



Ö. Toverud, S. Wingefors
Swedish Nuclear Power Inspectorate,
Stockholm, Sweden

Abstract

An important contribution to the discussion on retrieval in Sweden has been the ethical principle of the Swedish National Council for Nuclear Waste (KASAM). "The KASAM Principle" means that the present generation, which has reaped the benefits of nuclear energy, must also take care of the waste and not transfer the responsibility to future generations; a repository should be designed and constructed so that monitoring and remedial actions are not necessary in the future. However, future generations, probably with better knowledge and other values, must still have the freedom to make their own decisions; we should therefore not make monitoring and remedial action unnecessarily difficult. SKI generally supports the KASAM principle but its application in the individual case should be based on solid evidence that both aspects have been covered in a suggested repository design. There may be a number of possible reasons for retrieval of spent nuclear fuel from a repository and they range from technical to purely political. SKI supports that the repository shall not be designed so that it unnecessarily impairs future attempts to retrieve the waste, monitor or "repair" the repository. However, measures to facilitate any kind of access to the repository must not reduce the long term safety of the repository. SKI concludes that: Future generations may wish to retrieve the spent fuel from a sealed repository. Disposal method and repository design should consider this and not make such retrieval unnecessarily difficult. On the other hand, any measures taken to facilitate retrieval must not significantly impair the long term safety functions of the repository. It must be shown that the safety aspects have been adequately considered. Retrievability must always be discussed with caution, so that it will not give the impression of doubts concerning the safety of the repository.

1. INTRODUCTION

Retrievability has recently attracted considerable interest from regulators, implementers as well as other stakeholders in the siting of repositories for spent nuclear fuel.

Already in 1993 when the Swedish Nuclear Power Inspectorate (SKI) reviewed the Swedish Nuclear Fuel and Waste Management Co's (SKB) RD&D Programme 92 (presented to SKI every third year) retrievability was discussed. SKB then introduced a step-wise approach to disposal of spent nuclear fuel. In that context SKI commented that it is vital that the necessary preparations should be made to facilitate retrieval of the emplaced fuel canisters after the first demonstrational phase. This is still SKI's opinion concerning the first phase of a step-wise disposal of spent fuel.

1.1. Ethical principles – arguments in the public debate

An important contribution to the discussion on retrieval in Sweden has been the ethical principle of the Swedish National Council for Nuclear Waste (KASAM), “the KASAM Principle”. This principle means that the present generation, which has reaped the benefits of nuclear energy, must also take care of the waste and not transfer the responsibility to future generations; a repository should be designed and constructed so that monitoring and remedial actions are not necessary in the future. However, future generations, probably with better knowledge and other values, must still have the freedom to make their own decisions; we should therefore not make monitoring and remedial action unnecessarily difficult. (In this context the remedial actions include retrieval).

SKI generally supports this principle but its application in the individual case should be based on solid evidence that both aspects have been covered in a suggested repository design. The credibility in designing repositories that are at the same time safe, include features for prevention of human intrusion, and with a possibility for retrieval, has been contested by environmental groups. In their comments to SKB’s RD&D Programme 98 they claimed that the requirement for isolation, i.e. prevention of human intrusion, contradicts a requirement for retrievability. Thus, they consider that this double message destroys the credibility of the KBS-3 method (see below).

However, SKI does not agree on the argument that the requirement for isolation necessarily must contradict a demand on retrievability. It should be possible to develop a disposal method and repository design that balances between these two aspects. The KBS-3, or similar, disposal concepts provide for retrievability over extended periods of time without compromising neither operational nor long term safety of the repository.

For obvious reasons a balance may be difficult to achieve for some disposal methods, notably the very deep bore holes (cf discussion in the paper by M. Jensen, SSI).

