% by 2020, and the EU has committed to a reduction of 30% if other industrialised countries/regions adopt goals of a similar magnitude.

In addition to these medium-term goals, the Swedish government has set the goal for a vehicle stock that is “independent” of fossil fuels by the year 2030, and aims for fossil fuels to have been totally removed from the heating sector by 2020, with visions that Swedish net-emissions might reach zero by 2050.

Operationally, these visions, goals and targets have been translated into three action plans that are further developed by responsible authorities (e.g. the Swedish Energy Agency and the Swedish Environmental Protection Agency):

1. Action plan for renewable energy, which includes an increase in the ambitions within the electricity certificate system to a level of approximately 25 TWh of new renewable electricity by 2020, and introduces increased ambitions when it comes to finding suitable locations for wind power – meaning that local governments should have the readiness to introduce a total of 20 TWh wind power on shore and 10 TWh wind power off shore.
2. Action plan for energy efficiency, which is focused on fulfilling the Energy Services Directive and other directives in the energy efficiency domain, including Eco-design, Energy Labelling, Energy Performance of buildings, etc. primarily by raising awareness but also by introducing energy efficiency programmes targeted towards the industry (especially SMEs) and service sector companies. Heavy industry is already taking part in a voluntary agreement programme as well as, in most cases, the EU-ETS system.
3. Action plan for a vehicle fleet independent of fossil fuels, where economic incentives will play the major role, e.g. CO_2 taxes penalising the use of fossil fuels and tax rebates for environmentally friendly vehicles. In addition, blending of

renewables into petrol and diesel will increase to levels approved (10% ethanol in petrol and 7% FAME in diesel) by the European Fuel Quality Directive. The Government, via the Swedish Energy Agency and other actors, has also boosted energy- and climate-related transport sector research and development, aiming at e.g. increasing the share of electricity for transportation purposes. The government is also allocating considerable funding for the continued development of second generation biofuels, e.g. through gasification of biomass and black liquor and cellulosic ethanol.

The Government also stresses the importance of efficient energy markets, and promotes the further development of common electricity and gas markets, both in the North European and the pan-European context. For Swedish conditions, gas markets should be developed in a way that promotes the further introduction of biogas. The Government also stresses the importance of CHP, which is already well developed both in district heating and in industry.

Nuclear power will continue to play an important role in the Swedish energy system. From 2011, new reactors may be installed on locations where nuclear power plants are currently in operation. The total number of reactors may not exceed ten, i.e. that of today.

1.3. The electricity system

1.3.1. Electricity policy and decision making process

The Swedish electricity market was deregulated on January 1st, 1996. The electricity market is thus characterised by the fact that the distribution networks are open to all economic actors and that there is an unbundling of companies in the sector, separating grid services from production and/or sales. The distribution networks constitute a natural monopoly, and the network operation is supervised by the Energy Markets Inspectorate, which also grants permission for the installation of power lines as well as issuing line concessions.

1.3.2. Structure of electric power sector

Electricity production started early in Sweden. The first generating plants, based on hydropower, were established in the 1880s. They were small and intended to supply power to industries and communities in close vicinity. Hundreds of small hydroelectric power stations were constructed. As the technique of transferring power over longer distances developed, it became possible to exploit the larger rivers for distribution of power to the south of the country.

Many of the companies which are responsible for the power supply today were formed at this time. The Government became engaged in the production and distribution of power at this stage. In 1906, Parliament granted funds for the first state-owned hydropower project, and in 1909, the Swedish State Power Board (now Vattenfall AB) was formed. Since that time, the production of power has been divided almost equally between the Government, through the Swedish State Power Board (Vattenfall AB), and power companies, owned by industries, municipalities and other non-governmental bodies.

Since the restructuring of the industry, there have been a number of changes with respect to ownership of the production utilities in the Nordic countries. Vattenfall, Fortum and E.ON dominate electricity production, trade and distribution in Sweden. On the common Nordic market as a whole, Swedish Vattenfall, Finnish Fortum, Norwegian Statkraft and German E.ON are the major players.

The Electrical Producers
Electricity is generated in plants owned by the state, the municipalities, industries and private companies. Additionally, a small amount of power is generated in small-scale privately-owned wind power and hydropower plants. All in all, the state owns approximately 40% of the generating capacity, with overseas owners holding approximately 40%, the municipalities approximately 13% and others approximately 8%.
Mergers and acquisitions have gradually reduced the number of large producers, during the last 20 years. Through this structural rationalisation, the generation of electricity has become strongly concentrated. The three largest power companies accounted for approximately 80% of Sweden's overall electricity generation during 2010.

The Nordic market is merged together in the world's first international commodity exchange for electrical power. Nord Pool Spot organises trade in standardised physical power contracts to Nordic and northern European participants. Financial contracts are traded on Nasdaq OMX Commodities. These exchanges play a key role as part of the infrastructure of the Nordic electricity power market, and thereby provide an efficient, publicly known price of electricity, both in the spot and the derivatives market.

The Transmission of Power
The transmission of power from power plants to customers takes place in the interconnected electricity network. The network is normally divided into three levels: the high-voltage grid and the regional and local networks.

The utility Svenska Kraftnät is responsible for the high-voltage grid, which includes the 220 kV and 400 kV lines, as well as the bulk of the links with neighbouring countries. The regional networks are owned and operated by the large power companies’ network companies, and generally include lines of 20-130 kV.

The local networks are owned and operated by 173 (as of 2010) network companies, and normally include lines of a maximum of 20 kV. The number of local network companies is gradually decreasing due to the continuing structural rationalisation of network operations. When network companies become larger, this often entails the local and regional networks being co-ordinated within the same network company.

