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Energy Opinion in Sweden
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April 2008

Swedish Nuclear Power Policy

A Compilation of Public Record Material

SOM-INSTITUTET
samhälle opinion massmedia
GÖTEBORGS UNIVERSITET

Energimyndigheten

History

Nuclear Power

"In Sweden, nuclear technology started in 1947, when AB Atomenergi was constituted to carry out a development programme decided by the Parliament. As a result, the first research reactor went critical in 1954. This was followed by the first prototype nuclear power plant (PHWR) Ågesta located to 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 plant 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 9 BWRs (ASEA-ATOM design) and 3 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 on economical grounds, the licences had recently been extended until 2014, subject to certain conditions. The reactors were mainly used for commercial materials testing purposes, isotope production, neutron source for research purposes, medical applications and higher education. They are currently under decommissioning." **(From DS 2007:30:11-12)**

"Nuclear policy was the major domestic policy issue during the mid and late1970s. It acted like a lightning rod for much of the political opposition, and brought an end to nearly forty years of uninterrupted Social Democrat governments. However, the most powerful industrial organisations have been strongly supportive of nuclear power.

Nuclear investments were started as a part of a weapons project [Larsson, 1985]. The process continued with industrial ambitions, but as the cost of nuclear power was far higher than electricity prices, the nuclear power project became a not only environmental and political problem but also an economic problem to the owners during the last 15 years of the 20th century [Johansson, 1986; Jasper, 1990; Kaijser, 1992].

As a political problem, the nuclear power issue could not be resolved in the parliamentary process, as parties were divided. Instead, a national referendum on nuclear power was held in March 1980. The wordings of the referendum ballot options were ambiguous, to say the least, although unwritten meanings were well understood by the voters. There were three alternatives to vote on. All of them stated that nuclear power should be decommissioned. The winning alternative stated a maximum of twelve reactors should be built and all of them should be closed. According to a plan published by the campaign, all reactors should be closed within an estimated twenty-five years of operation.

The following is an attempt to outline some of the economic interests and rationalities that influenced nuclear power policy in Sweden. However, there is also an attempt to describe a framework for market economy in the energy sector that may serve a socio-economical purpose. Such policy options are described in the latter part of the text". **(From Kåberger, 2007:226)**

"In 1995 the electricity market was re-regulated in order to introduce competition between producers. The result of the reform was a visible and falling electricity price. From 1998 to 2000, the price was around 0,12 SEK/kWh. The production costs reported by reactor companies were all well above the market price. With the newest reactors this was due to remaining capital costs, but the oldest reactors were not even able to cover avoidable costs at market price.

In 1997 a negotiated parliamentary majority made the decision to close one of the oldest reactors, Barsebäck I, and pay compensation to the owner, Sydkraft. At the same time the decision to close all reactors after 25 years of operation was revoked. The second reactor at Barsebäck would be closed when renewable electricity and efficiency improvements would have compensated the loss of the capacity of the first. In the days following the decision share values of all power companies increased, but the value of Sydkraft increased more than the others [Kåberger, 1997].

In the economic settlement that followed, taxpayers paid more than USD 1 billion to the reactor owners.

To understand the political success of this settlement we must see how the decision affected the interested parties: The power companies only profited. One of several reactors that had avoidable costs far above the electricity price was closed. No power company lost anything due to the deal. All electricity producers expected to benefit from a marginally increasing electricity price. The nuclear power companies won. The decision to close all reactors at 25 years of age was removed and, most important, they where given compensation for closing reactors (even for the first oldest reactor with avoidable costs above market price).

Shortly afterwards the vice minister for energy who handled the decision, Peter Nygårds, was given the job of managing director of SKB, a waste management company owned by the Swedish nuclear reactor owners. This appointment indicates that the power industry was at least not disappointed by the political settlement.

The power intensive industry may have disliked the risk of a short term marginal price increase due to reduced over-capacity. However with the integrated electricity market including more countries than Sweden, the effect of closing one minor reactor was small. Revoking the decision to close all the other reactors after 25 years of operation was more important. The capacity loss would have been large enough in relation to transmission capacity in northern Europe to have an effect on prices in Sweden.

Many active nuclear opponents celebrated that the decommissioning started, and in political rhetoric statements, government spokesmen made successful efforts to support this image of the deal.

The taxpayers who had to pay the compensation to the reactor owners are a large number of individuals, who each lost a moderate sum of money. Such an interest is difficult to organise enough to even understand, and less to be able to defend their interests.