1.2. “Disposal” as opposed to “deep storage”

The observant reader of SKB’s RD&D programme and regulatory reviews cannot have failed to notice that SKB and the authorities use different terms for the planned deep geological repository. SKB consistently uses the term “deep storage” for what the authorities call “(final) disposal”. (The ambiguity is not apparent in English — in Swedish these terms are rather much alike: “djupförvar” vs “slutförvar”). In doing so, SKB wishes to emphasize that the deposition of spent nuclear fuel in deep rock formations, at least for the time being, is not to be regarded as an ultimate and final disposal. SKB wishes to emphasize that retrieval is possible. Such an approach may be defensible if it is acknowledged that future generations should have the right to make their own decisions concerning final disposal.

As a regulatory authority, SKI has not agreed to adopt the term “deep storage”. There are two main reasons for the regulator to use the term “(final) disposal”:

- SKI is adamant that the repository must be designed to fulfil the criteria of a “true” repository, i.e. with no intent to retrieve the waste. In SKI’s opinion the terminology should reflect this principle. Retrieval must not be a necessity, even if we realise that the possibility for retrieval may be provided.

- SKI does not wish to promote a terminology that may indicate that a repository is an unsafe and temporary solution.

Furthermore, the Swedish Act on Nuclear Activities explicitly stipulates that plans should be made for “safe final disposal”.

As long as this difference in terminology does not cause too much confusion, we consider it to be acceptable. However, we acknowledge that it presents some difficulties when communicating with the general public. Regardless of which term is used, it is possible to discuss different degrees of retrievability.

2. REASONS FOR RETRIEVAL — AND THEN WHAT?

There may be a number of possible reasons for retrieval of spent nuclear fuel from a repository and they range from technical to purely political.

For example, it is possible that the repository will not perform as intended during the time that it is in operation. Another scenario of technical nature is where a new assessment of the long term safety differs from those made during licensing of the repository.

A decision on retrieval might also be taken for purely political reasons, e.g. in order to satisfy public opinion.

However, retrieval for any of these reasons should preferably only be carried out if the continued safe management of the spent nuclear fuel is ensured. This aspect of retrievability has so far not been discussed as much as other aspects, e.g. reversibility of emplacement.

Furthermore, it is possible that future generations may wish to use the fuel for nuclear energy production, which can be combined with the burn out of some long lived radioactivity (transmutation). In such a scenario the further safe management of the spent fuels will have to be inherent in the proposed nuclear system.

3. REPOSITORY DESIGN

SKB’s main alternative, the KBS-3 method, implies vertical emplacement of individual copper canisters surrounded by bentonite and backfilled drifts at 500m depth in crystalline rock. If this concept is compared to other disposal concepts e.g. very deep holes or very long to medium long holes (horizontal emplacement) it is most likely that it will be easier and less expensive to retrieve spent fuel canisters from a KBS-3 repository compared to the other options.

SKI supports that the repository shall not be designed so that it unnecessarily impairs future attempts to retrieve the waste, monitor or “repair” the repository. However, measures to facilitate any kind of access to the repository must not reduce the long term safety of the repository.

3.1. Stepwise repository development

SKB intends to build the repository in at least two stages where the first stage is a demonstration phase (deposition of 10% of the spent fuel). After an evaluation period of the

demonstration phase for about 10 years, including a SKI review of a safety assessment, the licensing for a full-scale repository is planned. SKI endorses SKB's plan in this respect. Furthermore, the step-wise approach to siting and implementation provide possibilities to repeatedly evaluate, and if necessary, redirect or reverse the disposal programme.

The now accepted step-by-step construction of a repository for spent nuclear fuel and the issue of safeguards for a repository over an indefinite period of time have helped to bring the issue of retrieval and monitoring to the fore.

3.2. The operational phase

It is SKB's intention to backfill deposition tunnels as soon as all canisters are emplaced in the tunnel. The deposition tunnel will then be sealed with a thick concrete plug. As an alternative the backfilling might be postponed facilitating retrieval. However, an open deposition tunnel may contradict requirements dictated by safeguard needs. In addition, at least for the demonstration phase, tests are planned for the resaturation of the backfill and the bentonite buffer. In order to further enhance retrieval special actions could be taken for stabilising rock in tunnels and shafts.