The total length of the power lines in Sweden is 538,000 km, of which 59% are underground cables. The number of customers connected to the network is 5.2 million.

1.3.3. Main indicators

Today, most of Sweden’s electricity is produced by hydropower or nuclear power. In 2010, the country produced 145 TWh, of electricity, of which 46% was produced by hydropower and 38% by nuclear power, while thermal power production (primarily CHP using biomass/black liquor, municipal waste or peat) accounted for only about 13%. Oil-fired cold condensing power plants and gas turbines are only and rarely used as reserve capacity, during years with low precipitation and resulting low hydropower production. Restructuring of the electricity market has resulted in several reserve power stations being taken out of use for economic reasons. There are also more than 1,655 wind power plants in the country (as of December 2010). However, their contribution to the electricity supply is still small, supplying about 2.4% during 2010.

The total installed capacity of the Swedish electricity production system was 35.7 GW in December 2010. However, 100% capacity is never available, and transmission capacity between the north and south of the country is limited. The normal transmission capacity means that 7,600 MW (including the 130 kV grid) can be transferred from north to central Sweden, and 5,300 MW from central to southern Sweden. Table 5 shows the historical electricity production data and the installed capacities of electrical plants. Table 6 presents energy related ratios.

TABLE 5. ELECTRICITY PRODUCTION, CONSUMPTION AND CAPACITY

	1970	1980	1990	2000	2005	2010*	Average annual growth rate (%) 2000 to 2010*
Capacity of electrical plants (GWe)							
- Thermal	4.44	7.95	7.82	7.53	7.42	8.61	1.43
- Hydro	10.86	14.86	16.33	16.53	16.35	16.20	-0.20
- Nuclear	0.06	4.61	9.97	9.42	9.47	9.34	-0.08
- Wind	0	0	0.01	0.21	0.45	2.02	86.14
- Geothermal	0	0	0	0	0	0	
- other renewable	0	0	0	0	0	0	
- Total	15.36	27.42	34.13	33.69	33.69	36.17	0.74
Electricity production (TWh)							
- Thermal	19.05	10.96	5.28	9.19	12.25	20.80	12.63
- Hydro	41.54	58.87	73.04	78.62	72.87	66.83	-1.50
- Nuclear	0.06	26.49	68.19	57.32	72.38	55.63	-0.30
- Wind	0	0	0	0.46	0.936	3.47	65.35
- Geothermal	0	0	0	0	0	0	
- other renewable	0	0	0	0	0	0	
- Total (1)	60.65	96.32	146.51	145.59	158.44	146.72	0.08
Total Electricity consumption (TWh)	63.50	94.60	139.95	146.63	147.10	138.40	-0.56

(1) Electricity transmission losses are not deducted.
* Latest available data
Source: IEA, Eurostat, Swedish Energy Agency

TABLE 6. ENERGY RELATED RATIOS

	1970	1980	1990	2000	2005	2010*
Energy consumption per capita (GJ/capita)	197	205	233	224	241	223
Electricity consumption per capita (kWh/capita)	7 858	11 373	16 291	16 507	16 258	14 699
Electricity production/Energy production (%)	80	52	44	41	39	39
Nuclear/Total electricity (%)	0	28	47	39	46	38
Ratio of external dependency (%) (1)	83	61	40	35	33	35

(1) Net import / Total energy consumption.
* Latest available data

Source: IEA, Eurostat, Statistics Sweden, Swedish Energy Agency

2. NUCLEAR POWER SITUATION

2.1. Historical development and current organizational structure

2.1.1. Overview

Nuclear technology was introduced in Sweden in 1947, when AB Atomenergi was constituted to carry out a development programme decided upon by the Parliament. As a result, the first research reactor (R1) went critical in 1954. This reactor was followed by the first prototype nuclear power reactor, Ågesta (PHWR), located in a rock cavern in a suburb of Stockholm. The Ågesta reactor was mainly used for district heating, and operated from 1964 until 1974, when it was permanently shut down. The first commercial nuclear power reactor, Oskarshamn 1, was commissioned in 1972, and was followed by another eleven units sited at Barsebäck, Oskarshamn, Ringhals and Forsmark in the time period up to 1985. The twelve commercial reactors constructed in Sweden comprise nine BWRs (ASEA-ATOM design) and three PWRs (Westinghouse design). As a result of political decisions, the twin BWR units Barsebäck 1 and 2 were finally shut down in 1999 and 2005, respectively.

In 2004, Studsvik Nuclear decided to permanently shut down the two research reactors (R2 and R2-0) at the Studsvik site. They were closed in June 2005. The decision was taken based on economic grounds; the licenses had recently been extended until 2014, subject to certain conditions. These reactors were mainly used for commercial materials testing purposes, isotope production, and as a neutron source for research purposes, medical applications and higher education. They are currently under decommissioning.

2.1.2. Current organizational chart(s)

The restructuring of the European nuclear power industry, caused by the deregulation and widening of the electrical power markets, has brought about an internationalisation of the two Swedish utilities which were dominant for many years: Vattenfall AB and Sydkraft AB. Vattenfall AB has acquired large power production assets in Poland and Germany, including co-ownership of four German nuclear power plants, and has established itself as a major actor on the European level. The major German utility, E.ON, has acquired all shares in Sydkraft AB. As a result, Sydkraft AB has changed its name to E.ON Sverige AB. The Finnish utility Fortum, owner of the Loviisa nuclear power plant, has established itself as a big owner on the Swedish market, with a large share of OKG. The result is a large amount of cross-ownership of the Swedish nuclear power plants, as shown in Figure 3 below.

