

Nuclear waste management and long term considerations in Sweden

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1. About the author

The author is a civil engineer with a Ph D in engineering geology, working as a researcher and consultant since the late 1960s. Many tasks have concerned hydrogeology and siting, for instance sanitary landfills. Simultaneously the author has been engaged in several NGOs, among others the Waste Network since the early 1980s. This engagement has included numerous visits to local groups, participation in meetings and seminars, writing statements etc.

The standpoints presented in this paper solely reflect the opinions of the author.

2. Overview of Swedish nuclear waste management

Simplified, nuclear waste management in Sweden might be described in the following steps.

1. 1950-1960. “The Swedish line” (uranium mining, heavy water reactors, reprocessing and nuclear weapons). No waste problem was openly acknowledged.
2. 1960-1970. The nuclear waste problem was still not seriously acknowledged. Spent fuel was considered to be a resource for further power production or perhaps still for bombs. In the middle of the 1960s some responsible politicians still believed that the amount of waste was so small that it was needed for medical purposes.
3. 1970. The Center Party, at that time explicitly anti-nuclear, put the nuclear waste issue definitely on the political agenda.
4. 1972. The first light water reactor started operating in Oskarshamn.
5. 1972-1976. The AKA state investigation presented a first outline of the KBS method (canisters deposited in the bedrock). Reprocessing was still a prerequisite. The deposit should be localised in a none-fissured or low-fissured part of the crystalline bedrock in the Scandinavian shield.
6. 1977. The Stipulation Act stated that no more reactors should get operation permits until a completely safe method had been developed for waste disposal and a binding contract for reprocessing had been presented. This law was a compromise on nuclear power forced by the Center Party as a condition to enter the non-socialist coalition government after the election in 1976.
7. 1978. The Government approved the KBS 1 method (deposition after reprocessing) according to the Stipulation Act. Reprocessing had been contracted with COGEMA in La Hague. In reality this approval as a whole was a political and not a technical solution.

8. 1984. The Nuclear Technology Act replaced the Stipulation Act demanding an approval by the Government based on a statement of ongoing activities every 3 years. In 1984 KBS 3 (direct deposition without reprocessing) was approved according to the Nuclear Technology Act.
9. 1980-1985. Test drillings were performed by SKB (a company managing nuclear waste on behalf of the nuclear industry) in “type areas” with the purpose to find the best bedrock conditions for a final deposit. The drillings were finally stopped early in 1986 due to considerable local protests.
10. 1992-2000. Preliminary studies were performed in 8 municipalities after an inquiry for voluntaries to all municipalities in Sweden. Now the purpose had changed to find municipal acceptability. The validity of bedrock conditions was openly declared less important.
11. 2003. Test drillings were permitted and started in Oskarshamn and Östhammar, both municipalities depending on the nuclear industry because of hosting nuclear power plants. The EIA (Environmental Impact Assessment) process for an application started separately in both municipalities.
12. 2006. The local branch of the Social Democrat party in Oskarshamn declared to promote a nuclear waste deposit in the municipality. In reality the two municipalities compete to get the deposit.

3. Nuclear waste management in Sweden at present (2006)

From 1984 the Nuclear Technology Act demands that the nuclear industry shall account for its development of nuclear waste management every third year to the Government as a condition for nuclear power plant operation. On behalf of the nuclear industry SKB has presented research and development reports, which have been examined and agreed, sometimes with critical remarks, but never been rejected.

The Government’s demands on development of alternative methods have been weak and thus in the opinion of SKB the KBS 3 method is in reality approved. Solely based on the Nuclear Technology Act this might perhaps be a reasonable conclusion. However, presently the deposit should also be approved according to the Environmental Code. The Code states considerably more specific prescriptions on applications. This concerns e. g. precautionary principle, alternatives, BAT (best available technology) and resource economizing.