Barsebäck I was closed in 1999. In order to continue the decommissioning of the other reactor at Barsebäck, electricity production of the first reactor was to be substituted by renewable supply or improved efficiency. This was achieved in a few years." **(From Kåberger, 2007:230-231)**

"Consequently, Barsebäck II was closed in 2005. A similar compensation arrangement to the owner was applied.

The remaining nuclear power plants, comprising 10 reactors in total, are currently in operation. No further decisions have been made on continued decommissioning. The present government has explicitly stated that no decisions will be taken during their term in office.

Partly due to carbon emission constraints, electricity prices have increase in Europe. As a result nuclear power plants are no longer an economic burden on the owners. The owners are instead investing in modernisation of the plants and some have been allowed to increase their generating power. If all plans are carried out, the increased power of the remaining reactors may be as large as the capacity lost when the two small Barsebäck reactors were closed.

This appears to be economically rational. One may see the operation costs of the older and smaller reactors as to high too justify continued operation, while the newer and larger ones were too expensive to build but possible to operate with defensible operating costs. New reactors are not profitable investments, but a marginal increase in the best existing reactors may appear profitable.

So the decision by the political leadership to close Barsebäcks reactors may appear economically rational in a narrow sense. But there are other relevant factors.

Barsebäck is situated near Sweden's third largest city, Malmö, and just across the Öresund straight from København, the capital of neighbouring Denmark. A reactor accident in Barsebäck could have greater economic and social consequences than around other Swedish nuclear plants situated further away from large population centres.

Secondly, Barsebäck staff showed safety related behaviour that raised concerns from the safety authority for many years.

While no other nuclear power plant in Sweden is as badly located, another plant is beginning to catch attention for similar problems with safety culture among its staff. Forsmark nuclear power plant that used to be seen as the best performing nuclear plant is under investigation for illegal breaking of safety regulation. The plant is now under special surveillance by the authority, and one reactor has been closed for safety reasons". **(From Kåberger, 2007:232)**

Nuclear Waste

"No formal requirements for the management of spent fuel and radioactive waste were established in Sweden until the late 1970's.

In the mid-1990's SKI and SSI initiated a joint study with the objective to understand past practices regarding management of radioactive waste better. This knowledge is important to allow for the proper and safe conditioning and disposal of old waste still in storage.

The study focused on the management of radioactive waste containing plutonium from research activities. Activities that generated plutonium-containing waste have been identified as well as the treatment, storage, and in certain cases, dumping at sea of the waste produced. Sea dumping occurred in Swedish territorial waters as well as in the Atlantic. The last dumping occurred at the end of the 1960's. Since 1971 sea dumping is prohibited in Sweden.

Early activities that generated most of the spent fuel and radioactive waste in Sweden are:
- R1 (the first research reactor, 1954 - 1970),
- Studsvik (an institute established for the Swedish nuclear programme with research reactors, 1958 -),
- Ågesta (the first power reactor in Sweden, 1964 - 1974).

Early waste management at the nuclear power plants

Swedish policy was originally based on the assumption that reprocessing and plutonium recycling would form attractive and desirable elements of the nuclear fuel cycle. However, the construction of a reprocessing plant in Sweden was not envisaged. As commercial NPPs were built arrangements were made therefore to send the spent nuclear fuel abroad for reprocessing. During the late 1970's attitudes changed, and reprocessing was, for various reasons, not considered an acceptable method for the management of spent nuclear fuel. The current policy regarding the management of spent nuclear fuel was established in the late 1970's, and aims at direct disposal without reprocessing.

Reprocessing

In 1969 the Swedish nuclear power company, OKG, signed a contract with the United Kingdom Atomic Energy Agency, which was later taken over by The British Nuclear Fuel Limited (BNFL), for the reprocessing of spent nuclear fuel from OKG in Windscale (later Sellafield). In all 140 tons of fuel was shipped to Sellafield between 1972 and 1982. The fuel was reprocessed in 1997 and resulted in 136 tons of uranium and 833 kilograms of plutonium. OKG's plans to manufacture and use about 100 MOX-fuel elements.

Between 1978 and 1982 an agreement was made between the Swedish Nuclear Fuel Supply Company (SKBF later renamed SKB) and Compagnie Générale des Matières Nucléaires (COGEMA) regarding the reprocessing of 672 tons of spent nuclear fuel from the Barsebäck, Ringhals and Forsmark sites (Swedish nuclear power companies). A total of 55 tons was shipped to La Hague before the contracts were cancelled. The fuel was then exchanged for 24 tons of used MOX-fuel from Germany. The exchange meant that Sweden did not have to build a repository for vitrified waste and Germany did not have to build a repository for used MOX-fuel. The used MOX-fuel from Germany is now stored in the CLAB facility.