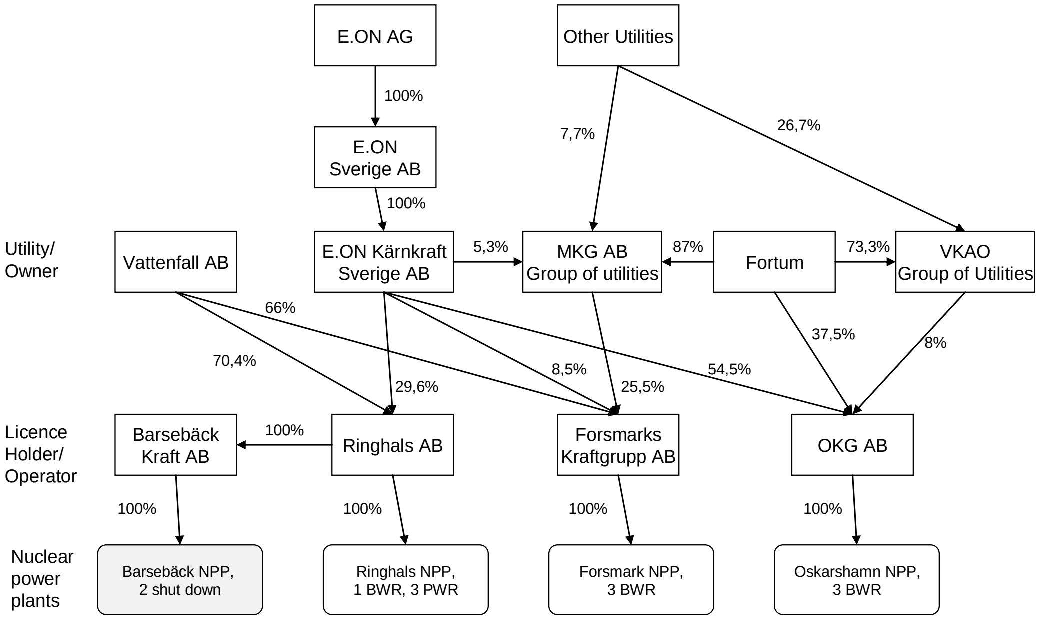

FIGURE 2. STRUCTURE OF THE NUCLEAR ELECTRIC SECTOR IN SWEDEN

2.2. Nuclear power plants: Overview

2.2.1. Status and performance of nuclear power plants

At present, as of February 2011, there are 10 nuclear power reactors in operation in Sweden, as specified in Table 7. Three power reactors have been permanently shut down, namely Ågesta, Barsebäck 1 and Barsebäck 2. All the BWRs were designed by the domestic vendor ASEA-ATOM (later ABB Atom, now Westinghouse Electric Sweden AB) and all the PWRs, except Ågesta, were designed by Westinghouse USA.

Eight of the power reactors (including Barsebäck 1 and 2) were uprated during the period 1982-1989, by 6-10 % of the original licensed power levels. In recent years, new uprating plans have been launched for several NPPs (see Section 2.2.4.).

Of the total electrical power production in Sweden (133,700 GWh(e) in 2009), nuclear power contributed 50,039 GWh(e), which is about 37%. The share normally varies between 40 and 50%. The energy availability factor 2007-2010 was 72.5%, and the unit capability factor 73.7%. The unplanned capability loss factor was 14.5%.

During 2010, two incidents have been classified as Level 1 events according to the INES-scale.

See the IAEA Power Reactor Information System for performance data of individual reactors.

TABLE 7. STATUS AND PERFORMANCE OF NUCLEAR POWER PLANTS

Station	Type	Net Capacity	Operator	Status	Reactor Supplier	Construction Date+	Grid Date ++	Commercial Date	Shutdown Date	UCF for year **
FORSMARK-1	BWR	1014	FKA	Operational	ABB ATOM	01-Jun-73	06-Jun-80	10-Dec-80		
FORSMARK-2	BWR	1014	FKA	Operational	ABB ATOM	01-Jan-75	26-Jan-81	07-Jul-81		
FORSMARK-3	BWR	1190	FKA	Operational	ABB ATOM	01-Jan-79	05-Mar-85	18-Aug-85		
OSKARSHAMN-1	BWR	473	OKG	Operational	ABB ATOM	01-Aug-66	19-Aug-71	06-Feb-72		70,8
OSKARSHAMN-2	BWR	624	OKG	Operational	ABB ATOM	01-Sep-69	02-Oct-74	01-Jan-75		78,1
OSKARSHAMN-3	BWR	1152	OKG	Operational	ABB ATOM	01-May-80	03-Mar-85	15-Aug-85		16,8
RINGHALS-1	BWR	855	RAB	Operational	ABB ATOM	01-Feb-69	14-Oct-74	01-Jan-76		
RINGHALS-2	PWR	866	RAB	Operational	WH	01-Oct-70	17-Aug-74	01-May-75		
RINGHALS-3	PWR	1051	RAB	Operational	WH	01-Sep-72	07-Sep-80	09-Sep-81		
RINGHALS-4	PWR	935	RAB	Operational	WH	01-Nov-73	23-Jun-82	21-Nov-83		
AGESTA	PHWR	12	VAB	Permanent Shutdown	ABBATOM	01-Dec-57	01-May-64	01-May-64	02-Jun-74	
BARSEBACK-1	BWR	615	BKAB	Permanent Shutdown	ASEASTAL	01-Feb-71	15-May-75	01-Jul-75	30-Nov-99	
BARSEBACK-2	BWR	615	BKAB	Permanent Shutdown	ABBATOM	01-Jan-73	21-Mar-77	01-Jul-77	31-May-05	

* UCF (Unit Capability Factor) for the latest available year (only applicable to reactors in operation).

** Latest available data

+ Date, when first major placing of concrete, usually for the base mat of the reactor building is done.