The present denomination of a method and site for nuclear waste long term storage is unclear in Sweden. When the waste problem was originally acknowledged in the 1970s final deposition was self evident and it was thought that the deposit should not need supervision and maintenance because the deposit should contain material of no value and of nobody’s interest. At least partly, this probably was a consequence of the fact that originally only reprocessing residues should be deposited. The conditions started to change, when instead spent fuel should be deposited.

Thus, in some of the research and development plans presented by SKB in the 1990s the deposit was denominated “deep deposit”. This was a consequence of SKB’s plan to apply for stepwise deposition and presume retrievability and supervision. However, the Nuclear

Technology Act still states “final deposit”, why SKB has changed back to the original denomination without changing the design and accomplishment of the method.

SKB, the company owned by the nuclear industry, is at present preparing a proposal for a final deposit (or deep deposit) either at the nuclear power plant in Oskarshamn or at Östhammar. According to present planning the proposal following the Environmental Code will be handed over to the Environmental Court in 2008. On the same time also the proposal for the encapsulation plant will be finished. Parallel applications will be made according to the Nuclear Technology Act.

The proposals worked out by SKB are expected to implement the KBS 3 method. The spent fuel will be deposited in canisters in the bedrock at a depth of about 500 meters. This is the only method seriously considered and developed since the early 1970s. Until the final deposit is in operation the spent fuel is kept in water basins in a rock cavern at 50 meters depth near the power plant in Oskarshamn. This interim storage is named CLAB and is claimed to be safe for at least about 100 years.

A proposal to increase the capacity of the nuclear power plant in Ringhals was the first nuclear energy project to be examined according to the Environmental Code. In April 2005 the regional Environmental Court denied permission on the following grounds:

- No site for a final deposit for spent fuel exists.
- The risk of serious radiological accidents is too high with respect to what is stated in the Environmental Code.
- The amount of energy released by the cooling water is an unlawful misuse of resources.

The Court’s decision clearly illustrates the difference between the Nuclear Technology Act and the Environmental Code. However, according to the Code, the Environmental Court had to pass the final decision to the Government, which approved the increase of capacity at the power plant because of its alleged significance for the society as a whole.

Late in 2005 Prime Minister Persson suddenly and unexpectedly declared that he felt the KBS 3 method to be “out of date”. At least temporarily this caused a general sense of uncertainty concerning the further work on nuclear waste management in Sweden.

4. Environmental impact assessment in Swedish legislation

The first Environmental Protection Act in Sweden was established in 1969 and stated that environmentally harmful activities should have permits. However, nuclear activities were not treated fully by the law.

Even if the Environmental Protection Act did not stipulate an EIA, the proposals according to the Act tended to include descriptions of environmental consequences and sometimes also alternatives. EIA became a formal part of the environmental legislation in 1991. Alternatives should be presented and consultations carried out with the concerned stakeholders. But the rules were vague and often the EIA was only a document produced by the operator of the activity and shortly describing environmental consequences of a project.

In 1990 SKI (The Swedish Nuclear Inspectorate) initiated the so called Dialog project. The purpose was to create a dialog between different actors and stakeholders on the issue of handling a proposal for a nuclear waste deposit. Most organisations and authorities concerned participated, but SKB refused. Several environmental NGOs including the Waste Network also participated. A part of the project was carried out as a game on reviewing a fictitious application for a disposal. Some of the unanimous conclusions of the project, published by SKI in 1993, were:

- The EIA process should be open and allow active participation of other actors than the applicant.
- Other actors as municipalities, environmental NGOs and local populations must be given resources e. g. for engaging experts for serious participation in the EIA process.
- It should be considered to have an independent coordinator of the EIA process.
- Alternative methods compared to KBS 3 should be developed and valued.
- The choice of site should be carried out in a systematic way according to a procedure presented in advance.

In 1999 the Environmental Code finally and more seriously introduced EIA into the environmental legislation and also extended its validity into several more laws on environmentally influencing activities. Nuclear activities such as a waste deposit should be approved according to the Environmental Code.

