
Beratungsunterlage zu TOP 4
der 16. Sitzung der Kommission am 2. Oktober 2015

Anhörung „Rückholung/Rückholbarkeit hoch radioaktiver Abfälle aus einem Endlager, Reversibilität von Entscheidungen“

Retrievability of spent nuclear fuel in a Swedish final repository

von Erik Setzman, Swedish Nuclear Fuel and Waste Management Co (SKB), Stockholm, Sweden

---

Kommission
Lagerung hoch radioaktiver Abfallstoffe
K-Drs. 130 b

Retrievability of spent nuclear fuel in a Swedish final repository

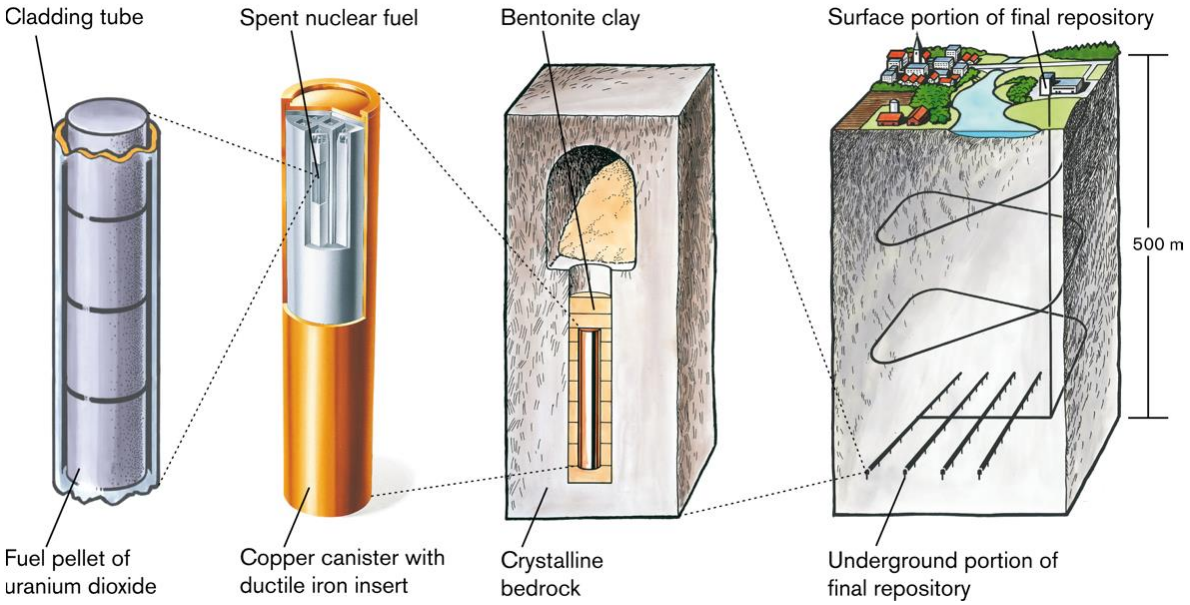
Erik Setzman
Swedish Nuclear Fuel and Waste Management Co (SKB),
Original paper from OECD NEA Reversibility and Retrievability conference 2010, finalised and approved 2012, updated 2015-09-22 for Berlin Hearing with The Commission on the Storage of Highly Radioactive Materials

The Swedish Radioactive Waste Management Programme

The Swedish Nuclear Activities Act stipulates that the nuclear power industry, the reactor owners and license holders, are responsible for taking care of the spent nuclear fuel and radioactive waste from their electricity production. The Swedish Nuclear Fuel and Waste Management Co (SKB) was founded by and is owned by the reactor owners to fulfil this mission safely and without negative effects for human health and the environment both in the short and the long term. Safety is the top priority. The system has to be reliable and resistant against malfunctions and safety after closure is to be based on a system of passive barriers without surveillance or monitoring. SKB´s work within the Swedish Radioactive Waste Management Programme is financed through payments from the reactor owners to The Swedish Nuclear Waste Fund which is controlled by the Government and administrated by the regulator. Final disposal of spent nuclear fuel must be safe without surveillance or monitoring.

SKB´s planned final disposal concept with a geologic repository (Figure 1) in the stable crystalline Swedish bedrock, the KBS-3 system, is based on more than 30 years of research, development and demonstration (RD&D).

Figure 1:SKB's final repository KBS-3



Permit applications for an encapsulation plant (in Oskarshamn) and a final repository (in Forsmark) for spent nuclear fuel have been submitted both to the regulator, The Swedish Radiation Safety Authority (SSM) and to the Land and Environment Court in Nacka (Stockholm). Licensing procedures according to the Nuclear Activities Act and the Environmental Code are ongoing since 2011. Judgements from the regulator and the court and a Governmental decision are expected in 3-4 years. Current planning indicates a possible start of construction around 2020 and a possible start of operation around 2030 continuing until the 2070´s with possible closure at the end of the 21st century.

