

**19<sup>th</sup> Annual Canadian Nuclear Society Conference  
Toronto 18-21 October 1998**

**Siting a Used Fuel Disposal Facility in Sweden**

Claes Thegerström  
Swedish Nuclear Fuel and Waste Management Co., SKB  
Sweden

**Abstract**

Siting has been started in Sweden for a deep geological repository for encapsulated spent nuclear fuel. It is based on a voluntary process and presently it involves four municipalities. Keys to a successful siting is believed to be excellency in safety matters and an open and democratic decision process with active participation of all parties concerned.

**Background**

The Swedish nuclear waste programme is aimed at final disposal of encapsulated spent nuclear fuel into the crystalline bedrock. Extensive research and development work has been performed since the 1970s. SKB, the Swedish Nuclear Fuel and Waste Management Co., is now shifting to practical demonstration and execution of encapsulation, repository design, and site selection. Research is focusing on examining those processes that are most important for safety and gathering data as a basis for designing the barriers.

Recent developments include:

- The construction of an encapsulation laboratory for the development of industrial-scale seal-welding of thick copper canisters. This laboratory will be taken into operation in 1998.
- R&D work at the Äspö Hard Laboratory, including preparations for full-scale inactive testing of deep disposal techniques and barriers.
- Siting feasibility studies – presently in four municipalities – based on a voluntary process.

The programme calls for completion of the research, development and demonstration work by first building the final repository as a deep repository for demonstration deposition of spent nuclear fuel (Figure 1). When the first stage (demonstration deposition) has been completed, the results will be evaluated before a decision is made whether or not to expand the facility to accommodate all the waste. An option of retrieval is included in the planning. The siting process is only affected to a limited extent by whether the planning applies to a deep repository for demonstration deposition or to a complete deep repository. The requirements on background information from SKB in the different phases (pre-investigation, detailed investigation, construction of repository) are essentially the same [1].

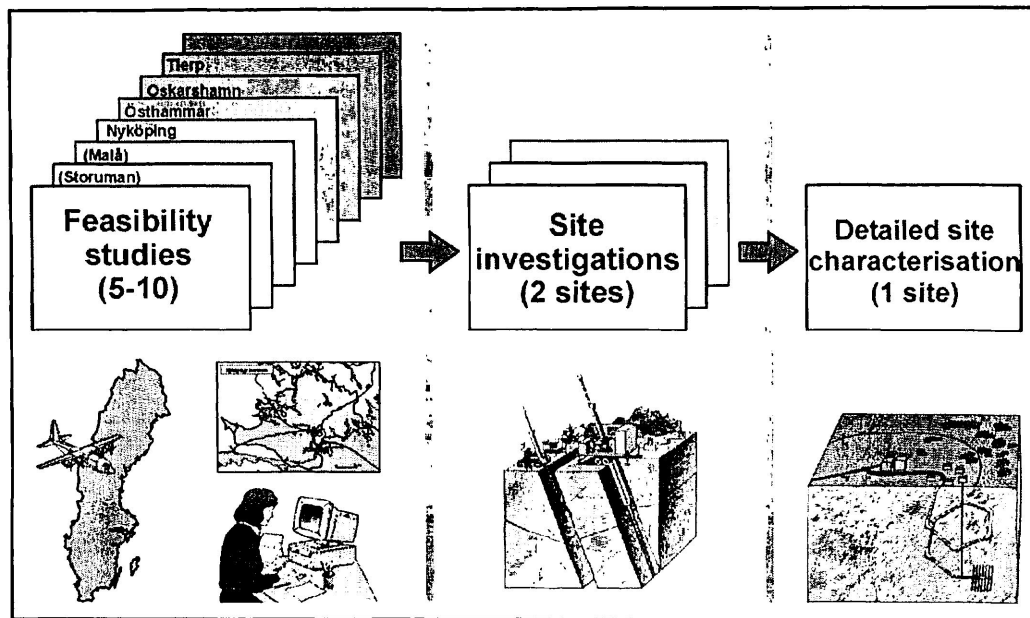


Figure 1. General Layout of a Deep Repository Geological Disposal of Encapsulated Spent Nuclear Fuel.

### Step-wise implementation

Decisions on siting, construction and operation of the remaining facilities will be taken in steps following licensing reviews based on a progressively more detailed body of data, with the opportunity to integrate new knowledge and experience into consideration at each step. The main outline of the planning is illustrated in Figure 2.