The nuclear weapons programme

As early as the middle of August 1945, Sweden decided to evaluate the then new situation regarding atomic weapons. The main aim of the research was to find out how Sweden could best protect itself against a nuclear weapon attack. However, from the outset there was an interest in investigating the possibilities of manufacturing nuclear weapon. In 1968, the Swedish government signed the Non-Proliferation Treaty and the plans to acquire nuclear weapons were abandoned.

The development of the waste management programme

In 1973 the Government appointed a committee (Committee on Radioactive Waste) to investigate the problem of handling high-level waste from nuclear power plants. The report from the committee was submitted in 1976 and has to a great extent influenced subsequent developments.

The main findings of the committee were:
- Reprocessing of spent fuel was recommended, with disposal of glass or ceramic solidification of the high-level waste in bedrock, but
- Further studies should be carried out to clarify the conditions for a non-reprocessing scheme, i.e. direct disposal in bedrock
- A central storage facility for spent fuel should be established
- A central repository for low- and medium level radioactive waste should be established

In the mid-1970's the Parliament promulgated the "Conditional Act", which required a government permit to load nuclear fuel into a new reactor. A permit could be issued if the utility presented either an agreement for reprocessing of the spent fuel, or a plan for the completely safe disposal of the high radioactive waste. This meant that direct disposal of the spent fuel could be accepted.

As a result of the "Conditional Act" the nuclear industry initiated a joint project on nuclear fuel safety (KBS). This included a wide-ranging programme of geological site surveys for the purpose of identifying suitable bedrock sites for the disposal of highly radioactive waste.

The first summary report of the KBS project (KBS-l) was published in 1977. This described a method for the disposal of high-activity reprocessed vitrified waste. The report formed the basis for the subsequent permission (in 1979 - 80) to load fuel into a number of reactors.

A second summary report (KBS-2) dealing with the disposal of spent non-reprocessed nuclear fuel was issued in 1978. The work initiated by KBS continued on a long-term basis, and a completely revised version of the second report (KBS-3) was published in 1983.

Since 1986 SKB has produced five R&D programmes with KBS-3 as the main alternative for the disposal of spent fuel. At present SKB is conducting site investigations in two municipalities. The authorities are engaged in the Environmental Impact Assessment (EIA) in connection with this siting". **(From Ds 2003:20:20-22)**.

Nuclear Power Policy

"The electrical power consumption in Sweden was about 146 TWh 2006 as compared with 148 TWh 2005 and 145 TWh in 2003.[1] The total electrical power production was 139,8 TWh 2006 and 154,7 TWh 2005, which meant that Sweden had to shift from power exports 2005 to power imports 2006. The 2006 nuclear power production was 64,7 TWh, down from 69,5 TWh 2005 depending on forced outages of Forsmark 1 and other units. The 2006 hydropower production was 61,2 TWh down from 72 TWh 2005 depending on a very hot summer and low water levels in the reservoirs until the last quarter of the year. Fossil- and bio fuel power production amounted to about 13 TWh. Wind power production was 0,99 TWh a steady increase over the last years. 2005 Sweden had 770 major wind power plants in operation and several new wind power parks under planning. In a normal year, hydropower and nuclear power deliver over 90% of the total electrical production with about equal shares. The renewable sources bio- and wind power, which are favoured by the taxation system, are slowly gaining larger production shares.

Since 1996 the electrical power market has been deregulated and competitive in principle for both the production and sale of electricity. The national high voltage grid is managed by a state company: Svenska Kraftnät. Regional and local grids are operated by various grid companies as regulated monopolies. A Nordic marketplace "Nord Pool" has been created for the electricity trade. Spot market prises have fluctuated considerably during the operational period of Nord Pool. The first years after deregulation prices fell to very low levels but the last years average prices have been higher, depending to a large extent on the availability of hydropower.

Political development of the Nuclear Power Issue

In 1997, the Act (1997:1320) on the Phasing-Out of Nuclear Power was adopted by Parliament. This Act authorises the Government to shut down a nuclear power reactor as a consequence of conversion of the energy system. The location, age, design and importance for the energy system of a particular reactor shall be considered when taking such a decision. The Act also includes provisions for reimbursement of the reactor owner, in the case a shut down decision is taken according to the Act.

Pursuant to the new Act, Barsebäck 1 was shut down on 30 November 1999 and Barsebäck 2 on 31 May 2005. The reactor owner Sydkraft AB was fully compensated by shares in the state owned utility Vattenfall. The Government decided 2006 to allow power uprates of Ringhals 1, Ringhals 3 and Oskarshamn 3. Except of this, no firm decisions have been taken about the future of the nuclear power programme in Sweden. The earlier time limit 2010 for decommissioning of the remaining units was revoked already in 1997 as a result of an energy policy agreement between the political parties. The present Government declared in their election programme 2006 that no more units will be considered for shut down and no decisions will be taken on new nuclear power during the election period ending 2010.