++ Date of the first connection to the grid

Source: PRIS database (www.iaea.org/pris).

2.2.2. Plant upgrading, plant life management and license renewals

In Sweden, major investments are being made to increase safety, reduce environmental impact, upgrade and extend the lifetime of existing plants. In the years ahead, continued investments are planned primarily in safety upgrades, capacity increases and continued modernisation, so that the 10 remaining operating reactors can be in operation for 40 years and beyond.

The physical protection is also being extensively upgraded. The Swedish Radiation Safety Authority controls the upgrading through regulations issued a few years ago. The regulations on design and construction of nuclear power reactors take into account operating experience, safety analyses, development of safety standards and research results. The modernisation programmes are conducted in large projects over several years, either during extended outages or planned longer shut-down periods. The programmes primarily address the following safety areas:

- improvement of physical and functional separation
- diversification of safety functions
- improvement of the accident management capability
- improved withstanding of local dynamic effects from pipe breaks
- improved withstanding of external events
- improvement of operator aids
- improvement of environmental qualification and surveillance

Original planning included installations to be finalised around 2013. Several delays of the major installations have been experienced due to, inter alia, problems with delivery of equipment.

2.3. Future development of Nuclear Power

2.3.1. Nuclear power development strategy

In connection with the modernisation work, the licensees have applied for uprating of eight reactors. This programme, including measures on the conventional side, will add approximately 1,275 MWe to current nuclear power production capacity as shown in Table 3.

The operating license, issued by the Government, stipulates the highest allowed thermal power level. The license only applies up to this power level. To further increase the power level, the licensee has to apply to the Government for a new license in accordance with the Act (1984:3) on Nuclear Activities.

Nine of the power reactors (including Barsebäck 1 and 2) were uprated during the period 1982-1989 by between 6-10 % from the original licensed thermal power levels. This was possible due to better use of existing margins, better methods of analysis and improved fuel design. Major plant modifications were not necessary. Current plans for uprating include major uprates of seven reactors and a minor uprating of one reactor. The current power levels as of 2010 and the uprating plans are shown in the table below.

TABLE 7.1. POWER LEVELS OF THE SWEDISH OPERATING REACTORS.

Reactor	Original power level		Current power level		Planned power level		Total thermal uprate %
	Thermal	Electrical	Thermal	Electrical	Thermal	Electrical	
F 1	2711	900	2928	1014	3253	1134	20,0
F 2	2711	900	2928	1014	3253	1134	20,0
F 3	3020	1100	3300	1190	3775	1360	25,0
O 1	1375	440	1375	473	1375	473	
O 2	1700	565	1800	624	2300	806	35,3
O 3	3020	1055	3300	1152	3900	1400	29,1
R 1	2270	750	2540	855	2540	880	11,9
R 2	2440	785	2660	866	2660	920	9,0
R 3	2783	915	3000	1051	3160	1110	13,5
R 4	2783	915	2783	935	3300	1160	18,6
Total	24813	8440	26357	9232	29516	10465	

F= Forsmark, O= Oskarshamn, R= Ringhals

A power increase can affect the facility in a number of different ways and to a varying degree depending on the size of the increase. The conditions and parameters which can affect safety must therefore be identified and analysed in order to establish whether the safety requirements are met with the necessary safety margins.

The Government has so far approved power uprates of Ringhals 1, Ringhals 3, Forsmark 1-3 and Oskarshamn 2-3. Applications have been submitted for Ringhals 4.

The Swedish Radiation Safety Authority has developed a detailed process in several steps for reviewing power uprate cases, and to issue the necessary permits after the initial approval by the Government.

Table 8.

N/A

2.3.2. Project management

N/A

2.3.3. Project funding

N/A

2.3.4. Electric grid development

N/A

2.3.5. Site Selection

N/A

2.4. Organizations involved in construction of NPPs

N/A

2.5. Organizations involved in operation of NPPs

The operators and some of the owners of Swedish nuclear power plants are shown in Figure 2. Some additional information about the power utilities is given in Table 7 and 7.1. It should be mentioned that all the operators are relatively independent of their parent organisations when it comes to technical capability.

The Swedish nuclear power plant operators jointly own the following support organisations:

- Nuclear Safety and Training Ltd (Kärnsäkerhet och Utbildning AB - KSU AB) provides operational training, including simulator training, on a contracting basis, for all Swedish nuclear power plants. KSU also analyses international operational experience and provides the results to the Swedish operators. In addition, KSU publishes regular reports about operational experience from Sweden and provides other energy- and nuclear-related information to politicians and decision makers.
- Swedish Qualification Centre (SQC) is a company for independent qualification of NDT systems to be used by NDT-companies in Swedish nuclear power plants.

- ERFATOM is a co-operation between the Swedish and Finnish BWR operators and Westinghouse Electric AB (former ABB Atom), to carry out experience feedback analysis of events at Swedish and Finnish BWRs.
- Swedish Nuclear Fuel and Waste Management Company (Svensk Kärnbränslehantering AB - SKB) is a company jointly owned by the nuclear power companies for management and disposal of spent nuclear fuel and radioactive waste. SKB owns and operates the facility for intermediate storage of spent fuel (CLAB) in Oskarshamn, and the repository for low- and medium-level waste (SFR) in Forsmark. SKB is also responsible for the R&D work in connection with developing a technical concept and siting for a repository for the spent fuel, including the Äspö Hard Rock Laboratory.

2.6. Organizations involved in decommissioning of NPPs

N/A

2.7. Fuel cycle including waste management

Swedish utilities meet all their needs for uranium and enrichment services through imports. Westinghouse (previously ABB Atom) manufactures reactor fuel both for BWRs and PWRs. Half of its deliveries are to utilities abroad. The Swedish utilities buy part of their fuel elements from abroad.