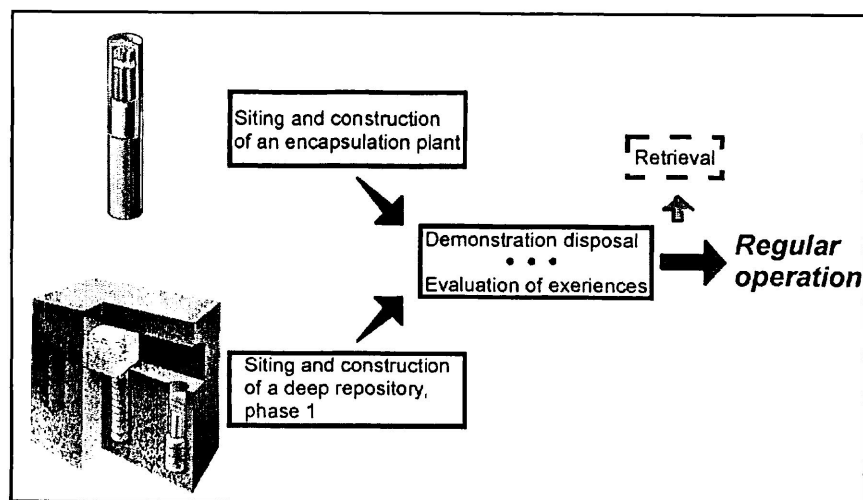


Figure 2. Plan for remaining parts of the Swedish nuclear waste management system.

The siting work for the deep repository (the upper half of the figure) is currently under way. When SKB has gathered all the data needed to be able to propose a site, a thorough review will be undertaken by the regulatory authorities before a permit can be issued to begin the construction process. After construction, in an initial phase for a limited quantity of waste, a new regulatory review will be held concerning an operating permit for initial trial operation. SKB's objective is that operation can commence around year 2012. Approximately one-tenth of the encapsulated waste will be disposed of during initial trial operation. A similar process is planned for the encapsulation plant (lower half of Figure 2) up to initial operation.

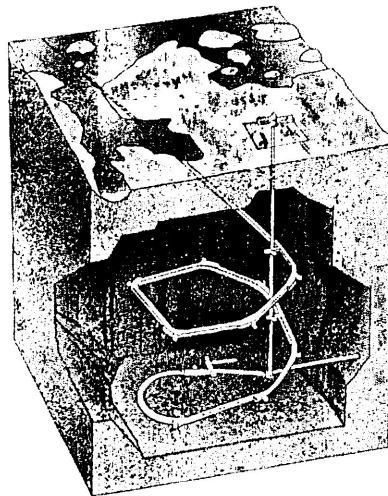
After initial trial operation, a thorough evaluation will be made of the entire system. This will provide an opportunity to take into account operating experience and the general development of technology that has occurred during the course of the process. The deposited canisters can be retrieved at this point if deemed desirable for any reason. If the evaluation shows that continued deposition is suitable, the deep repository will be further expanded and activities will continue until all waste has been deposited, which is estimated to occur around 2040.

### **Äspö Hard Rock Laboratory – A dress rehearsal for the deep repository**

The exact design and siting of the deep repository for spent nuclear fuel have not yet been decided. Data has been gathered through extensive research, both in the laboratory and in the field.

For the purpose of summarising present-day knowledge and demonstrating methods to be used in the deep repository under natural and actual conditions, SKB has built the Äspö Hard Rock Laboratory (HRL). Situated near the Oskarshamn Nuclear Power Station, the HRL is located at a depth of about 460 meters and is reached by a tunnel about 3,600 m long.

An overriding ambition for the Äspö HRL is that it should be a leading centre for research on the final disposal of high-level waste.



*Figure 3. The Äspö Hard Rock Laboratory.*

## Demonstration of disposal system

An important part of the work during the operating phase of the Äspö HRL is to develop, test and demonstrate the technology that is planned to be used in the deep repository under realistic conditions. Several full-scale tests will be performed within the framework of this work.

The prototype repository will be a full-scale simulated deep repository at a depth of 450 meters. The purpose is to study the interaction between the different barriers – canister, bentonite buffer and surrounding rock – over a long time and compare the results with models and assumptions.

Technology for back-filling of tunnels is being developed and different mixtures of bentonite and crushed rock will be tried as backfill material. In another project, machines for handling and deposition of canisters and bentonite buffer are being developed and tested. Additional tunnels have been excavated to provide locations for these tests.

## Siting process

Site selection for the deep repository is maybe the most difficult and sensitive issue within the whole programme. The repository will be sited at a suitable location in Sweden where both rigorous safety requirements can be fulfilled and the necessary activities can be carried out with the consent of the concerned municipality and population.

SKB intends to obtain background data for the siting of a deep repository by means of:

- Feasibility studies (in five to 10 municipalities) aimed at identifying interesting areas for site investigations and illustrating the possible consequences of a deep repository siting in the municipality and region; and
- Site investigations (on at least two sites) aimed at providing background data for designing a deep repository with respect to the properties of the site and carrying out an environmental impact assessment, including an assessment of long-term safety.