An EIA must include:

- Alternatives concerning method and site
- The consequence of no activity (“zero alternative”)
- Consequences concerning environmental conditions
- Mitigations to diminish the consequences, if necessary compensation.

The preparation of an EIA is an important part of proposal planning. The working out of an EIA should include consultations with authorities, organisations and the public. According to Swedish environmental legislation EIA is both a process and a document. The Environmental Code specially points out environmental NGOs to be consulted in the process.

Swedish environmental NGOs claim that the Environmental Code puts harder demands on an application than the Nuclear Technology Act. This opinion is supported by the decision of the Environmental Court on the case of the Ringhals power plant as described above. Thus the work carried out by SKB so far on choosing method and site might be insufficient according to the Code, even if the work was approved according to the Nuclear Technology Act.

5. Elements of long term governance and responsibility

5.1 What is long term?

It is rather unclear what should be meant by “short” and “long” term. Based on Swedish conditions short term could be the next 100 years coinciding with the supposed operation time of CLAB, the interim storage in Oskarshamn. Real long term could be beyond the next 1000

years. Based on the most common opinions on the safety of the KBS method the period 100-1000 years from now might be regarded as a less controversial medium term period.

The Swedish debate on nuclear waste long term management has preferably been focused on technical safety, pollution of groundwater and environmental impact on humans and biosphere. The debate has often started from specified amounts of years. Three figures describing long term often appear in the debate.

5000-10 000 years.

The period is supposed to last until the next glaciation (ice age). SKB claims the KBS method to be “absolutely” safe, but NGOs claim that safety is not proved and radioactivity might reach groundwater and biosphere probably before this period. This beginning of this period approximately coincides with the requirement presented by IAEA in the “Draft safety requirements for geologic disposal of radioactive waste” (2005-04-28).

100 000 years.

This figure is normally mentioned to describe the end of responsibility for the waste. Within this period one or more glaciations might occur. During a glaciation the rock conditions are not as stable as in the inter-glacials. The heavy ice sheet might cause earthquakes, rock displacements and change the groundwater flow. SKB still claims the deposit to be safe, but not so absolutely. NGOs claim the risks during a glaciation to be unknown, ignored and considerable.

1 000 000 years.

This is beyond normal human conception. SKB claims the waste to be harmless. NGOs claim that parts of the waste still have not declined totally and could be spread out completely long before it is harmless.

As mentioned above the general idea originally was to construct a final deposit not needing any supervision. But future generations should be informed that something dangerous was deposited 500 meters down in the bedrock. NGOs have doubted that information still might be preserved and understandable several thousand years into the future. Looking back about 3000 years one example is the rock carvings in many parts of Sweden and especially inside the north part of the west coast, by coincidence near Kynnefjäll, known for the 20 years vigil against test drillings. The people who made the rock carvings obviously wanted to deliver a message. However, today we are not at all sure how to interpret their message.

5.2 Ethical considerations by Swedish NGOs

Nuclear waste management has been a matter of debate within environmental groups and organisations (NGOs) in Sweden at least since the early 1970s. However, there are no completely agreed ethical standpoints on nuclear waste within the engaged groups and committed individuals. In some cases the opinions are even clearly contradictory as for instance concerning the fundamental question if a final solution should be sought now or should be left to future generations.

NGOs in Sweden often claim that nuclear waste must be defined in two categories, the waste that already exists and the waste that still has not been produced. The first category is inevitable, but the second category can be avoided by shutting the nuclear reactors. We all have a moral duty to take care of the first category, even if some of us never have approved the production of it. This is not valid concerning the second category. Thus, the further

production of nuclear waste must be validated concerning all the risks and environmental effects of nuclear technology.

Much ethical considerations by NGOs in Sweden have concerned the production of nuclear waste as the result of nuclear power operation. NGOs have resisted the KBS method as such and also as a product of SKB being the representative of the nuclear industry. NGO groups claim that the work of SKB is corrupted by the connection to nuclear power operation.