Studsvik Nuclear AB is still an important contractor for materials testing and nuclear fuel investigations. The materials testing reactors have been shut down, but there is a co-operation with the Halden reactor in Norway. A hot cell laboratory is also maintained. Studsvik is also expanding its business in the decommissioning and waste treatment fields.

Waste management practices in Sweden currently include the repository for radioactive operational waste (SFR), shallow land burials, the intermediate storage for spent fuel (CLAB), the transportation system and clearance. All facilities for waste and spent fuel management, unless part of a nuclear power plant or the Studsvik facility, are owned and operated by SKB.

SFR is a repository for short-lived radioactive waste resulting from the operation of Swedish nuclear reactors. In addition, small amounts of radioactive waste from hospitals, research institutions and industry are disposed of in SFR-1. SFR-1 consists of four rock caverns and a silo. The facility is situated at a depth of 50 m, in bedrock 5 m under the Baltic Sea level. Construction started in 1983, and the facility was taken into operation in 1988. The total capacity is 63,000 m^3. By the end of 2006, a total volume of 31,250 m^3 had been used. The nuclear power plants at Ringhals, Forsmark and Oskarshamn, as well as the Studsvik site, have shallow land burials for short-lived, very low-level waste (< 300 kBq/kg). Each of these burials is licensed for a total activity of 100-200 GBq (the highest allowed level according to the legislation is 10 TBq, of which a maximum of 10 GBq may consist of alpha-active substances).

Spent nuclear fuel from all Swedish nuclear power reactors is stored in a central interim storage (CLAB), situated close to the Oskarshamn nuclear power plant. The fuel is stored in water pools in rock caverns in the bedrock, at a depth of 25 m.

Construction started in 1980, and it was taken into operation in 1985. The original total storage capacity was 5,000 tonnes of spent fuel. CLAB has recently been expanded with a second rock cavern and water pool. The capacity after the expansion will be sufficient for storing all spent fuel from the nuclear power reactors, approximately 8,000 tonnes. All transportation of spent nuclear fuel and nuclear waste is by sea, since all the nuclear facilities are situated at the coast. The transportation system has been in operation since 1982, and consists of the ship M/S Sigyn, transport casks and containers, and terminal vehicles for loading and unloading.

Four major facilities remain to be designed, sited, constructed and licensed. Namely, a plant for the encapsulation of spent nuclear fuel, a final repository for spent fuel, a repository for long-lived low- and intermediate-level waste, and a repository for waste from decommissioning and dismantling the nuclear power plants. An application for the encapsulation plant was submitted by SKB in 2006.

The development work for the final repository of spent fuel has continued according to plans. In June 2009, SKB decided that an application for a repository for spent nuclear fuel will be based on the premise that the repository will be constructed in the municipality of Östhammar, close to the Forsmark site. An application to construct the repository was expected in March 2011.

Financing of decommissioning and waste disposal

The holder of a license for a nuclear facility which generates or has generated residual products must pay a fee to the Nuclear Waste Fund, to cover the licensee’s share of the total costs for the management and disposal of spent nuclear fuel and/or nuclear waste. The regulatory authority (in this case SSM) appointed by the Government reviews the cost calculations and submits a proposal for the size of the fees to the Government. The size of the fee is decided by the Government for a period of three years, and is individual to each utility. The purpose of the Fund is to cover all expenses incurred for the safe handling and disposal of spent nuclear fuel, as well as dismantling nuclear facilities and disposing of the decommissioning waste. The Fund must also finance SKB’s R&D.

2.8. Research and development

2.8.1. R&D organizations

Most of the research and development in the field of nuclear safety is directed by the SSM and the nuclear power operators. It is performed at universities, Westinghouse Electric Sweden, Studsvik, at the Vattenfall central laboratory in Älvkarleby and at other research institutes, both at home and abroad.

Research to support nuclear safety supervision is focused on a number of strategic areas, such as safety assessment, safety analysis, reactor technology, material and fuel questions, human factors, emergency preparedness and non-proliferation.

To fulfil these research needs, SSM contracts universities and consulting companies, with a dominant share going to research organisations in Sweden. However, since national resources are limited, Sweden has, for a long time, actively participated in international research. There has been a clear trend for many years of increasing levels of international co-operation,, also for safety research. SSM is prioritising co-operation on research conducted in the OECD/NEA, and is participating in a large number of projects organised within this framework. An example is the Halden Project in Norway, which conducts research of importance for fuel, materials and human factors. An example of an OECD/NEA international project performed in Sweden is the fuel project SCIP (Studsvik Cladding Integrity Project). Since Sweden joined the EU, the importance of joint European work has increased. SSM is itself actively participating and supporting Swedish organisations participating in European Commission projects, and intends to support such projects in the future. Furthermore, in the safeguards area, important joint work is performed in ESARDA (European Safeguards Research and Development Association).

In the field of radiation protection, SSM supports research within radioecology, radiation protection of power plant workers, emergency preparedness, nuclear waste matters, and questions related to risk perception and acceptance of waste disposal. About 25% of the radiation protection research budget is used for non-nuclear research, i.e. medical and technical applications and uses of radiation, and for non-ionising radiation (UV, electromagnetic fields). Newly-allocated research funds will be used to finance advanced research positions in radiation biology, radiation dosimetry, and radioecology at universities. The primary focus is to maintain competence in radiation protection. Part of the new funds will also be used to give research grants after application.

SKB is conducting a large research programme for developing methods for safe disposal of spent fuel. The research programme is conducted in collaboration with universities, institutes of technology and research institutions, both in Sweden and abroad.

