

MANAGEMENT OF SPENT NUCLEAR FUEL IN SWEDEN

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ABSTRACT

The management of spent nuclear fuel and waste in Sweden is carried out by the Swedish Nuclear Fuel and Waste Management Co, SKB, which is jointly owned by the utilities. SKB operates today facilities for intermediate storage of spent fuel, final disposal of waste from operation and a system for transportation. SKB has in the autumn 1998 presented the RD&D Program 98. It is an overall program for research, development and demonstration of the encapsulation and deep geological disposal of spent nuclear fuel. The general goal for SKB activities for the period up to year 2001 is to nominate two candidate sites for the deep repository. Geological investigations are then planned to start on these sites.

INTRODUCTION

Today about 50 % of the electricity in Sweden is generated by means of nuclear power from 12 reactors located at four sites and with a total capacity of 10 000 MW. Nine of the reactors are BWR and three PWR. The first commercial reactor was put in operation in 1972 and the latest in 1985. Today about 3 700 tonnes of fuel have been used in the power production. The Swedish government has decided to start phasing out reactors for political reasons and they are at present negotiating the terms for a shut down with one of the reactor owners. Due to i.e. this fact it is difficult to foresee the total amount of spent fuel to be taken care of in the future. If all reactors are operated for 25 years, 6300 tonnes of fuel will be used in total. If on the other hand all are operated for 40 years, it will result in a total amount of 9300 tonnes. The amounts of other high level waste will be 10 000 m³ up to 15 000 m³ respectively.

The responsibility for the management of the spent nuclear fuel, as well as for other radioactive residues from nuclear power production, lies with the operators of the nuclear power plants, i.e. the four nuclear utilities. The utilities have jointly formed SKB, the Swedish Nuclear Fuel and Waste Management Company, to safely manage the spent fuel and radioactive waste from the reactors to final disposal. The task of SKB is thus to plan, construct, own and operate the systems and facilities necessary for transportation, interim storage and final disposal.

In Sweden the fundamental guidelines and the division of roles have been established during a long period starting more than twenty years ago. A general policy is that nuclear waste produced in Sweden must also be disposed of in within the country. It is SKB's responsibility to take charge of waste management and find a method and a site for final disposal. The Swedish nuclear power inspectorate (SKI) and the radiation protection board (SSI) review SKB's proposals to make sure they meet the requirements on safety and radiation protection. The government issues permits and licences for siting, construction and operation. The municipalities where new facilities are to be built must approve the siting. Money for the activities is set aside in a special reserve fund via a charge based on the electricity production from the nuclear power plants.

SKB has developed a system that ensures the safe handling of all kinds of radioactive waste from the Swedish nuclear power plants for a long time period ahead. The keystones of this system are (Fig. 1.):

- A transport system which has been in operation since 1983.
- A central interim storage facility for spent nuclear fuel, CLAB, in operation since 1985.
- A final repository for short-lived, low and intermediate level waste, SFR, in operation since 1988.

