

Decommissioning in Sweden

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CURRENT STATUS

Experiences of decommissioning in Sweden

The main experiences of decommissioning in Sweden are the following projects:

- Some small research reactors and laboratories in Studsvik were decommissioned during the 1970:ies and 1980:ies.
- The research reactor R1 at the Royal Institute of Technology in Stockholm, which was operated between 1954 and 1970. The power of the reactor was less than 1 MW (th). The reactor was decommissioned between 1981 and 1983, and the underground localities were released for free use in 1985. Today, the resulting radioactive waste is either in a final repository or kept in interim storage. The spent fuel (metallic uranium) was shipped to Sellafield for reprocessing in October 2007.
- In Studsvik, the Active Central Laboratory with adjacent filter facility ACF was decontaminated and measured for free release between 1999 and 2005. The buildings were released and demolished in 2006.

Existing facilities

Today, the following nuclear facilities exist in Sweden:

- 13 nuclear power reactors at five sites (Barsebäck, Oskarshamn, Ringhals, Forsmark and Ågesta)
- Two research reactors in Studsvik.
- A central interim storage for spent nuclear fuel, Clab (situated at the Oskarshamn site).
- A repository for short-lived operational waste, SFR (situated at the Forsmark site).
- Several facilities for treatment of nuclear waste and investigations on high activity materials in Studsvik.
- A fuel fabrication plant in Västerås.
- A facility for extraction of uranium from contaminated residues in Ranstad.

Up to October 2007, five of the existing nuclear reactors have been shut down. These are the power reactors Ågesta (PHWR, shut down 1974) and Barsebäck 1 and 2 (BWR, shut down 1999 and 2005) and the material test reactors R2 and R2-0 in Studsvik (shut down 2005).

The remaining ten operating power reactors, the fuel fabrication plant and the waste treatment facilities are not foreseen to be decommissioned in the near future. The reactors were taken into operation between 1972 and 1985 and the licensees are currently evaluating the possibility of operation up to 60 years.

Decommissioning activities

Except for the Studsvik reactors, the licensees' intention is to dismantle the shut-down reactors after the establishment of a final repository for the low and intermediate level decommissioning waste. According to the plans by the Swedish waste management company SKB, the repository will be available from 2020. A repository for spent fuel is planned to be available around 2020

and a repository for other long-lived waste (such as activated reactor internals) is planned to be available around 2045.

In Barsebäck, the plant is in a phase of care and maintenance preceding dismantling. The last shipment of fuel to the interim storage Clab was performed late 2006. Primary system decontamination of both units is planned to be performed during the winter 2007/08. A license for care and maintenance of the Barsebäck NPP was issued by the local environmental court in July 2006. The license is valid until 31st of December 2012, since further investigations on the possibility for earlier dismantling are needed. In the Studsvik case, a license for dismantling of the two reactors was issued by the local environmental court in March 2007. Actual dismantling work is planned to start in 2008 and to be completed by demolition of the buildings in 2016. Radioactive waste will be treated and stored on site awaiting disposal. In the Ågesta case, no definite schedule has been set for future dismantling. An application for a license according to the Environmental Code for continued care and maintenance has been handed in to by the operator and is currently being processed by the local environmental court.

According to recent reports, the SKB and the operator of Barsebäck do not consider it possible or reasonable to start the dismantling of the Barsebäck NPP earlier than 2020. The studies will be reviewed by the authorities and judged by the government in 2008.

During 2007, decommissioning of some minor nuclear installations in Studsvik has been initiated by the licensee AB SVAFO.

Another shut down nuclear facility is the uranium extraction facility in Ranstad, where uranium was extracted from alun shales in the 1960:ies. The main remaining decommissioning activity is restoration of the industrial site and treatment of historical waste. This work has started in 2007.

POLICY OBJECTIVES OF D&D

There is for the moment no written and nationally agreed policy on D&D. No binding time limits for decommissioning are set in the current Swedish legislation or in the licences for operation of nuclear facilities. Disposal facilities for decommissioning waste should however be available before dismantling of the facilities can take place. The standpoint of the regulating authorities (the SKI and the SSI) from a safety and a radiation protection view is that a shut down power reactor should be dismantled, demolished and the site released for unrestricted use in a timeframe of about 5 – 15 years after final shut-down, provided that storage facilities are available for the waste. Twin reactors with common safety systems could motivate deferral of dismantling if only one of the two reactors is shut down.

The loss of competent personnel, the inevitable degradation of closed facilities and the issue of understanding and keeping relevant documentation are some important factors to be considered when planning the decommissioning of a nuclear facility. In Sweden, there is a common understanding that the generations that have benefited from the nuclear power should finance and take care of the waste both from operation and decommissioning.

The Swedish Act on Nuclear Activities clearly states that it is the responsibility of the licensee to dismantle a reactor that is no longer used. It is the responsibility of the authorities SKI and SSI to regulate decommissioning from a nuclear safety and radiation protection standpoint.

SOCIAL AND ENVIRONMENTAL IMPACTS

The two nuclear power sites on the eastern Baltic Sea coastline are situated in quite remote and sparsely populated areas. This means that they are important sources of employment in their regions. Shutdown and decommissioning of reactors will reduce the work force and have considerable social impact in the region on a longer time scale. The two sites in the south and western part of Sweden are situated in more densely populated regions with better job opportunities for the plant work force when a permanent shut-down is imminent. Sweden's dependence on nuclear power for electric power supply is about 50%.

To be able to close down reactors the responsible operator needs a permit from an Environmental Court according to the Environmental Code. In the licensing process, the Environmental Court is obligated to take into consideration the results from the Environmental Impact Assessment (EIA) and the Environmental Impact Statement (EIS). In the procedure of EIA, the operator is responsible for conducting consultations with affected individuals, governmental authorities and the general public.