2.8.2. Development of advanced nuclear technologies

No planning or research is currently performed regarding new nuclear power plants in Sweden.

2.8.3. International co-operation and initiatives

The international nuclear safety co-operation has a large and increasing volume. SSM is involved in about 140 international groups at different levels. Most of the reactor-safety co-operation takes place within the frameworks of IAEA, OECD/NEA and EU, but also occurs in connection with the international conventions ratified by Sweden and within associations such as the Western European Nuclear Regulators' Association (WENRA) and the International Nuclear Regulators' Association (INRA). In addition to these multilateral contexts, SSM has bilateral agreements with a number of countries to exchange information and to co-operate on technical issues as agreed. Sweden has a relatively high profile in the international technical groups. SSM considers active international involvement to be important for the quality of the national safety and radiation protection work, as well as to contribute to the development of international standards and the international knowledge base. In the field of radiation protection, Sweden has been active for many years in the International Commission on Radiological Protection (ICRP) and in working groups of NEA, IAEA and the EU. International agreements exist with authorities and technical support bodies in Europe and Asia as well as in the US, in areas such as emergency preparedness, occupational exposure, environmental radiological protection and radioactive waste management. Sweden is also a member of ISOE (Information System on Occupational Exposure).

The Swedish utilities are involved in international co-operation through membership in WANO, in owners group associations of the major European and US vendors, and by participation in the European Utilities Requirements project, IAEA activities, and various task forces representing most of the disciplines in nuclear facilities.
KSU analyses and evaluates operating experience gained at other nuclear power plants worldwide which can benefit the operation of the Swedish plants. KSU is also the main communication channel between the Swedish utilities and WANO.
SKB has a broad network of international contacts. Formal co-operation agreements exist with the following organizations:

- CEC/EURATOM EU
- TVO/IVO Finland
- CEA/ANDRA France
- JNFL Japan
- AECL Canada
- Nagra Switzerland
- USDOE USA

The following organizations have signed agreements of participation with SKB in the Äspö Hard Rock Laboratory project: Atomic Energy of Canada Limited (AECL), Power Reactor & Nuclear Fuel Development Corporation (PNC) of Japan, Central Research Institute of Electric Power Industry (CRIEPI) of Japan, ANDRA of France, TVO of Finland, NIREX of UK, USDOE and Nagra of Switzerland.

2.9. Human resources development

The academic education in nuclear technology in Sweden is mainly concentrated at the Royal Institute of Technology in Stockholm (KTH), Chalmers University of Technology in Gothenburg (CTH) and Uppsala University (UU). At KTH, the Swedish Centre of Nuclear Technology has existed since 1992. Having once been oriented mainly towards KTH and support of doctoral students, the Centre now aims also to support professor and lecturer posts and post-graduate education in the nuclear field at the three universities mentioned above.

Twelve professorships (of which one is currently vacant), with a specific nuclear technology or human factors profile, and eighteen lectureships exist in Sweden for higher nuclear education and research. The latter number has increased significantly during the last two years due to three reasons. First, a new bachelors' level nuclear education has started at Uppsala University, with strong financial support from the nuclear power plants. Second, a large grant on Generation-IV research was approved at the end of 2009, which has generated resources for additional positions. Third, three new positions have been created with industry support. About 300 students per year have attended the nuclear courses at the mentioned universities over the last years, and an additional increase will take place in

2012-13, due to a large new collaboration project with France on development of future nuclear technology.

Recently, the former nuclear power plant Barsebäck has been converted to a training facility for nuclear industry staff. At this site, personnel can be trained in repair and maintenance work, for example, under realistic technical conditions but with low ambient radiation.

Sweden has taken a systematic approach to maintaining basic academic resources for higher nuclear education and research. This is done by an agreement between the Swedish nuclear industry and SSM to support the Swedish Centre of Nuclear Technology economically during several years. The present agreement is valid for the years 2008-2013. An assessment of the present agreement was undertaken in 2009, resulting in a very positive report.

2.10. Stakeholder Communication

Stakeholder communication is an essential part of the work within the nuclear sector in Sweden. Openness and transparency are keywords.

Within each region where there are nuclear power plants, there are Local Liaison Safety Committees. These committees gather information on safety related issues from the owner of the facility and make that information available to the public. The government appoints the members of each committee based on proposals from the municipalities involved.

There are different levels of stakeholder communication in the Swedish nuclear waste management program. The formal consultation process has been one way for the industry (the Swedish Nuclear Fuel and Waste Management Company, SKB) to communicate with representatives from the two municipalities (Oskarshamn and Östhammar), the Swedish Radiation Safety Authority (SSM) and NGOs.

Another level of stakeholder communication is managed by the Swedish National Council for Nuclear Waste and their transparency programme. Within the framework of this programme, the Council have regular meetings with all central stakeholders. One objective for these meetings is to discuss what issues each of the stakeholders finds to be most important. Other activities within the transparency programme are seminars and hearings, which provide an opportunity for more in-depth discussions of specific topics.

It should also be pointed out that the Swedish Radiation Safety Authority (SSM) also has ways of interacting and communicating with stakeholders.

As with all governmental authorities in Sweden, openness and transparency towards the public are important tasks for the Swedish Radiation Safety Authority. According to the communication policy of SSM:

- the authority shall be available and provide a good service to media, the public and professionals,
- information shall be proactive and fast,
- information shall be fact based, correct and unbiased,

- the communication process shall be an integrated part of SSM's activities,
- management has the overall responsibility for communication,
- experts are responsible for information within their professional areas,
- all information activities shall be coordinated with the Department of Communication.

The Department of Communication at SSM currently has seven professional communicators. SSM makes extensive use of its website, and publishes a lot of information material.