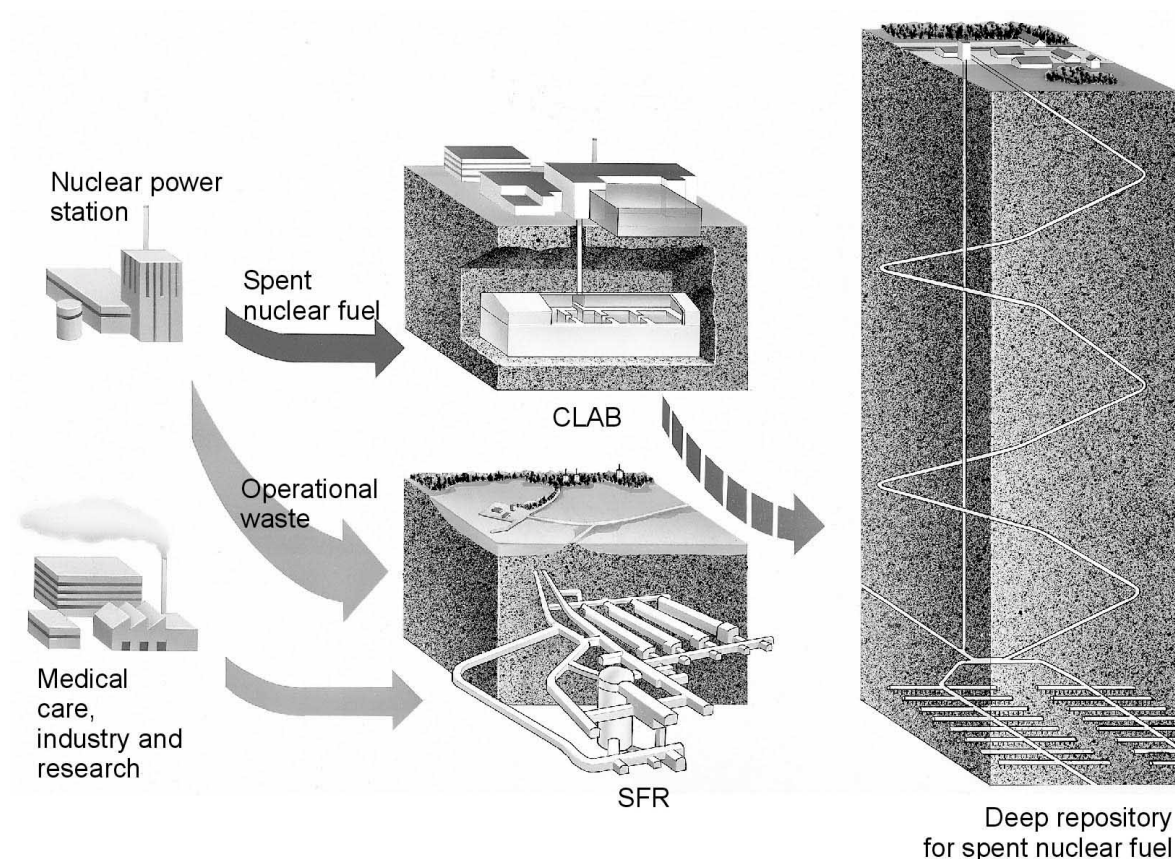


Figure 1. The Swedish system for handling of spent fuel and radiological waste

In the CLAB fuel assemblies are stored in water pools in a storage cavern. The Government gave permission for the expansion of CLAB in August 1998. Construction of a second storage cavern has started in the end of 1998 and the work shall be finished in 2004. Via the system with SFR, CLAB and the ship M/S Sigyn, SKB is already managing and disposing of the radioactive waste products of nuclear power today. The planning for final disposal of spent nuclear fuel is to encapsulate it in durable copper canisters to be placed in a deep repository. SKB is today in an advanced stage of planning and testing methods for the encapsulation and disposal. The remaining components of the system that are now being planned are (Fig. 2):

- An encapsulation facility for spent nuclear fuel adjacent to CLAB,
- A factory for canister production and
- A deep disposal facility for encapsulated spent fuel and other long-lived radioactive wastes.

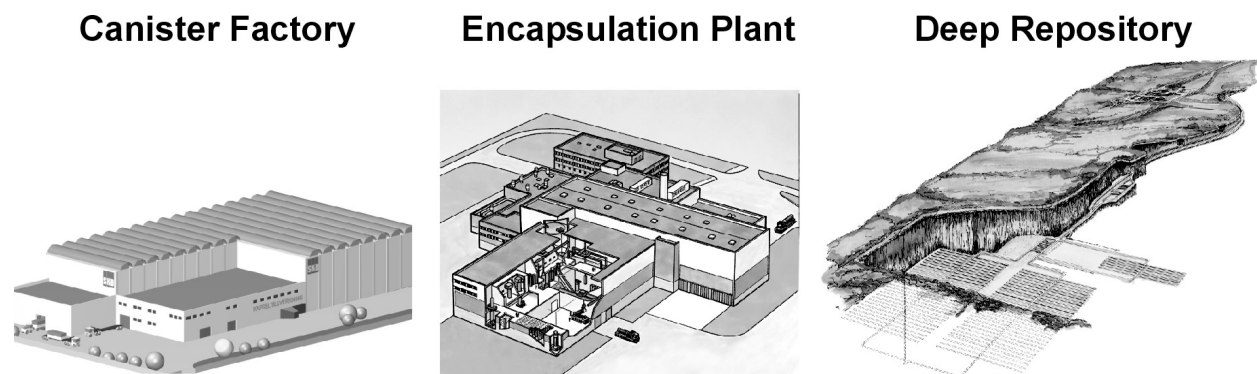


Figure 2. Remaining facilities to be built for encapsulation and final disposal of spent fuel

Programme for Research, Development and Demonstration (RD&D Programme 98)

SKB has been conducting extensive research and development since the end of the 1970s. The main purpose has been to develop the methods and gather the scientific data needed to assess the long-term safety of the repository. Important areas for continued research are:

- *Spent fuel.* Improved knowledge of the durability of the spent fuel in groundwater and models are being developed for the safety assessment.
- *Buffer and backfill.* The properties of the bentonite as a buffer between canister and rock are being investigated and an important research area is the stability of the bentonite.
- *Structural geology and mechanical stability of the rock.* Methods for surveying and interpretation of the structure of the rock are being further refined and more studies are being conducted regarding how earthquakes can affect a deep repository.
- *Water flow and transport.* Models and measurement methods are being progressively improved. It is also important to study how substances are retained in the rock by sorption on the minerals in the rock. Such experiments are being performed at the Äspö laboratory.
- *Groundwater chemistry.* Investigations are being conducted to determine how stable this environment is, how it reacts to the construction of the repository, and how it might change in the future.

- *Radionuclide chemistry.* The influence of microbes, colloids, gas and pore water in concrete is being investigated.
- *Radioactive substances in the biosphere.* Models and data for calculations of the consequences of a release are being improved.

SKB has been working for some years now on gathering the supporting documentation that is needed to apply for a siting permit for an encapsulation plant and the initial stage of a deep repository. SKB has in the RD&D Programme 98 presented a step-by-step programme for implementing deep geologic disposal of encapsulated spent nuclear fuel (demonstration deposition). It also includes an active programme for research and development around central issues relating to technology and safety for the deep disposal method and for alternative methods.

It will take at least 40–50 years to carry out all measures needed to dispose of all long-lived and high-level nuclear waste in a safe manner. It is therefore appropriate to proceed in steps and keep the door open for technological development, changes and possibilities for retrieving already deposited waste. This will ensure freedom of choice for the future while at the same time demonstrating the deep disposal method on a full scale and under actual conditions. Decisions regarding siting, construction and operation of an encapsulation plant and a deep repository will also be taken in steps and based on progressively more detailed information.