[1] *According to statistics from the organisation "Swedish Energy". The figures are corrected for the average outside temperature.*

Nuclear Power Installations in Sweden

At present, in May 2007, there are 10 nuclear power reactors in operation in Sweden as specified in Table 1. Three power reactors have been permanently shut down, namely Ågesta, Barsebäck 1 and Barsebäck 2.

Name	Licensed thermal power level MW[2]	Electrical gross output MW	Type	Operator	Construction start	Commercial operation
Power reactors						
Ågesta	105	12	PHWR	AB Atomenergi Vattenfall	1957	1964–1974[3]
Barsebäck 1	1800	615	BWR	Barsebäck Kraft AB	1970	1975–1999
Barsebäck 2	1800	615	BWR		1972	1977–2005
Forsmark 1	2928	1014	BWR	Forsmarks Kraftgrupp AB	1971	1980
Forsmark 2	2928	1014	BWR		1975	1981
Forsmark 3	3300	1190	BWR		1978	1985
Oskarshamn 1	1375	487	BWR	OKG Aktiebolag	1966	1972
Oskarshamn 2	1800	623	BWR		1969	1975
Oskarshamn 3	3300	1197	BWR		1980	1985
Ringhals 1	2540	880	BWR	Ringhals AB	1968	1976
Ringhals 2	2660	870	PWR		1969	1975
Ringhals 3	3000	1010	PWR		1972	1981
Ringhals 4	2783	915	PWR		1973	1983

Table 1. Nuclear power installations in Sweden. Main data.

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, by Westinghouse USA. Eight of the power reactors (including Barsebäck 1 and 2) were uprated during the period 1982–1989 between 6–10% from the original licensed power levels. The Government has recently approved further uprating of Ringhals 1, Ringhals 3, Oskarshamn 3. Uprating is planned for more reactors. In total this programme, including measures on the conventional side, will add 1275 MWe to the current generating capacity." **(From DS 2007:30:11-12)**

"**Nuclear facilities under decommissioning. Experience from past decommissioning activities**

Sweden has limited experience from decommissioning of nuclear facilities. It is limited to the decommissioning of the R1 research reactor and laboratories in Stockholm as well as some smaller test facilities and laboratories in Studsvik. The most relevant decommissioned facilities are listed below.

The research reactor R1, which was in operation between 1954 and 1970, was situated in a rock cavern in central Stockholm and was used for research and isotope production. The reactor was decommissioned between 1981 and 1983, and the site was released for unrestricted use in 1985. Virtually all waste was shipped to Studsvik. Exceptions were electric motors, handrails, stairways, etc, from non-classified areas that were released for unrestricted use. All waste and salvageable material produced at R1 was measured and registered. The measurements were nuclide-specific and were done using a gamma-ray spectrometer. The graphite from the reflector was packed in steel boxes and is temporary stored in the storage facility AM at Studsvik.

The research reactor R0, a "zero power" reactor in Studsvik, was a low power reactor, which was in operation between 1959 and 1968. The normal operational power was about 1 W, and the maximum power was 50 W. The reactor vessel was transferred to R2 (another reactor in Studsvik) for alternate usage. Some parts could not be decontaminated and were packed and stored in Studsvik. The concrete elements from the radiation shield were disposed of in a refuse disposal facility in Studsvik, since no activity could be measured.

The KRITZ-reactor was an experimental reactor in Studsvik with a maximum power of 100 W, used between 1969 and 1975. The reactor vessel was equipped with a radiation protection shield of lead. The lead protection could, after measurements, be released from regulatory control and was sold. The reactor vessel could also be released, except for an inner tank with induced activity, which was packed and stored at the Studsvik site.

The Alfa-laboratory in Studsvik was mainly used for studies on steel used in pressure vessels and on irradiated fuel cladding material. The work in the laboratory started in the beginning of the 1960's and the laboratory was in operation for about 25 years. The laboratory contained seven ventilated hot cells built of lead bricks. After decontamination some of the lead bricks and other components could be released from regulatory control, others were packed in special packages for interim storage. The building was released for unrestricted use in 1985.

The Van de Graaff laboratory in Studsvik was used for neutron physics experiments between 1962 and 1989. The building was not classified as a nuclear facility but later it was found to be contaminated with tritium. An extensive measuring program was performed to identify the contaminated material and surfaces. After decontamination the building was released from regulatory control and demolished in 1999. Three drums and one steel box with tritium contaminated waste is now stored in the interim storage, AM. Non-radioactive waste, classified as hazardous, was separated and transported to SAKAB, a company managing non-radioactive hazardous waste.