COMPETENT BODIES AND ROLES

Industry

Nuclear power licensees

- Barsebäck Kraft AB
- Forsmarks Kraftgrupp AB
- OKG Aktiebolag
- Ringhals AB

Fuel fabrication plant licensee

- Westinghouse Electric Sweden AB

Research reactors licensee, waste handling operator

- Studsvik Nuclear AB

Waste handling operators (licensees)

- AB SVAFO
- The Swedish Nuclear Fuel and Waste Management Company (SKB)
- Ranstad Mineral AB

Other actors

Vattenfall AB (company controlled by the Government, and share holder with interests in the power plants at Ringhals, Forsmark, Barsebäck). Vattenfall AB is also licensee of the Ågesta reactor.

Authorities

- The Swedish Nuclear Power Inspectorate (SKI)
- The Swedish Radiation Protection Authority (SSI)
- The Swedish Environmental Protection Agency
- The National Board of Occupational Safety and Health
- The National Chemicals Inspectorate (KEMI)

- The County Administrative Boards
- The Local Authorities (Municipalities and Local Safety Committees)
- The Board of the Nuclear Waste Fund
- The Swedish Council for Nuclear Waste
- The Environmental Courts

The above-mentioned government agencies take independent decisions according to the Swedish constitutional law. The responsible government ministers are only allowed to influence the decision making of the authorities through ordinances and similar legal documents.

The licensee has the full responsibility for decommissioning, and through the governmentally controlled waste funding system there should be enough money available for the decommissioning tasks.

It is likely that the decommissioning activities will be performed in close co-operation between the licensee and the SKB. This company, owned by the licensees, is financed through the nuclear waste funds. In the end, if needed, the Government is responsible according to the Joint Convention on the safety of spent fuel management and on the safety of radioactive waste management.

In 2007, the government decided to merge SKI and SSI to one authority. The new authority is planned to enter into force on the 1st of July 2008.

FUNDING AND ARRANGEMENTS

The Act on Financing of Management of Residual Products from Nuclear Activities lays down the principles for the financing of decommissioning, handling and disposal of spent nuclear fuel and nuclear waste, including the research needed for these activities. The act requires the licensees to present, every three years, estimates of all future costs for management and final disposal of spent nuclear fuel and nuclear waste, and decommissioning.

As of 1989, a special fee has been levied on the nuclear power utilities according to the Act on the Financing the Management of Certain Radioactive Waste. This fee shall cover expenses for the management of nuclear waste from older experimental facilities, in particular the facilities at Studsvik, the Ågesta reactor and the uranium mine in Ranstad, and for decommissioning of these facilities. Cost estimates according to the act must be presented annually.

The basis for the Swedish funding system is that future costs shall be covered by the fees paid to the Nuclear Waste Fund. If the fund should prove to be inadequate there is an additional system, a system of guarantees, to cover the unforeseen costs.

The SKI is responsible for the review of the nuclear power industry's cost estimates for waste management and for proposing the size of the fees and guarantees to the Government, which then establishes the fee or (for the Studsvik funding) gives a proposal for change of the fee by parliament decision. The Board of the Nuclear Waste Fund manages the fund.

DECOMMISSIONING TECHNIQUES AND INSPECTION

The anticipated future D&D operations at the Swedish plants will include the following steps:

- The operator or the Government decides a date for final closure.
- Due to the situation, the safety culture at the plant could be negatively influenced and the inspection efforts by the SKI and the SSI will eventually be increased.
- When a reactor is finally shut down, all fuel is removed to an interim storage (Clab) after approximately 1 year cooling time. A phase of care and maintenance begins.
- When a non-reactor is shut down, any residual operational radioactive waste is removed to an interim or final storage.
- The D&D plan is updated and sent to the SKI and the SSI for review.
- Before decommissioning activities of a reactor may start, a permit from the local Environmental Court is needed according to the Environmental Code.
- When all fuel or waste has been removed from the site, and the safety report of the facility has been approved by the SKI, dismantling operations can begin.

RADIOACTIVE WASTE MANAGEMENT

On an early stage, it is important to investigate the occurrence and distribution of radioactive substances in the facility, in order to plan the radioactive waste management in a correct way. During dismantling it is important to have well established methods and routines for separation and safe management of different waste categories. This is valid both for clearance and reuse of materials, and for characterization, treatment and management of different kinds of radioactive waste. Rational and safe waste management will depend on clear rules and quality assurance measures. High demands will also be put on logistics, since large components will be handled and large amounts of waste will arise. The Swedish plans for waste repositories are presently as follows:

- A repository for short-lived decommissioning waste is planned to be built as an extension to the existing SFR repository.
- Long-lived waste will be stored until a planned repository has been built in the bedrock at about 300 m depth.

In addition the possibility of licensing landfills for wastes with very low-level activity exists according to the Ordinance on Nuclear Activities.

PUBLIC INFORMATION / ACTION PLANS (NEXT STEPS)

On behalf of the power plant operators, the SKB is responsible for planning and construction of facilities for management and final disposal of spent fuel and nuclear waste. Every third year, the SKB presents an R&D program on planned activities, including decommissioning. The program is reviewed by a number of organizations and approved by the government. The SKI and the SSI have a special obligation to inform the public in an objective way about nuclear safety and radiation protection issues. In municipalities with nuclear reactors the Government has instituted Local Safety Committees, which has the legal status of an authority, and has a legal right to require safety related information from the operator and the supervising safety authorities, as SKI and SSI. The Committees consist of local politicians, and they have their own network for cooperation in Sweden.