An interim goal in our plan for implementing deep disposal is to be able to choose at least two sites for investigations by 2001. At this time the regulator authorities and the Government are expected to make clear their views regarding SKB's main method. Based on analysis of various methods it should be possible to take a clear stand on whether the method chosen by SKB represents the right strategy. In support of coming siting applications for an encapsulation plant and a deep repository, SKB will prepare environmental impact statements based on environmental impact assessments. Consultations have been initiated locally, regionally and nationally and will continue throughout the siting process.

A central part of SKB's work in the years to come is to develop, test and demonstrate the different parts of the deep repository system on a full scale and under realistic conditions. The tests will include the most important steps in fabrication and sealing of canisters as well as construction, operation and closure/sealing of the deep repository. Some tests, for example trial fabrication of canisters on a full scale, have already been going on for several years. SKB plans to expand the activities for development and testing of full-scale technology during the coming years. The majority of the tests will be performed at the Äspö HRL (Hard Rock Laboratory) and the Canister Laboratory. In addition to the technical aspects of the full-scale tests, it is important to be able to practically demonstrate the various steps in encapsulation, transport, emplacement and retrieval to both specialists and the general public.

TECHNICAL REQUIREMENTS FOR THE REPOSITORY

The primary function of the deep repository is to *isolate* the waste. The canister provides direct isolation, but the buffer and the rock are also needed for the canister to fulfil its isolating function. These barriers must satisfy a number of requirements to provide good isolation. If this isolation should be breached, the deep repository is also supposed to *retard* the transport of

radionuclides from the fuel. The canister, the buffer and the rock work in conjunction to provide this function as well. The retarding function makes additional demands on the barriers.

The canister

The canister must be designed to ensure high safety during encapsulation, transport and deposition and be able to be serial-fabricated to specified quality requirements. The requirements made on the canister for the long-term safety can be divided into requirements related to the isolating function and requirements related to the retarding function. To achieve isolation, the canister must be leak-tight on emplacement, be resistant to the chemical environment anticipated in the deep repository. The canister must withstand all known corrosion processes so that it can be expected to remain intact in the deep repository for at least 100,000 years. It must also be able to withstand the mechanical loads anticipated in the deep repository, caused by the pressure exerted by the groundwater and the swelling bentonite. Future ice ages or major rock movements can also give rise to mechanical stresses on the canister.

Chemical resistance means that the outside of the canister must not be affected by corrosive substances in the groundwater or by any harmful substances that may be introduced during construction of the repository. Moreover, the canister must not corrode internally as a consequence of the harmful substances that may remain or be formed in the canister. To ensure the retarding function, the canister must influence the chemical properties of the buffer and the rock as little as possible. The heat flux and radiation dose to the near field must be limited. The material of which the canister is made must not affect the rate of dissolution of the fuel or radionuclide transport through buffer and rock. The canister must be designed so that there is no risk of criticality in connection with handling of the canister with fuel during the encapsulation process or in the long run in the final repository if water should enter the canister.

The buffer

The requirements on the buffer can, like the requirements on the canister, be divided into requirements related to the isolating function and requirements related to the retarding function. For the isolating function, the buffer must completely enclose and protect the canister for a long period of time, and keep it centred in the deposition hole. It shall also prevent groundwater from flowing through the buffer and thereby prevent corrosive substances from being transported to the canister in any other way than by diffusion.

These requirements in turn require that the buffer should remain in the deposition hole and that it should be chemically stable over a long period of time. Another requirement is that the buffer should efficiently conduct heat away from the canister. Several of the requirements relating to the isolating function also relate to the buffer's retarding function. For this function, the buffer must create conditions where radionuclide transport takes place by diffusion and where radionuclides sorb on the surface of the clay particles. The buffer must also filter colloids that may form on dissolution of the fuel. Gas that may form inside a damaged canister must be allowed to escape. As far as the operating period is concerned, blocks of buffer material must be able to be fabricated, transported and emplaced in the deposition holes in a manner that guarantees the necessary quality.

The bedrock

The host rock also has an isolating and a retarding function. For the isolating function, the bedrock must constitute a mechanically stable environment for the deep repository. It shall also provide a chemical environment that is long-term stable and favourable with respect to the function of the other barriers. It also reduces the risk of future intrusions and alternative uses (e.g. mines).

For the retarding function, the composition of the groundwater must be such that the solubility of the radionuclides is limited. The bedrock must also limit the transport of the radionuclides with the groundwater to the biosphere. To the requirements relating to long-term safety are added requirements relating to construction and operation. The bedrock must possess such properties that the deep repository can be built and operated with adequate safety and known technology. This means, among other things, that it must be possible to construct stable rock excavations and that it must be possible to operate the repository with good control of excavation stability and groundwater seepage. The principle is to select a site, with the aid of increasingly detailed investigations, where the bedrock satisfies the fundamental requirements while also providing other favourable conditions, and to adapt the layout of the repository to conditions on the site.

The backfill material and seals

When the canisters are positioned in the deposition holes the tunnels shall be back-filled. The backfill material to be used should contribute to tunnel stability and hold the bentonite around the canisters in place. The backfill is also supposed to prevent or limit the flow of water around the canister positions. Furthermore, the backfill material should not cause deterioration of the quality of the groundwater and should remain chemically stable over a long time.