A general observation concerning the above activities is that – despite the lack of regulations regarding decommissioning – the activities were performed without any accidents, due to the knowledge about regulations on transport and handling, and experience from radiological work of the people involved.

Nuclear facilities currently under decommissioning

The nuclear power unit Barsebäck 1, which was closed in November 1999, was the first commercial nuclear power unit to be permanently taken out of operation in Sweden. The Government decided that the reactor should be shut down as part of the policy to phase out nuclear power in Sweden. All spent fuel has been transferred to the central interim storage for spent fuel (Clab). Already before the unit was shut down the regulatory authorities increased their control and review activities at the site to ensure that there would be no decline in the safety work. Detailed planning for decommissioning is underway and is being closely monitored by the regulatory bodies. The actual decommissioning work will not commence until the second unit at the site, Barsebäck 2, has also been permanently shut down. According to current plans, large scale dismantling and demolishing work will begin not sooner than 10–15 years from now.

The nuclear power unit Barsebäck 2 was finally shut down on May 31, 2005. As was the case for Barsebäck 1 the Government decided that the reactor should be shut down as part of the policy to phase out nuclear power in Sweden. SKI increased the monitoring activities at the site as soon as the Government announced its decision that the unit be closed down, and is closely following the developments at the site. Spent fuel will be stored in the fuel pool at the unit at least until the end of 2006 before being transported to Clab. According to current plans, large scale dismantling and demolishing work will begin not sooner than 10–15 years from now.

The Ågesta district heating nuclear power reactor (heavy water) was operated between 1964 and 1974 supplying parts of the Stockholm suburb Farsta with heated water. The reactor is now shut down in such a manner that it is not possible to start it up again. The fuel from the reactor has been transferred to Clab for interim storage. The heavy water has been removed and two, out of four, steam generators have been dismantled, but otherwise the facility is more or less intact. Detailed planning for its decommissioning is underway and is being closely monitored by the regulatory bodies.

The central active laboratory (ACL) in Studsvik was built between 1959 and 1963 with the purpose to be used as a research facility for reprocessing spent fuel. The activities in the laboratory ended in 1997, and had involved for example research on plutonium enriched fuel, plutonium analyses, material testing and test fabrication of rods with MOX-fuel. Cleaning and decontamination work was started after an extensive measurement program. According to the plans the remaining decommissioning work will be completed in 2006.

The tank and silo facility (TS) in Studsvik was constructed at an early stage, with the purpose of storing liquid and semi-liquid radioactive waste. The facility is now in the process of being decommissioned. The remaining parts consist of two concrete silos lined with ceramic tiles.

The research reactors R2 och R2-0 in Studsvik were finally shut down 15 June 2005. SKI increased the monitoring activities at the site as soon as Studsvik announced the decision to finally shut the research reactors down, and is closely following the developments at the site. The remaining spent nuclear fuel from the reactors will be returned to the United States".
(From Ds 2005:44:33-34)

Nuclear Waste Management

“Nuclear waste

The Swedish nuclear power programme, including the Studsvik facilities and the Westinghouse Electric Sweden AB fuel fabrication plant in Västerås, will generate approximately 19 000 m3 spent fuel, 60 000 m3 low and intermediate level waste (LILW), and 160 000 m3 decommissioning waste (based on 40-year operation of each reactor). The typical total annual production of LILW at the nuclear facilities is 1 000–1 500 m3.

Existing waste management practices are the repository for radioactive operational waste, SFR-1, shallow land burials, Clab, the transportation system and clearance.

SFR-1 is a repository for LILW 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 50 m depth, in the bedrock 5 m under the Baltic Sea level. Construction started in 1983 and it was taken into operation in 1988. The total capacity is 63 000 m3. By the end of 2006 a total volume of 31 250 m3 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).

The spent nuclear fuel from all Swedish nuclear power reactors is stored in a central interim storage (Clab) situated at the Oskarshamn nuclear power plant. The fuel is stored in water pools in rock caverns at 25 m depth in the bedrock. Construction started in 1980 and it was taken into operation in 1985. The current total storage capacity is 5 000 tonnes of spent fuel. 4 775 tonnes were being stored at the end of 2006. Clab is currently being 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. The commissioning of the extended part of the storage facility is delayed but is planned within the near future.