Retrievability, reversibility or recoverability

SKB is convinced that a broad (both concerning participants and alternatives), patient, transparent stepwise acceptance, evaluation and decisionmaking process with clear roles and responsibilities from early studies through consultations, site selection and licensing and further on contributes to the absolutely essential trust and confidence. It, especially the stepwise triannual decisions on RD&D and financing and on licensing and acceptance, also gives reversibility of decisions if needed.

As a result of the OECD Nuclear Energy Agency (NEA) project on Reversibility and Retrievability (R&R) ending in a conference in Reims 2010 SKB prefers to employ the term and the concept of **retrievability** in most discussions of relevance to these subjects. Subtle differences between retrievability and concepts such as reversibility and recoverability are difficult to communicate to a wider audience. The use of obscure terms in this case creates a risk of confusion instead of clarification. SKB finds moreover that it is vital to uphold a clear distinction between retrievability before closure and retrievability after closure of a final repository.

SKB's task and mission is to plan, construct, operate, close and seal **a final repository** for spent nuclear fuel **not a facility for long-term storage**. Retrievability is not a prime subject in Sweden due to the KBS-3-system and the host rock. There are currently no legislation, other requirements or provisions prescribing or promoting that it should be possible to retrieve or recover spent nuclear fuel after repository closure. No specific design or construction measures to facilitate retrieval or retrievability are included or planned. Such requirements or measures would risk interfering with safety concerns and would have to be proved not to affect safety negatively. However, SKB cannot completely exclude situations whereby the issue of retrieving material from a repository may have to be addressed. Retrieval of canisters from a KBS-3 repository (Figure 1-2) will be possible, both before and after closure. In Figure 2 SKB's plans for a KBS-3 repository are mapped onto the NEA "R&R" "retrievability scale". It shows the steps and activities in a "Swedish retrievability scale".

The KBS-3-system and the host rock makes controlled, stepwise retrieval of spent fuel canisters for correction of mistakes fully possible during operation up until repository closure. If decided by future generations retrieval of canisters after closure will also be possible but post closure retrieval requires more knowledge, technology and resources and will be more complicated than before closure. This ensures security. Outside SKB interest for this subject is shown primarily from decisionmakers, the regulator, media and some stakeholders.

5 potential retrievability scenarios

Before closure

Scenario 1: Shortcomings/mistakes during deposition operations may have to be corrected by retrieving single canisters for inspection or other measures

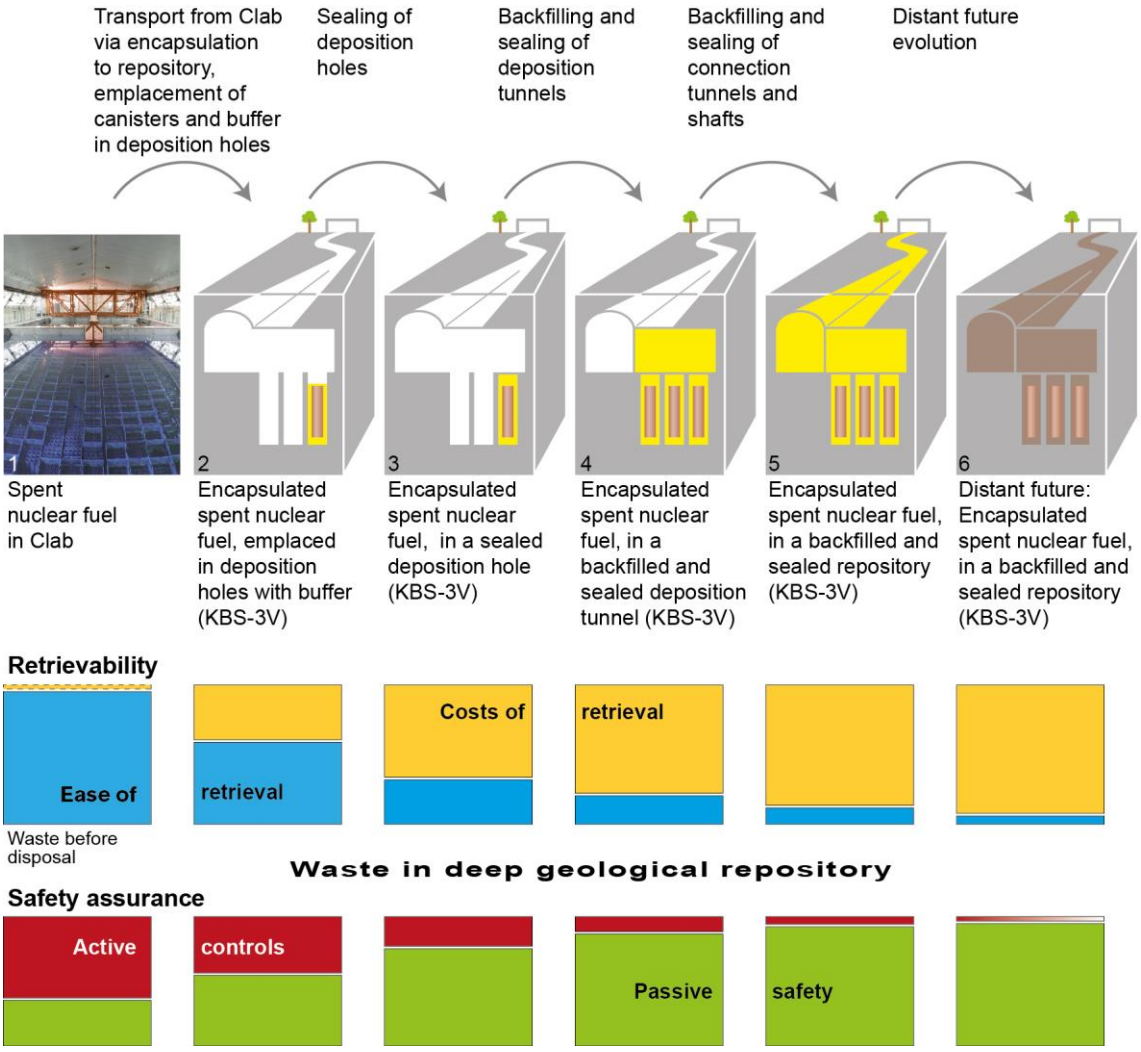
It is realistic to assume that shortcomings and mistakes will occur during deposition operations. We must therefore be prepared to handle a situation that may call for a retrieval of a single canister or a few canisters to a place where inspection or other measures can be safely carried out. This situation is considered in research at the Äspö Hard Rock Laboratory, where it has been shown how to remove a canister from a deposition hole with a bentonite buffer. This scenario is fully addressed in the safety case included in SKB's permit applications from March 2011.