The tunnels and shafts in the deep repository may need to be sealed, temporarily or permanently, with plugs. Temporary plugs will be needed during the operating phase to separate backfilled deposition tunnels or other areas that need to be temporarily separated from areas that are open and accessible. The requirements on these seals are that they should firstly hold buffer and backfill material in the closed-off area in place, and secondly prevent or reduce water transport from the closed-off area inside the plugs to the open area outside. Permanent seals may be needed to reduce water flows in or along tunnels or to isolate tunnel sections that are intersected by water-bearing fracture zones. A more precise definition of the requirements on permanent seals requires access to data from the specific site and to results of performance assessments.

CANISTER DESIGN AND FABRICATION

Design

The reference canister chosen by SKB consists of an outer corrosion barrier of copper and a pressure-bearing insert of cast iron, see Figure 3. A 50 mm wall thickness made of oxygen-free copper with low phosphorus content is being used as reference. The bottom and lid are joined to the shell by electron beam welding. The canister insert is of cast iron and has a minimum wall thickness of 50 mm. The canister holds either twelve BWR assemblies or four PWR assemblies. Its diameter is 1 050 mm and its length is 4 830 mm. The total weight, including fuel, of a BWR canister is about 25 tonnes, and of a PWR canister about 27 tonnes. The copper material is equivalent to UNS 10100 with an addition of about 50 ppm phosphorus to increase the material's creep ductility. The insert is made of nodular graphite iron equivalent to SS 14 07 17.

The canister is designed to withstand the mechanical stresses that arise in a deep repository in granite rock down to a depth of 700 metres. This gives a load of up to 7 MPa of hydrostatic pressure from the groundwater, plus about 7 MPa of swelling pressure from the bentonite. With addition of conventional safety margins the canister is therefore designed for an external pressure of 35 MPa. It must also be taken into account loads that can be expected during an ice age. With an assumed maximum ice thickness of 3 000 metres and a corresponding increase in the groundwater pressure, the maximum external pressure to which the canister could be subjected is 44 MPa, which is regarded as an extreme case for which no extra safety margins are required.



Figure 3. Copper canister with cast insert (reference design).

Canister Fabrication

The operating period for the encapsulation of spent fuel will extend over a time span of more than 40 years. It is thus possible that several different fabrication methods will be used during this time if alternative methods are developed and become available. Trial fabrication of full-sized canisters has shown that both forming from rolled plate and extrusion are possible methods for fabricating copper cylinders on a full scale. Casting of inserts in one piece has also been done with good results.

A preliminary study of how a canister-factory could be designed has been performed (Fig. 5). The copper tubes are fabricated in the factory by roll forming of rolled plate into tube halves, which are subsequently welded together by longitudinal electron beam welding. Copper lids and copper bottoms are machined from forged blanks. The bottoms are then electron-beam-welded to the copper tubes. All welds are tested by both ultrasonic and X-ray (radiographic) inspection. Cast and rough-

machined inserts of nodular graphite iron are delivered to the canister factory for finish machining. Blanks for insert lids are cut out of rolled steel plate and then finish-machined in the factory. After cleaning of all parts, the insert is lifted down into the copper shell. The canister is then finished for delivery to the encapsulation plant. Where the canister factory will be located has not yet been decided.