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. Although clearance is not a “facility” it is an important component in the waste management system. Material may be cleared for unrestricted use or for disposal as conventional non-radioactive waste. For example, in 2004 approximately 600 tonnes were cleared for disposal at municipal landfills. In addition 500 tonnes of scrap metal (< 500 Bq/kg) were cleared for recycling.

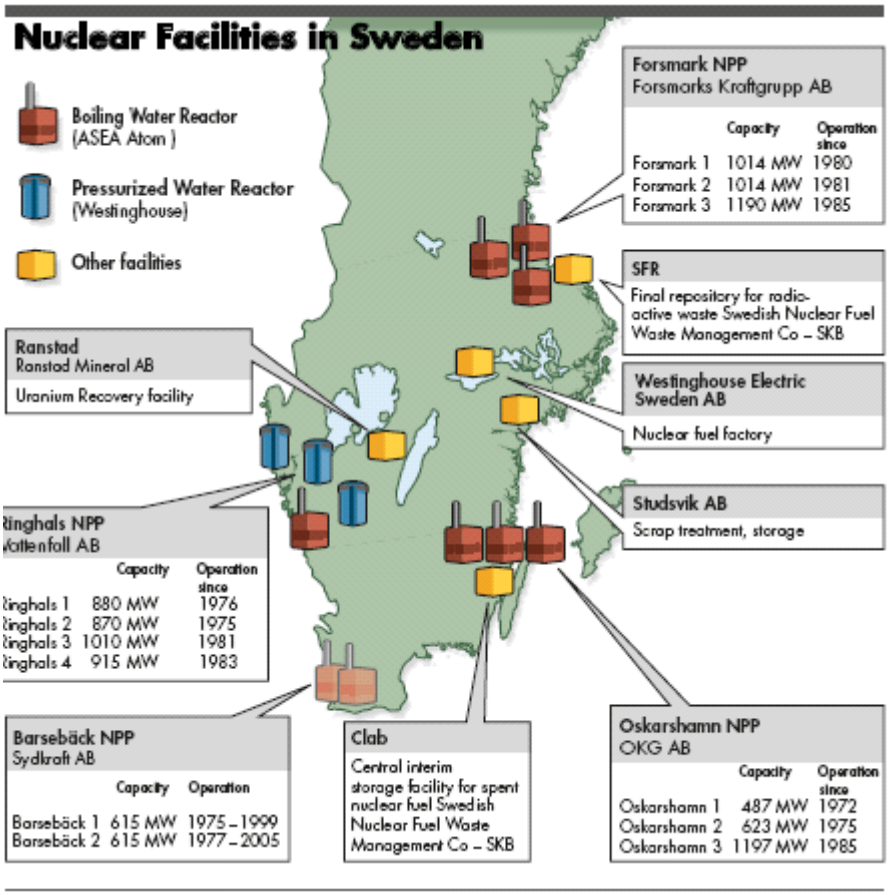
Four major facilities remain to be designed, sited, constructed and licensed. Namely a plant for the encapsulation of spent nuclear fuel, a final repository for spent fuel, a repository for long-lived low and intermediate level waste, and a repository for waste from decommissioning and dismantling the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

The development work for the final repository of spent fuel has continued according to plan and the process for selecting suitable sites is underway. Östhammar, close to Forsmark, and

Oskarshamn are presently being investigated as possible locations for the final repository. These investigations are planned to be completed in 2008." **(From Ds 2007:30:14-15)**

"The main alternative is to site the encapsulation plant adjacent to CLAB. Other alternatives are however under investigation, e.g. co-siting with the spent fuel repository. The time schedule for encapsulation of the spent nuclear fuel has been developed by SKB, and the following sequence of events is proposed:

2005 Submission of the license application for siting and construction
2007-2012 Construction and commissioning, including inactive trial operation
2012 Submission of application for operation
2014 Active trial operation, followed by operation" **(From Ds 2003:20:13-15)**



Comment: The first of the two reactors in Barsebäck were shut down in 1999, the second one in 2005. **(From Ds 2007:30:15)**

"Fundamental principles

The rationales for the management system for spent fuel and radioactive waste are based on basic principles that have been derived from extensive discussions in the Swedish parliament. The Swedish parliament has supported four basic principles for the management of spent nuclear fuel and nuclear waste.

1. The expenses for the disposal of spent nuclear fuel and nuclear waste are to be covered by revenues from the production of energy that has resulted in these expenses.

2. The reactor owners are to safely dispose of spent nuclear fuel and nuclear waste.

3. The state has the ultimate responsibility for spent nuclear fuel and nuclear waste. The long-term responsibility for the handling and disposal of spent nuclear fuel and nuclear waste should rest with the state. After a repository has been closed, a requirement should be established to ensure that some kind of 36 responsibility for and supervision of the repository can be made and maintained for a considerable time. A government authority could assume responsibility for a closed repository.