Scenario 2: During the operation time of the repository the acquisition of new knowledge results in the long-term safety case being questioned

According to current plans, the repository is expected to operate until the 2070s. Though the possibility of the long-term safety case being called into question seems to us to be highly improbable, it is, however, worth reflecting upon. The necessary response measures depend on the detailed implications of such new knowledge and when the scenario occurs. Measures could range from what can be achieved within the framework of a revised KBS-3 repository, to a

retrieval of some or all deposited canisters in order to plan for an alternative site or method for final disposal of the spent fuel.

Figure 2: The NEA "retrievability scale" adjusted to SKB's plans for a KBS-3 repository – A "Swedish retrievability scale"



Scenario 3: During the operation time of the repository it is decided that new nuclear power should be installed in Sweden

Assuming once again an operation time up to the 2070s, a decision to install new nuclear power in this scenario would be based on the notion that new reactor types could make use of the remaining energy content in today's spent fuel. SKB does not speculate on the probability of such a development. It does not seem probable that such a scenario would result in retrieval of already deposited canisters. A more likely development could be the cancellation of further deposition operations in the repository, which could then be closed and sealed with deposited canisters remaining there. Alternatively, the spent fuel that remains in the Central Interim Storage for Spent Nuclear Fuel (Clab), located near Oskarshamn nuclear power plant, could be used.

After closure (at the end of the 21st century or later according to current planning)

Scenario 4: Some time after deposition of the last canister the acquisition of new knowledge results in the long-term safety case being questioned

A decision on closure of the repository cannot be expected unless responsible actors (operators, regulators and decision makers) are strongly convinced of the long-term safety case. In theory it cannot, however, be excluded that the acquisition of new knowledge results in the long-term safety case being questioned. Which measures must be taken under such a scenario? This is not a question for which we can produce a proper response – only generations living at the time will be able to address this type of situation. The current generation, though, has a responsibility to contribute to the knowledge base so that future generations will be equipped to respond appropriately.

Scenario 5: At some future point in time after closure of the repository at the end of the 21st century the repository is regarded as an asset containing valuable material and not waste

It is assumed that such a scenario could take place at any point in time near or far after closure. As with Scenario 4, we have to assume that a decision on closure of the repository cannot be expected unless those who will be responsible (operators, regulators and decision makers) are strongly convinced that the contents of the repository are waste and not assets. Theoretically however it cannot be excluded that an opposite assessment will be made in the future. Once again, it will be up to those living at the time to address the issue. They will be the ones to judge if resources needed to make use of this "asset" are in due proportion to what can be achieved through a retrieval operation.

Legal issues under observation

Strategical legal issues that have been identified as requiring more thoughts are

- responsibility for a sealed final repository for spent nuclear fuel,
- ownership of spent nuclear fuel in a final repository and
- application of national and international provisions about safeguards, security and physical protection on a sealed final repository for spent nuclear fuel.

These issues have been discussed within SKB, with the regulator, within a Swedish government committee and during public consultations but they are currently not regarded as priorities.

Figure 3: Schematic illustration of planned final repository for spent nuclear fuel at Forsmark