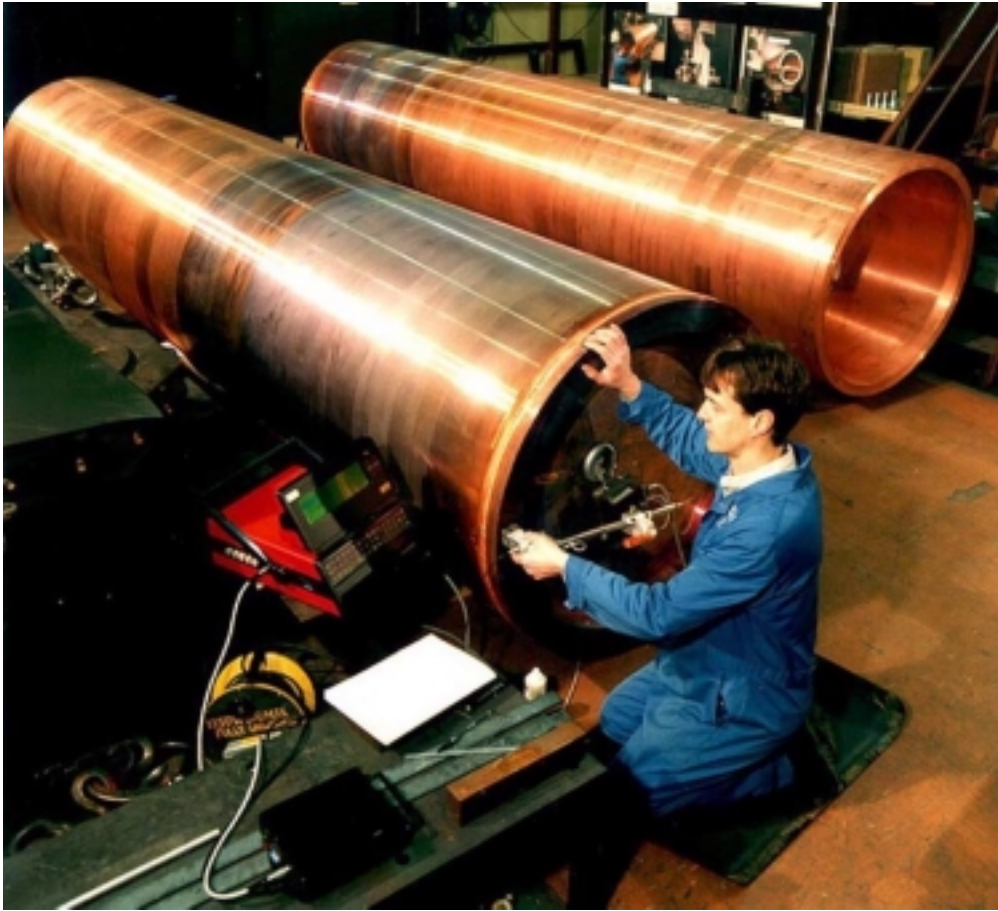


Figure 4. Machining of 50 mm copper-cylinder for a trial canister

To fulfil the stringent requirements on sealing of the copper canister, a method is being developed employing electron beam welding of the copper lid. The same method is also employed to attach the bottom of the copper canister. Alternative methods that have been proposed are friction welding and diffusion bonding. Methods for non-destructive testing of the weld are being developed in parallel in order to verify that it complies with the stipulated requirements. Results obtained show that electron beam welding is a feasible method for fabricating and sealing copper canisters. Fully satisfactory results have not yet been obtained from the work of development of methods for non-destructive testing; this will require further efforts.

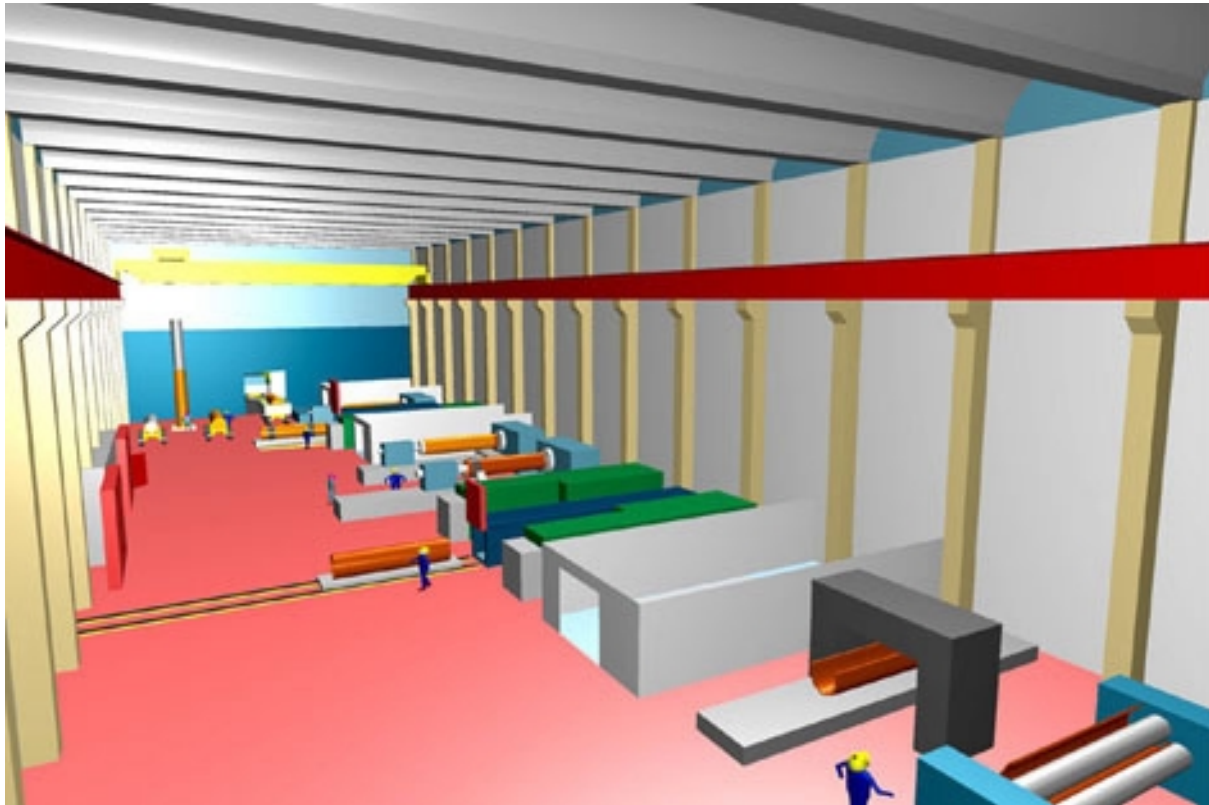


Figure 5. General layout for a canister-factory

ENCAPSULATION TECHNOLOGY

Encapsulation Plant Design

The encapsulation plant can either be sited at CLAB, at the deep repository, at an existing nuclear installation, or at some other location. SKB's main alternative is co-siting of the encapsulation plant with CLAB, since this alternative offers a number of advantages. One of the advantages is that the experience of fuel handling possessed by the personnel at CLAB can best be exploited if the encapsulation plant is built on the same site. Furthermore, several of the existing systems and plant sections in CLAB can also be utilised for the encapsulation process. No new land needs to be developed, and no new roads or cooling water plants are needed. Moreover, CLAB and the Oskarshamn Nuclear Power Station provide valuable access to other nuclear resources, such as expertise in radiation protection and handling of radioactive waste.