4. Each country is to be responsible for the spent nuclear fuel and nuclear waste generated in that country. The disposal of spent nuclear fuel and nuclear waste from nuclear activities in another country may not occur in Sweden other than in an exceptional case.

These are the basic principles for the structure of the Act (1984:3) on Nuclear Activities. They are also contained in the Act (1992:1537) on the Financing of Future Expenses for Spent Nuclear Fuel. The first principle has been wholly incorporated into the Financing Act. The second principle has been regulated in 10–12 §§ of the Act on Nuclear Activities.

The fourth principle is embodied in 5 a § second paragraph of the Act on Nuclear Activities. Another basic prerequisite for the actual management of spent fuel is that reprocessing will not take place. Thus, spent nuclear fuel is in practice considered as, and treated as, waste, although it is not legally defined as waste until disposed of in a repository."
(From Ds 2005:44:35-36)

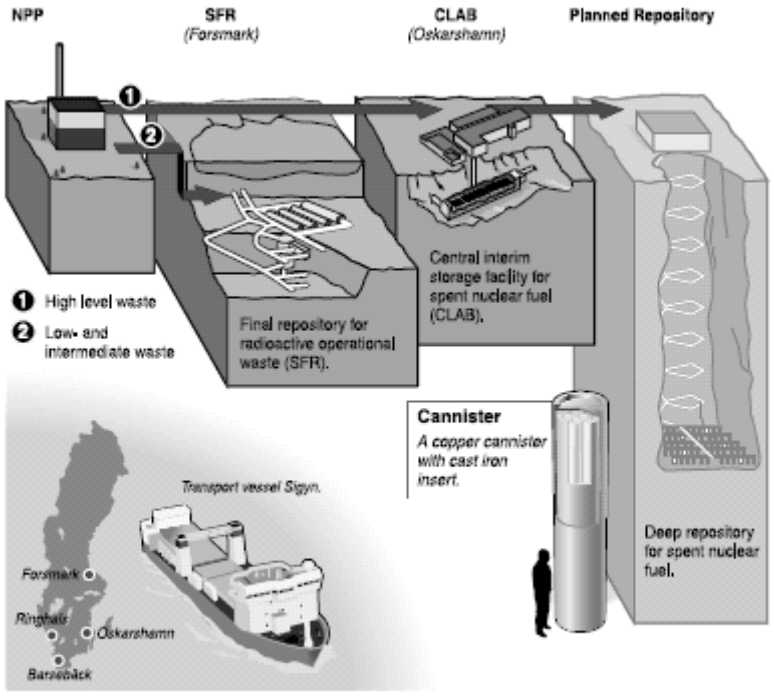


Figure A2: Management system for spent fuel and nuclear waste

(From Ds 2003:20:22)

Nuclear Power Policy Positions of the Political Parties

Exerpts from recent public policy and program documents issued by the Swedish political parties

Greens:

Election in 2006	5,2%	"Nuclear Power must be phased out. Uranium mining must not be permitted in Sweden"
Seats in parliament	19	
In opposition since 2006		
Sifo poll in March 2008	7,0%	"Nuclear Power in Sweden shall be phased out quickly, starting immediately. The phase-out can be completed within 10 – 12 years" (From: www.mp.se. Energi. Kärnkraft.)

The Left Party:

Election in 2006	5,9%	"The phase-out (of Nuclear Power) should be done at an even pace and the last reactor should be shut down no later than in 2025" (From: www.vansterpartiet.se. Vår politik. Energipolitik.)
Seats in parliament	22	
In opposition since 2006		
Sifo poll in March 2008	5,7%	

Social Democrats:

Election in 2006	35,0%	"Nuclear Power shall be phased-out taking in consideration a responsible environmental policy, an active occupational policy and an ambitious social welfare policy"
Seats in parliament	130	
In opposition since 2006		
Sifo poll in March 2008	43,3%	"Nuclear Power will be an important energy source for a long time to come. But it must be phased out…" (From: www.socialdemokraterna.se. En hållbar utveckling. Häfte F. Kongress 2005.)