This work is intended to lead to a proposal to carry out a detailed characterisation and construct a deep repository of the site (Figure 4).

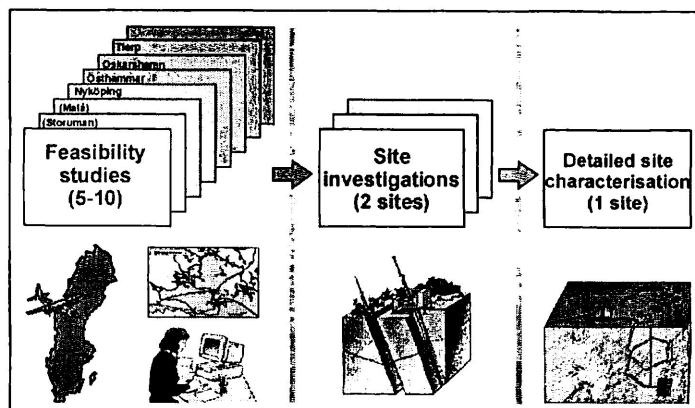


Figure 4. Steps in the Siting Process.



In the ongoing phase, feasibility studies, the prospects for and consequences of a deep repository siting within specific municipalities are examined. SKB needs no formal permits to conduct a feasibility study. However, in practice the feasibility studies are conducted in consensus between SKB and the municipality in question. A feasibility study takes approximately two years to complete and results in a comprehensive body of material that should provide a good picture of the general prospects for siting of a deep repository in the municipality. Possible consequences for the environment, infrastructure, local economy, etc., are illuminated as well as technical issues.

A feasibility study should thus furnish a broad body of facts for both the municipality and SKB. Both parties can then decide for themselves whether they are interested in starting a site to have a say and state their views long before any decisions need to be taken on the siting of the deep repository.

To date, feasibility studies have been performed or are presently being performed for six different municipalities. For two northern municipalities, Storuman and Malå [2, 3], that volunteered for a feasibility study, local referenda were held after completion of the feasibility study in 1995 and 1997, respectively. In both cases the outcome of the referendum turned out to be negative to a continuation of the siting studies. In Storuman only 27% wanted the siting process to continue, and in Malå 44% were in favour of continuation. Due to these results SKB has stopped any further studies in these municipalities. According to SKB these referenda came up too early in the siting process. The experiences from the work and interaction with the public in Storuman and Malå have been very valuable to SKB and other parties in the siting programme.

Presently, feasibility studies are underway in four municipalities in the south, three of them having previous experience with nuclear facilities. Discussions within these municipalities between SKB, the municipality, and the public are constructive and promising for the future development of the work for siting a deep repository.

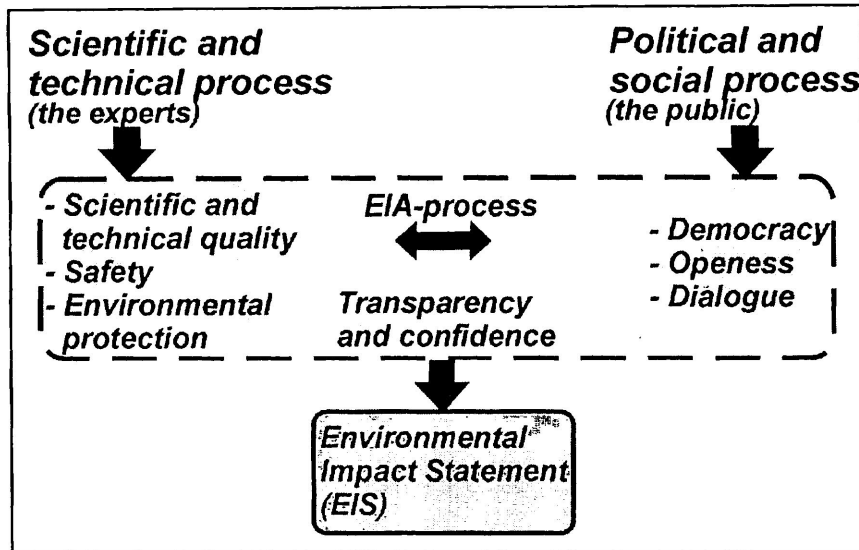
### **Environmental Impact Assessment**

When SKB applies for siting of a deep repository an Environmental Impact Statement (EIS) will be submitted to the competent authorities. The purpose of the Environmental Impact Assessment (EIA) is to ensure that the basis for decision-making is as adequate as possible for all parties. Thus, the EIA procedure is an important part of an open and credible decision-making process, see Figure 5.