At a first stage only spent fuel will be encapsulated in the plant but preparations will be made for the later addition of equipment for treating core components. In designing the Encapsulation Plant a great deal of emphasis will be placed on radiation protection for the personnel and the environment. This means, among other things, that the actual encapsulation procedure will be performed by remote control in heavily radiation-shielded compartments (hot cells). A large part of the handling of canisters will also be done by remote control.

The Encapsulation Plant will be approximately 65 x 80 meters in size and about 25 meters high, which is equivalent to the height of the existing receiving building in CLAB. The cost of the Encapsulation Plant is in the order of SEK 1700 million (USD 260 million). The operating staff can work both in the Encapsulation Plant and in CLAB. During normal operation, approximately 30 people are working daytime with encapsulation and maintenance.

The encapsulation process is being designed and engineered to deliver well-fabricated and carefully inspected canisters with fuel to the deep repository. In designing the process, special attention will be given to matters related to industrial and radiological safety. The fuel is transported in storage canisters from the storage section of CLAB. The fuel is taken from the water to the handling cell (Fig. 6), where it is dried and placed in a disposal canister. In this part of the plant, where the fuel is handled freely, special requirements must be met to prevent the escape of radioactivity. The transfer canister is lifted to the handling cell where it is placed in one of two drying stations. There, the fuel is dried with recirculating air with a temperature of about 120°C. A shielded frame with an empty disposal canister is docked from below to another part of the cell. The connection between the canister and the handling cell is tight so that the outside of the canister will not be contaminated and the air in the cell cannot escape and cause airborne activity in other parts of the plant.

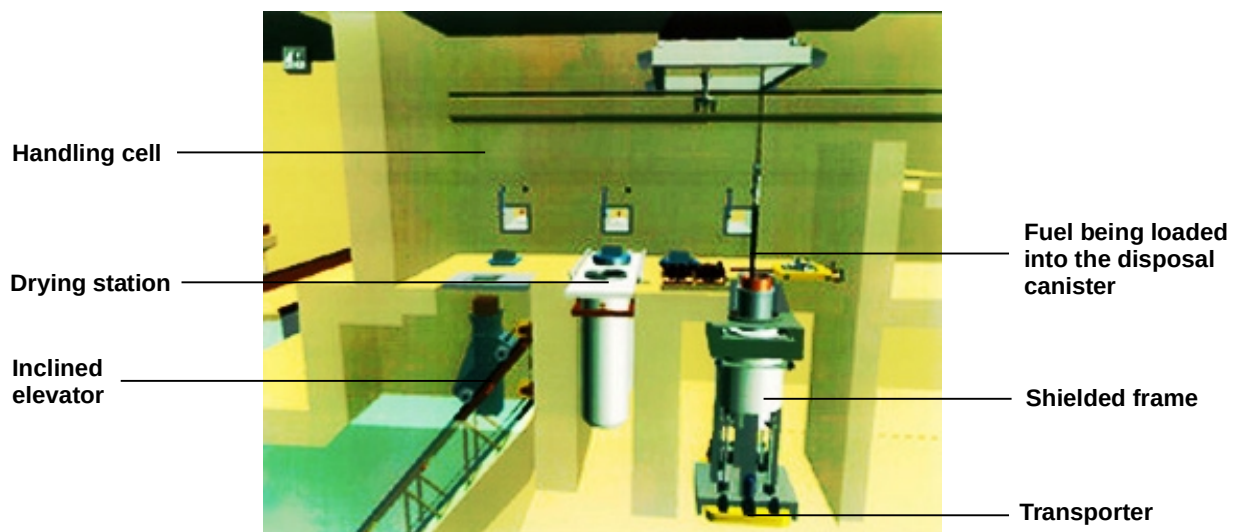


Figure 6. The Handling Cell where the fuel is dried and placed in the canister

Three stations are planned for sealing of the canister. The first will contain the functions required for the exchange of air to inert gas in the canister and, if necessary, packing around the fuel assemblies. Finally, the steel lid is fitted and sealed. Thereafter there is no risk of radioactivity escaping from the fuel. This workstation is also designed to meet the requirements made on a hot cell. The copper lid is placed on and sealed in a welding station. The design of the welding station will be based on the current work of developing an electron beam welding method. The material in the copper lid and the copper cylinder are melted together by an electron beam in a vacuum chamber. The last of the three stations will house equipment for inspection of the lid weld and for machining of the weld area on the canister and for removal of an improperly welded lid. The result of the sealing operation will be

inspected by means of non-destructive testing using a technology that is being developed at the same time as the sealing method.

A routine check of surface contamination is planned, and decontamination of the outside of the canister will be possible in a separate workstation. Then the canisters are placed in a buffer store from which they can be delivered to the deep repository at a suitable pace.

The Canister Laboratory

The Canister Laboratory will serve as a centre for development of encapsulation technology and training of personnel for the encapsulation plant. The main purpose is to test equipment for sealing and inspection of canisters. This is needed to provide a good basis for the continued planning and design of the encapsulation plant. In the Canister Laboratory, SKB will demonstrate that canisters can be sealed with the requisite quality at the production rate that will be required in the encapsulation plant. The results from the Canister Laboratory will comprise an important part of the application for a licence for the encapsulation plant.