Even if NGOs in Sweden have no agreed ethical standpoints on nuclear waste the following have been discussed and put forward to other stakeholders:

- The ethical ambition should be not to expose us or future generations to unnecessary risks, responsibilities or costs due to produced nuclear waste.

Based on this overall ethical ambition three functional conditions, partly contradictory, were formulated in the 1990s, partly coinciding with the principles presented by KASAM (Swedish National Council for Nuclear Waste):

1. The deposit should be designed not to demand supervision or maintenance.
2. The deposit should be designed to admit retrieval if and when this is found necessary for repair and improvement.
3. The deposit should be designed to admit breaking the possibility of retrieval, if future generations find this necessary, e. g. if retrievability is supposed to be too risky.

Nuclear waste should be looked on and treated from a holistic view on society and development. Nuclear waste does not appear naturally and should therefore not be treated only as a technical problem to be solved without questioning the production. What is the object of solving the nuclear waste problem? Is it self evident that nuclear waste management is just a question of long term storage under specific conditions concerning the difficulty to change this storing? The connection between nuclear technology as a whole and nuclear waste is in now way a hidden agenda according to the Swedish environmental NGOs.

Nuclear waste must therefore be looked upon considering the nuclear technology as a whole. This includes:

- Uranium mining creating large amounts of wastes in the areas of indigenous peoples
- Nuclear power plants causing accident risks or being targets for terrorists
- Nuclear weapons proliferation and tests
- A manifold of transports creating risks
- The risk of actions by terrorists not bothering about radiation hazards.

The nuclear waste problem might be solved today using the existing knowledge and resources to create a final deposit with the aim to restrict later changes. If so, this is an expression that the people living now want to lift off this problem from future generations. On the other hand a group of nuclear enthusiasts oppose any final disposal making the access to the waste difficult. In their opinion the waste is a valuable source of energy (or maybe bombs).

There are also people in NGO groups apposing any solution now. One opinion is that future generations probably will find better ways to handle the waste. Another opinion is

unwillingness to discuss the matter at all before the closure of all nuclear reactors. These examples show that groups expressing the same opinion might have very different motives.

Reasons for implementing a fast solution (pessimistic):

- Those who have benefited from nuclear power should also take the whole responsibility to solve the waste deposition.
- It is not possible to rely on the stability of the society either from technical, moral or economical viewpoint.
- The Swedish nuclear waste fund might not be sufficient in the future due to wrong calculations, later technical or organisational problems or a general economic collapse.

Reasons for not implementing a fast solution (optimistic):

- It is up to future generations to find an acceptable solution, as we are not able to do that today.
- It is wrong to finalize a deposit now, which might not be accepted by future generations and which makes it difficult for them to change if they want to.
- We should not finalize a deposit now, which is not completely safe. It is better to continue keeping the waste in a guarded interim storage.
- Future generations will probably develop methods for eliminating the waste completely.

5.3 Financial resources

Nuclear waste management in Sweden is financed by a tax on nuclear energy. The money is collected in the Nuclear Waste Fund, founded in 1981 in accordance with the Financing Act.

Money from the Fund is transferred to SKB for financing its research and development work. This reimbursement is decided by SKI (the Nuclear Power Inspectorate). SKI may also transfer some money to municipalities concerned by SKB activities. Some local NGO groups have secondly got limited grants by the municipalities. However, up to 2005 the Financing Act did not allow grants to be given directly from the fund to NGOs.

NGOs have pointed out some weaknesses of the fund and the statutes of the fund:

- The fund prescribes that one solution is to be decided and executed. When the chosen solution is completed the fund should be empty. This does not allow any re-start if the chosen solution for some reason must be given up uncompleted.
- If the deposit has been completed and somewhat later needs maintenance or complementary actions, no money is available.
- If the deposit needs supervision this is not foreseen in the statutes of the fund.
- The general risks of social and economical collapse.