3. NATIONAL LAWS AND REGULATIONS

3.1. Regulatory framework

3.1.1. Regulatory authority(s)

Since 1 July 2008, Sweden has a new and integrated regulatory body for nuclear safety and radiation protection, the Swedish Radiation Safety Authority (SSM). SSM is a merger of the two earlier regulatory bodies, the Swedish Nuclear Power Inspectorate (SKI) and the Radiation Protection Authority (SSI). SSM has taken over all the missions and tasks of the two earlier authorities. The main motive for the merger was the Government's general ambition to make civil service more efficient by reducing the number of authorities, but also to enhance and reinforce the supervision of both nuclear- and non-nuclear activities with radiation.

SSM has a staff of approximately 270, and is organised under a Director General in three main departments (Nuclear Power Plant Safety, Radioactive Materials and Radiation Protection) and the Secretariat for International Co-operation and Development.

SSM is financed through the state budget, but about 70% of the SSM budget is recovered from licensees by fees of different kinds, and 30% is covered by taxes. 95% of the fees are collected from nuclear facilities, while the remaining part is collected from hospitals and industry with activities falling under the Radiation Protection Act. Standard fees are regulated in an Ordinance (2008:463) about certain fees to the Radiation Safety Authority: A reactor in operation has to pay about 26 MSEK per year for regulatory supervision, research, emergency preparedness and non-proliferation.

SSM's roles and responsibilities are defined in the Ordinance 2008:452, amended 2009:949, with instruction for the Swedish Radiation Safety Authority. The Ordinance states that SSM is the central administrative authority for issues dealing with protection of people and the environment against harmful effects of ionising and non-ionising radiation, safety of nuclear activities and nuclear non-proliferation. Hence, the area of responsibility includes regulation of all areas of nuclear activity in Sweden, including physical protection and transport issues. Generally, the authority shall actively promote improved radiation safety in society and work to:

- prevent radiological accidents and ensure radiation-safe operation and waste handling within nuclear activities
- minimize risks and optimize effects of medical exposures

- minimize risks of occupational exposures
- minimize risks of exposures from naturally-occurring sources
- improve radiation safety internationally

SSM is mandated to issue legally binding regulations within its activity areas. In addition, the following more-detailed tasks are mentioned in the Ordinance:

- handle certain financial issues with regard to future costs for residual products from nuclear activities and liaison with the Nuclear Waste Fund,
- responsibility for the national metrology laboratory for ionising radiation,
- administer the national dose register and issue dose passports,
- contribute to development of national competence within the activity area,
- provide information to the public within the activity area,
- handle international issues within the activity area,
- co-ordinate national emergency preparedness within the activity area,
- provide advice on radiation protection and decontamination in cases of emergency,
- maintain and manage a national expert organisation in cases of emergency,
- provide technical advice to responsible authorities for protective actions in cases of emergency

SSM is further involved in international development co-operation with Russia, Ukraine, Georgia and Armenia.

SSM reports to the Government through the Ministry of Environment.

3.1.2. Licensing Process

The Act (1984:3) on Nuclear Activities includes the basic legal requirements for licensing, and the legal sanctions to be imposed on anyone who conducts nuclear activities without a license. For major installations and activities, the license is granted by the Government upon a written recommendation from the regulatory body. An application for a permit to construct, possess or operate a nuclear installation shall, along with the particular documents concerning construction and nuclear safety, contain an Environmental Impact Assessment (EIA). Procedures regarding the EIA are laid down in the Environmental Code. These provisions are also applicable in the licensing procedures according to the Act on Nuclear Activities. The EIA aims to facilitate an overall assessment of the planned operation's effects on the environment, health and management of natural resources, thus providing a better basis for the decision.

SSM is given the mandate to decide upon license conditions for nuclear safety and radiation protection. Previously, this mandate was given by the Government in every particular license, but according to a legal amendment on 1 July 2006, SSM now has a continuous and general mandate to decide such conditions for all sorts of licenses issued under the Act on Nuclear Activities.

For all the existing Swedish nuclear power plants, the licenses are valid without time limit, although licensing conditions can be limited in time and function as control stations. If the licensee complies with all legally-binding safety requirements, a prolongation of the license cannot be denied in principle.

If a licensee fails to comply with conditions attached to the license or with safety obligations arising in any other manner under the Act on Nuclear Activities, the Government or the regulatory body has the authority to revoke the license altogether. The decision lies with the authority that has issued the particular license. Revoking a license for other reasons than safety, as in the Barsebäck 1 and 2 cases, requires a special law.

There is a legally binding requirement to conduct a periodic safety review of every major nuclear installation every 10 years of operation. The purpose of this review and its regulatory assessment is to determine whether the installation still complies with all regulations and licensing conditions, and that safety is developing as required. SSM regards the periodic safety reviews as time-limited licensing conditions.

For these reasons, the concept of "Lifetime Extension" has no formal meaning in Sweden. The expression "40 years technical lifetime" is used in a non-formal way, mostly by the licensees in their long-term planning. The plants will be made fit for 40 years operation and beyond. The background of this expression is the assumption that on-going and planned modernisations increase the technical lifetime of the plants. Originally, when designing the plants, 40 years was an assumed technical lifetime, "guaranteed" with large margins for the major passive structures and components. Today, based on international operational experience, technical lifetime for similar rector designs is expected to be 50 to 60 years.

3.2. Main national laws and regulations in nuclear power

The following five Acts constitute the basic nuclear legislation of Sweden:

- The Act (1984:3) on Nuclear Activities
- The Radiation Protection Act (1988:220)
- The Environmental Code (1998:808)
- The Act (2006:647) on Financing of the Management of Residual Products from Nuclear Activities
- The Nuclear Liability Act (1968:45)

With exception of the Nuclear Liability Act, all Acts are supplemented by a number of ordinances and other secondary legislation, which contain more detailed provisions for particular aspects of the regime.