Figure 7. Interior from the Canister Laboratory

The objective of the work in the Canister Laboratory is to verify the performance and availability of the equipment and to determine processing times and capacities. Operating and maintenance instructions will then be prepared prior to assembly and commissioning of equipment in the encapsulation plant. The equipment for sealing and inspection of canisters is installed in three different stations (fig. 7): a welding station, a station for non-destructive radiographic (X-ray) testing and a station for non-destructive ultrasonic testing. The equipment that is installed in the Canister

Laboratory is designed in basically the same way as the equivalent equipment in the encapsulation plant. The programme for the coming three-year period includes series of trial sealing of copper lids.

The equipment for non-destructive testing will be tried out to make sure it meets the requirements for detection of defects. This is planned to be carried out during the coming three-year period. This will be followed by a period when the methods for non-destructive testing will be qualified, which can take place at the same time as licensing of the encapsulation plant. The Canister Laboratory will also be used for testing and demonstration of other parts of the encapsulation process, such as handling in the encapsulation plant's handling cell. Another important task is the training of operating and maintenance personnel for the encapsulation plant.

REPOSITORY TECHNOLOGY

Repository Design

The design process includes both facilities and equipment above and below ground, as well as planning of the activities during the construction and operating phases. In the same way as for the encapsulation plant, the deep repository is designed in steps that represent a gradually increasing level of detail. During the course of the work, system studies are conducted to investigate layouts and sub-systems. Earlier phases of the design work have resulted in a facility description with examples of how the deep repository can be configured (Fig 8).

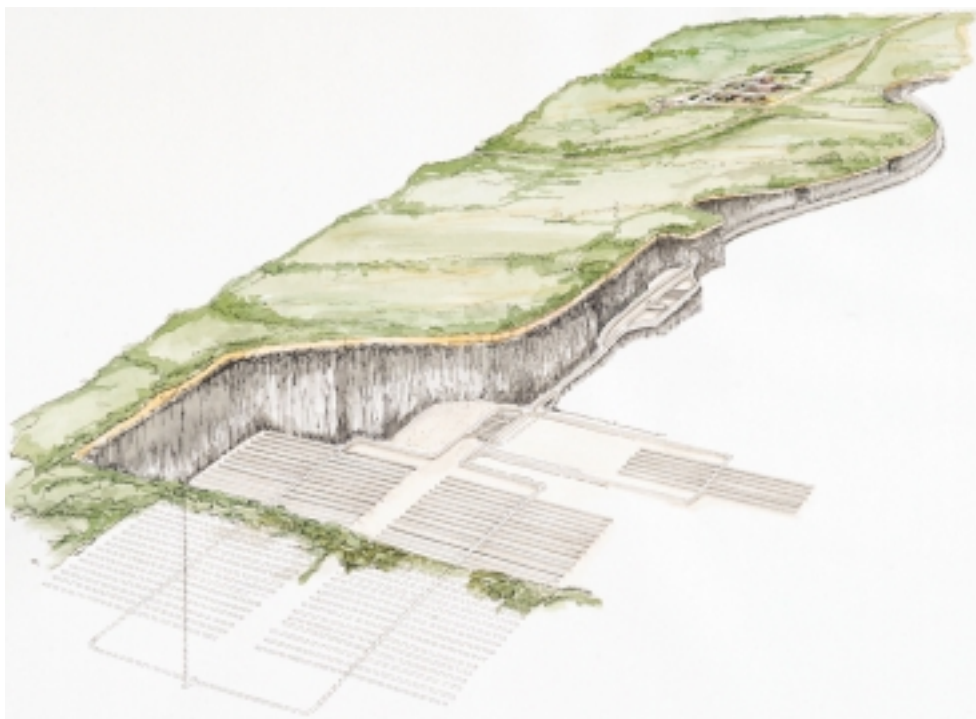


Figure 8. Layout of the Deep Repository

The general siting studies and feasibility studies that have been or are being conducted do not furnish the data on the bedrock that is needed for adapting the underground facilities to local conditions. Data that are needed for site-adapting the surface facilities are more readily available. The feasibility studies have therefore in some cases included sketches of on-surface layouts for specially studied locations. Among other things, the possibilities of joining the deep repository's surface facilities to existing nuclear installations have been studied.

The design work becomes increasingly detailed as data become available from the site investigations. An initial phase is expected to commence roughly one year after the start of site investigations. Then the locations and layout of the surface facility and underground repository will be adapted in rough terms to the characteristics of the site. Connections between the surface and underground portions are also determined (shaft or ramp). Layout drawings of surface facilities tunnel systems and access ramps/shafts are prepared. In a second phase, starting a couple of years later, drawings and other documents describing both the layout and function of individual facility parts and how the parts are tied together into a whole are produced. The end product is a site-adapted layout and design of the deep repository that is included in the supporting documentation for applications for permits for detailed characterisation and construction.

The Äspö Hard Rock Laboratory (Äspö HRL)

The program for development activities at Äspö HRL comprises among other things; drilling of deposition holes, testing of a deposition machine, testing of methods for backfilling, sealing and retrieval.