Within the Waste Network it was expected that environmental NGOs should be given the opportunity to get grants from the waste fund as a consequence of the Dialog project. This became even more important when SKB during the 1990s claimed to have started the working out of an EIA. But still in 1998 the Government rejected applications for resources referring to what was stated in the Financing Act and showing no intention to change the rules. Finally in 2003 things started to change.

In October 2003 several environmental NGOs were invited to a meeting on the issue of economic resources for participating in the EIA process concerning a nuclear waste deposit. It was obvious both to the investigator and most of the NGOs that it would be unpractical to administer a lot of grants to many NGOs. Therefore at the meeting the NGO group proposed a coordinated NGO secretariat to manage the EIA participation. The investigator agreed on this idea and proposed the Government to change the Financing Act in this way. Grants should be given to NGOs or groups of NGOs fulfilling the same conditions (formal organization, at least 2000 members and at least 3 years of activity) stated by the Environmental Code for appealing against a permit given according to the Code. The Government proposed the change of the law in March 2004 and the parliament later came to the decision. From 2005 it is possible for NGOs to apply for grants from the Nuclear Waste Fond, 3 million SEK per year during 4 years.

The following grants have been given in 2005 and 2006.

- The Swedish NGO Office for Nuclear Waste Review (MKG) was founded by the Swedish Society for Nature Protection (by far the biggest environmental NGO in Sweden), Fältbiologerna (the Field Biologists, a youth organisation) and OSS (the local group in Östhammar associated to the Waste Network). MKG got 1 950 000 SEK in 2005 and 1 925 000 SEK in 2006.
- The Nuclear Waste Secretariat of the Swedish Environment Movement (Milkas) was founded by the Swedish Anti Nuclear Movement (FMKK) and Friends of the Earth Sweden (MJV). Milkas got 1 000 000 SEK in 2005 and 1 050 000 SEK in 2006.
- MFK (Environmentalists for Nuclear Power), a pro-nuclear organisation mostly engaging people employed by the nuclear industry, got 50 000 SEK in 2005. The grant was not used to participate in the EIA process, but was given as a scholarship to a student at a technical university. No application was made for 2006.
- SERO (Swedish Renewable Energies Association), an organisation mainly active in supporting renewable energy, got 25 000 SEK in 2006. SERO has not earlier been actively engaged in the nuclear waste issue or cooperated with other NGOs on this issue.

6. NGO demands to be presented in the EIA Process

As explained above Swedish environmental NGOs have no complete consensus on the issue of nuclear waste management. However, concerning the demands on the EIA process most of the opinions coincide. The following standpoints generally reflect those represented by MKG as interpreted by the author:

- Continuation of nuclear waste production, also in connection with uranium mining, is inconsistent with sustainable development.
- The problems of nuclear waste management must be dealt with now and not left to an undecided future. However, this does not automatically mean that any final solution needs to be implemented within a short period of time.
- Irrespective of storage or disposal method nuclear waste is a possible source for nuclear weapons for a very long time and must therefore be subject to long-term safeguards.
- Any storage or disposal must be designed considering the risk of intentional or unintentional intrusion.
- The management of nuclear waste is a national task. The EIA process should thus be performed on a national scale, not as now in the municipal and to some extent regional scale.
- The choice of method should precede the choice of site.
- The choice of method should be made according to a systematic process and considering functional conditions set up in advance. Different alternatives should be evaluated and compared according to strict long-term environmental standards that comply with sustainable development. This demands extensive information on more than one possible method.
- The choice of site should also be made according to a systematic process and considering functional conditions set up in advance. A clear and understandable sieving process at a national scale should be performed to find the best possible site considering environmental conditions.
- Changes have to be made so that an independent body supervises the EIA process instead of the nuclear industry. This increases the chance that the choice of method and site gain legitimacy and acceptance in the eyes of ordinary citizens.