Operation of a nuclear facility can only be conducted in accordance with a license issued under the Act on Nuclear Activities and a license issued under the Environmental Code. Thus, operation of a nuclear facility requires two separate licenses.

The Act on Nuclear Activities is mainly concerned with issues of safety and security, while the Environmental Code is focused on the general environmental aspects and impacts of environmentally hazardous activities as to which Nuclear Activities are defined.

The Act on Radiation Protection aims to protect people, animals and the environment from the harmful effects of radiation. The Act is of particular importance with regards to the protection of employees involved in radiological operations.

The Act on Financing of the Management of Residual Products from Nuclear Activities contains provisions concerning the future costs of spent fuel disposal, decommissioning of reactors and research in the field of nuclear waste. Means for that purpose have to be available when needed.

The Nuclear Liability Act implements Sweden's obligations as a Party to the 1960 Paris Convention on Third Party Liability in the Field of Nuclear Energy and to the 1963 Brussels Convention Supplementary to the Paris Convention.

Other relevant Acts are the Act on Control of Export of Dual-Use Products and Technical Assistance (2000:1064) and the Act on Inspections according to International Agreements on Non-proliferation of Nuclear weapons (2000:140). Emergency-preparedness matters are regulated by a separate Act (2003:778) and Ordinance (2003:789) on Protection Against Accidents with serious potential consequences for human health and the environment. Specific security matters are regulated by the Act (1990:217) on Protection of Important Facilities, and the Act (1996:627) on Security Protection.

After the formation of SSM, a new series of regulations, SSMFS, was created. In this series, all regulations formerly issued by SKI and SSI have been re-issued as SSM regulations. There are now about 50 such regulations in force, issued in 2010 (see: www.ssm.se). Also as a consequence of the formation of SSM, the Government has appointed a special investigator to review and propose changes to the Act on Nuclear Activities and the Radiation Protection Act, with a possible objective of merging the two acts and introducing the concept of Radiation Safety into the legislation. Decisions by the Parliament about this are expected in 2012.

The management of the Nuclear Waste Fund is the responsibility of a separate governmental agency, the Nuclear Waste Fund.

References

Sweden’s Fourth National Report under the Convention on Nuclear Safety. Ds 2007:30. Ministry of the Environment, Sweden 2007.

www.ssm.se

Appendix 1: International, Multilateral and Bilateral Agreements

INTERNATIONAL (MULTILATERAL AND BILATERAL) AGREEMENTS:

AGREEMENTS WITH THE IAEA

Amendments of Article VI & XIV.A of the	Ratified:	13 July 2001

IAEA statute		
EURATOM/IAEA NPT related safeguards agreement INFCIRC/193	Entry into force:	1 June 1995
Additional Protocol (GOV/1998/28)	Signature:	22 Sept.1998
Agreement on privileges and immunities	Entry into force:	8 Sept. 1961

OTHER RELEVANT INTERNATIONAL TREATIES ETC.

NPT	Entry into force:	9 Jan. 1970
Convention on physical protection of nuclear material	Entry into force:	8 Feb. 1987
Convention on early notification of a nuclear accident	Entry into force:	30 March 1987
Convention on assistance in the case of a nuclear accident or radiological emergency	Entry into force:	25 July 1992
Convention on Third Party Liability in the Field of Nuclear Energy (Paris Convention)	Entry into force:	1 April 1968
Convention supplementary to the Paris Convention (Brussels Convention)	Entry into force:	1 April 1968
Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention	Entry into force:	1 Jan. 1992

(Convention to amend the Vienna Convention on Civil Liability for Nuclear Damage is not a relevant treaty for Sweden, for the reason that Sweden is a Party to the Paris Convention.)

Convention on nuclear safety	Entry into force:	24 Oct. 1996
Joint convention on the safety of spent fuel management and on the safety of radioactive waste management	Entry into force:	18 June 2001
ZANGGER Committee	Member	
Nuclear Export Guidelines	Adopted	
Acceptance of NUSS Codes		

Summary: Codes well suited for national safety rules. Compatible with Swedish law and other rules.	12 June 1990	
Nuclear Suppliers Group	Member	
EURATOM treaty	Member State:	1995

MULTILATERAL AGREEMENTS

Exchange of ministerial notes between Sweden, Denmark, Finland and Norway about guiding principles for contacts about nuclear safety concerning nuclear plants at the borders between Denmark, Finland, Norway and Sweden. (SÖ 1977:48).

The Swedish Radiation Safety Authority participates in the following regulatory networks:

- Western European Nuclear Regulators' Association
- International Nuclear Regulators' Association
- European Nuclear Security Regulators' Association
- Heads of European Radiation Control Authorities

Sweden is also a Member of the Nuclear Energy Agency of the OECD and participates in all NEA Committees and most of the Working Groups.

BILATERAL AGREEMENTS

The Swedish Government has bilateral agreements with the following countries on early notification, information exchange and co-operation within the area of nuclear safety: Denmark, Finland, Norway, Russian Federation and Germany.

The Swedish Radiation Safety Authority has bilateral agreements on exchange of information and co-operation with the safety authorities of the following countries: Ukraine, USA, Russian Federation, Germany, Lithuania and South Africa,

Safeguards agreements exist with: Australia, Canada and Germany.

Appendix 2: main organizations, institutions and companies involved in nuclear power related activities

Not provided

Name of report coordinator: Stefan Appelgren
Institution: Ministry of the Environment
Contact: Stefan.apwpelgren@environment.ministry.se, +46 8 405 31 38