Drilling of deposition holes

SKB has for many years been working on the development of the method for boring of deposition holes. Important milestones have been the choice of the downward dry full-face boring method and the initial field tests performed in Finland. At present we are boring several deposition holes for full-scale tests and technology demonstration at the Äspö HRL. The diameter of the holes will be 1.75 metres and the depth about 8 metres.

During boring, a wide variety of boring parameters will be continuously recorded. With these data as support, the performance of the machine and the peripheral equipment can be studied and optimised. We will also follow up the mechanical effects of the boring procedure on the walls of the holes and other aspects of whole quality. Methods for analysis of the damaged zone have already been developed. Supplementary laboratory tests, as well as field tests, are planned to study the hydraulic characteristics of the system consisting of the bentonite, the rock surface and the damaged zone.

Testing of deposition machine

To test and demonstrate the technology for emplacement of canisters in the deep repository, SKB is developing a full-scale prototype of a deposition machine. The purpose is to acquire experience from design, manufacture and operation of such a machine. The main goals of the project are to develop and test methodology and equipment for emplacement of canisters. The various steps in emplacement and retrieval of canisters shall also be demonstrated to both specialists and the general public. The deposition machine will be put into operation in a tunnel at the 420-metre level in the Äspö HRL. Repeated tests of emplacement and retrieval of canisters are planned in two full-sized deposition holes.

The work of designing the deposition machine was begun in early 1997. The machine is under manufacture and delivery to the Äspö HRL is planned in 1999. The deposition machine is railborne and designed to be used in both blasted and bored deposition tunnels. The design is chosen so that the dimensions of the tunnels are limited, since this is of great importance in the deep repository. Another feature needed in the deep repository is that it should be possible to dismantle, relocate and reassemble the machine in a new tunnel with a reasonable labour input. The machine is radiation-shielded and remote-controlled, but faults can nevertheless be corrected on site. A schematic drawing of the machine is shown in Figure 9.

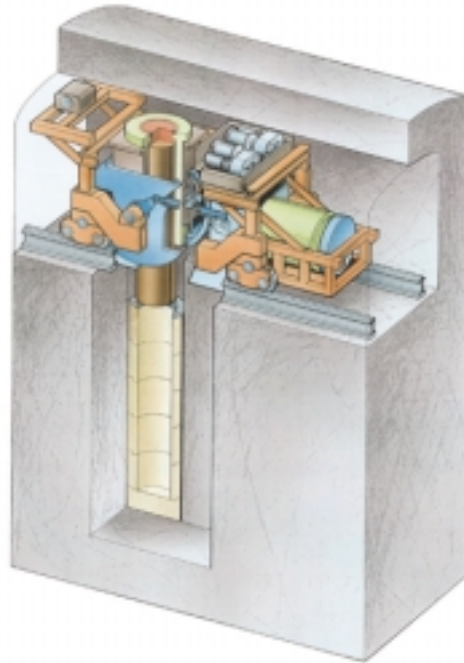


Figure 9 Deposition machine for disposal of canisters in the deep repository

Testing of backfilling and sealing methods

SKB plans to test different backfill materials on a full scale at the Äspö HRL (Backfill and Plug Test). The main goals of the project are to develop and test materials and compacting method for backfilling of blasted tunnels, test the backfill's function and interaction with surrounding rock and develop and test method for and performance of plugs for temporary sealing of deposition tunnels.

The test will be conducted in a tunnel at the 420-metre level. The inner part of the tunnel is backfilled with a mixture of 50 percent bentonite and 70 percent crushed rock and the outer part with crushed rock alone. A layer of pre-compacted blocks consisting of 50 percent bentonite and 50 percent crushed rock is placed nearest the roof in the outer part of the tunnel. The test tunnel is sealed with a concrete plug.

The backfill is compacted with inclined layers, which is a technique developed in earlier tests. During the test, the sealing capacity of the backfill and the concrete plug will be measured. When the measurements are finished, the backfill will be removed for examination and analysis.

Testing of retrieval

Since one requirement for the deep repository is that it shall be possible to retrieve deposited canisters, it is necessary to develop and test the method for retrieval as well. The main goals of the project are to, under realistic conditions develop and test the method for freeing a canister from water-saturated and swollen bentonite.

The retrieval tests will be conducted in a new tunnel at the 420-metre level. Two full-sized canisters will be placed in deposition holes and surrounded with bentonite. The canisters will be equipped with electric heaters and the bentonite blocks with some instrumentation. The deposition holes will be sealed with concrete plugs. The deposition holes will be left for 3–5 years to give the bentonite time to become saturated with water. During this time, equipment for freeing of canisters will be designed and manufactured. When the bentonite is saturated, the two test canisters will be freed and lifted out.

CONCLUSION

The Swedish program for HLW and spent fuel management is now focused on the siting process for the deep repository. The nearest goal is to get acceptance for the repository design and to be able to start investigations on two sites in year 2001. SKB's planning for the coming period includes the following activities:

- Report the results of general siting studies and the results of the feasibility studies performed in at least five communities with SKB's choice of at least two sites for site investigations.
- Present programmes for geo-scientific site investigations and site evaluation with criteria.
- Submit a new comprehensive assessment of long-term safety and have it reviewed by Swedish and international experts.
- Present results from the work of technology development and planning/design of encapsulation and deep disposal.
- Compile supporting material for an application for a permit to build an encapsulation plant.