A number of parties are involved in the current siting activities and in the EIA-procedure:

- SKB
- Affected municipalities
- The Swedish Nuclear Power Inspectorate (SKI), the regulatory safety authority
- The Swedish Radiation Protection Institute (SSI), the regulatory authority for radiation protection issues
- The National Council for Nuclear Waste (KASAM), and advisory group to the Swedish Government
- The National Co-ordinator for nuclear waste disposal
- Affected County Administrative Boards
- Land owners

- Local and regional associations
- The interested public.



*Figure 5. The EIA process in Sweden – the importance of both the technical background material and the open dialogue with the society to ensure that relevant questions have been defined and discussed.*

During the scoping procedure questions and issues that should be taken up in an EIS are identified. Alternatives to the system in question are also treated in this step. This step is now implemented in Sweden. There is a very active and constructive participation on the local and regional level from municipality representatives and the interested public [4].

### **Social and political challenges**

Several experiences have been gained since the siting process started late 1992. Somewhat provocatively there are two decidedly different views on the deep repository:

- In one perspective, the deep repository is a safe environmental facility of importance to everyone, where the nuclear waste is isolated so that people in the future will be protected. It is based on long-term planning and stringent quality standards. It provides good jobs with advanced technology, attracts positive both in Sweden and internationally, and contributes in many ways to the positive development of the municipality and the region.
- In another perspective the deep repository is an atomic waste dump and a threat to the environment and the future. This arouses anxiety and fear among the population. The general attitude towards the municipality and the region will be negative, visitors will stay away and the region's economic development will be adversely affected.

The perceptions and attitudes of members of the public have to be met in an open and honest way. To most people the siting of a deep repository is a very special project and many of those potentially affected by the project will feel deeply engaged in the issue. This will mean

that, to be successful, such a project will feel deeply engaged in the issue. This will mean that, to be successful, such a project has to be managed in a different way, compared to less sensitive projects. Key aspects are

- Facts and emotions

The projects must consider all facts but also all emotions that may arise. They are as real as the facts and they have to be met in a respectful and serious way.

- Time

To most people radioactive waste and the concept of geological disposal is not very well known and it will take time and effort to provide knowledge and understanding of all different aspects of a deep repository project. Thus there is a need to show patience. Changing attitudes and building confidence simply takes time.

- Flexibility

Science and technology is in a state of rapid development. Social values and community values also develop with time. It is important to be flexible so that the concept can accommodate these changes. The concept should be possible to develop in stages where new information can be incorporated during each stage of the development. This is in line with the environmental and ethical basis for geological disposal, namely that *stepwise implementation of plans for geological disposal leaves open the possibility of adaptation, in the light of scientific progress and social acceptability, over several decades, and does not exclude the possibility that other options could be developed at a later stage* [5].

- Democracy

An ongoing social change is that citizens more and more directly participate in the decision-making process. This is a development of democracy that should be shown full respect. There is no other road to success than to accept and support the democratic process. A national political decision will only be made possible after the technical, scientific, social and local political issues are solved. However, it should also be a responsibility of the national politicians to support the municipalities that try to find a suitable site for solving a national issue. The citizens will accept a repository if they find good reasons to say YES.

The SKB-programme for communication is focussed to “hands-on”-experience by visits to the interim storage facility CLAB, where the spent fuel is stored, by visits to the Encapsulation Laboratory and the Äspö Hard Rock Laboratory where practical demonstration can be given. Every summer the SKB transportation ship Sigyn is used as a floating exhibition with some 1000-3000 daily visitors. A second focus for the communication is to rely more on personal meetings rather than printed matters.

In the municipalities, the feasibility studies put a considerable pressure on the local politicians to handle the issue in a well balanced way given the different views held by its population. One political solution has been to launch early local referenda. It is quite obvious that it is difficult to win early referenda as it takes time to overcome the emotions and find reason for voting yes. There now seems to be a general feeling that the public has the right not only to full access to relevant information but also to the time needed to understand it and to put it

into context. Active participation in the EIA-procedure and decision-making within the normal representative democracy may well be the preferred way to proceed with the siting process in some of the municipalities and in case there will be a referendum it will be held in a late stage of the siting process.

## References

- [1] RD&D-PROGRAMME 95. Treatment and final disposal of nuclear waste. Swedish Nuclear Fuel and Waste Managing Co., Stockholm (1995).
- [2] SKB TR 95-08. Feasibility study for siting of a deep repository with the Storuman municipality (1995).
- [3] SKB TR 96-22. Feasibility study for siting of a deep repository within the Malå municipality (1996).
- [4] ENG, T., THEGERSTRÖM, C. Deep geological disposal of high level radioactive waste in the Swedish bedrock and the corresponding EIA-process. IAIA '98, 18<sup>th</sup> Annual Meeting of the International Association for Impact Assessment (1998).
- [5] OECD/NEA, The Environmental and Ethical Basis of Geological Disposal. A collective opinion of the NEA Radioactive Waste Management Committee (1995).