The Center Party:

Election in 2006	7,9%	"Nuclear power will be phased-out in a balanced way. The aim is that all future energy sources shall be renewable" (From: www.centerpartiet.se. Politik A – Ö. Kärnkraft.)
Seats in parliament	29	
In Government since 2006		
Sifo poll in March 2008	5,8%	

Christian Democrats:

Election in 2006	6,6%	"The Swedish Nuclear plants should be phased-out of the energy system as it is replaced by renewable energy" (From: www.kristdemokraterna.se. Vår politik. Politikområde. Miljö och energi.)
Seats in parliament	24	
In Government since 2006		
Sifo poll in March 2008	4,5%	

Liberals:

Election in 2006	7,5%
Seats in parliament	26
In Government since 2006	
Sifo poll in March 2008	7,6%

"Nuclear Power should be utilized as long it is technically and economically viable; terminate the law on decommissioning Nuclear Power"
(From: www.folkpartiet.se. Vår politik. Miljö och klimat. Kärnkraft.)

"Sweden should follow Finland; a build-up of more Nuclear Power will lower the price of electricity…"
(From www.folkpartiet.se. Bygg ut kärnkraften. Folkbladet 12 maj. Jan Björklund, Linnea Darell och Karin Granholm)

"There are no reasons having a law forbidding the building of Nuclear reactors in Sweden"
(From: www.folkpartiet.se. Dags för grön el. Energiprogram antaget av folkpartiet liberalernas landsmöte 18-21 augusti 2005)

"…the law forbidding the building of new Nuclear Power (plants) should be lifted by the parliament, and for the up-coming four year period after 2010 four new reactors should be planned"
(From: www.folkpartiet.se. Nyhetsbrev nr 3. Bygg ut kärnkraften.)

Conservatives:

Election in 2006	26,2%
Seats in parliament	97
In Government since 2006	
Sifo poll in March 2008	22,0%

"Our goal is not to replace Nuclear Power. Neither is it our goal to retain Nuclear Power. Nuclear Power, Wind Power, Hydro Power etc are all means to reach our energy production goals, never goals as of themselves"
(From: www.moderaterna.se. Vår politik. Energi. Vad tycker moderaterna om kärnkraft?)

"Nuclear Power should be given an opportunity to develope"
(From: www.moderaterna.se. Remiss handlingsprogram. Vår tids arbetarparti. Moderat förnyelse för att trygga jobben, välfärden och miljön. Februari 2007)

Sweden Democrats:

Election in 2006	2,9%	"…the Swedish nuclear reactors should be utilized during their entire economic life time"
Seats in parliament	0	
Not represented in Parliament		
Sifo poll in March 2006	3,7%	"The law forbidding all new development of nuclear technology in Sweden must be abolished" (From: www.sverigedemokraterna.se. Handlingprogram, energipolitik. Antaget vid riksårsmötet den 26 mars 2006.)

REFERENCES

Kåberger, Tomas. 2007. History of Nuclear Power in Sweden
Estudos Avançados
Print ISSN 0103-4014
Estud. Av. Vol.21 no59 Sau Paulo Jan./Apr. 20
The Scientific Electronic Library Online – SciELO
http://www.scielo.br/pdf/ea/v21n59/en_a17v2159.pdf

Ds 2007:30. Sweden's Fourth National Report Under the Convention on Nuclear Safety. Ministry Publications Series (Ds). Fritzes, Customer Service. Stockholm.

Ds 2005:44. Sweden's Second National Report Under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. Ministry Publications Series (Ds). Fritzes, Customer Service. Stockholm.

Ds 2003:20. Sweden's First National Report Under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. Ministry Publications Series (Ds). Fritzes, Customer Service. Stockholm.

Documents from the political parties.

The Center Party
www.centerpartiet.se. Politik A – Ö. Kärnkraft.
Christian Democrats
www.kristdemokraterna.se. Vår politik. Politikområde. Miljö och energi.
Conservatives
www.moderaterna.se. Vår politik. Energi. Vad tycker moderaterna om kärnkraft?
www.moderaterna.se. Remiss handlingsprogram. Vår tids arbetarparti. Moderat förnyelse för att trygga jobben, välfärden och miljön. Februari 2007.
Greens
www.mp.se. Energi. Kärnkraft.
The Left Party.
www.vansterpartiet.se. Vår politik. Energipolitik.
Liberals
www.folkpartiet.se. Vår politik. Miljö och klimat. Kärnkraft.
www.folkpartiet.se. Bygg ut kärnkraften. Folkbladet 12 maj. Jan Björklund, Linnea Darell och Karin Granholm
www.folkpartiet.se. Dags för grön el. Energiprogram antaget av folkpartiet liberalernas landsmöte 18-21 augusti 2005.
www.folkpartiet.se. Nyhetsbrev nr 3. Bygg ut kärnkraften.
Social Democrats
www.socialdemokraterna.se. En hållbar utveckling. Häfte F. Kongress 2005.
Sweden Democrats
www.sverigedemokraterna.se. Handlingprogram, energipolitik. Antaget vid riksårsmötet den 26 mars 2006.