3.3. Retrievability of wastes will always be possible — time periods

SKB considers that the KBS-3 method will provide possibility for retrieval, which can be carried out in a number of different stages: from the Central Interim Storage for Spent Nuclear Fuel (CLAB), during encapsulation of the spent fuel, during deposition of canisters, after sealing of the deposition holes, after backfilling of the drifts and after closure of the repository. SKI agrees with SKB that it is possible to retrieve the canisters during the above mentioned phases. Furthermore, for each further step in the disposal sequence retrieval will undoubtedly be more technically difficult and more costly, but it will never be impossible. Taking into account the long term requirements of the canister, it is probable that retrieval of undamaged canisters will be possible, even after thousands of years. After still longer times retrieval will be more and more like mining. However, the difficulties will increase with time — the rock may become damaged, resulting in the partial collapse of existing holes during excavation.

To be credible, it is important that methods for retrieval are developed and tested on a full scale before a decision is made to start a detailed site investigation for a repository. Therefore, SKB has, for a number of years, conducted R&D in this area and are now planning for a retrieval experiment at the Äspö Hard Rock Laboratory (HRL) for the benefit of members of the public and experts.

4. SOME CONCLUDING REMARKS

- It can not be excluded that the repository will not perform as intended during the operational phase. Therefore, the repository design should take retrievability of waste packages into account. Demonstration of such retrieval should be regarded as a condition for siting or construction of a repository.
- It must be considered that waste packages should only be retrieved when arrangements have been made for their subsequent safe management.
- Future generations may wish to retrieve the spent fuel from a sealed repository. Disposal method and repository design should consider this and not make such retrieval

unnecessarily difficult. On the other hand, any measures taken to facilitate retrieval must not significantly impair the long term safety functions of the repository. It may have to be shown that both these aspects have been adequately considered.

- Retrievability must always be discussed with caution, so that it will not give the impression of doubts concerning the safety of the repository.

QUESTIONS (Q), COMMENTS (C) & ANSWERS (A) AFTER THE PRESENTATION

Q: Is there any political discussion in Sweden of this issue?

A: No political decision has been taken because we are now working with the regulations. At an early stage, we discussed to include retrievability in this work and we have now decided not to do that. I would like to pass this question to Mr. Wingefors, who is responsible for writing the regulations on this matter.

A: It is correct that there is not political decision. And it would probably be difficult for us to demand from the industry that they should include a retrievability concept. We can certainly tell SKB to consider this and recommend that it should be considered in the design of the repository.

Q: Who eventually will decide that a disposal facility for radioactive waste should be carried out in a retrievable form?

A: I think we pass that question to SKB.

C: Well, I do not know if I can give an answer from SKB, because the question of decision is very unclear here. We believe that when we eventually will get this suggested repository it will be retrievable and the question is, if the retrievability level is acceptable or do we want to change? The decisions must then be balanced in order not to jeopardise the safety of the repository. But you can say that every action you take might affect the long term safety, sometimes in a beneficial way, sometimes in the other way, depending on which scenario you are considering. So perhaps the good formulation would be that it should not impair the capacity of the repository to comply with safety criteria. That is indicating that the critical issue is whether you can go over the threshold of acceptance. If you are well below, or if you are at a much safer state than the threshold of acceptance or compliance with safety criteria, then it will be a question of balances, how we regard it.

Q: I was a bit concerned when you showed the double KASAM principle, where you use the word "repair". The question of repair would come, because there is a safety breach, this is what I understand. But in the absence of any active control or active safety monitoring system, it would be too late to go up to that repair and find that it is really affecting the future generation. I would like to have your comments about that.

C: I do not know if I am the right person to comment on it because I have not attended the previous sessions of this seminar. First of all, the KASAM principle has not been formulated by the SKI, but this is a principle that we at SKI agree with. But the exact meaning of the word repair could be discussed. As I see it, the alternative is probably not to repair the repository. If there are some serious problems with the engineered barrier system, you have to take a step back and maybe consider also other disposal options. Actual repairing of canisters or barriers etc. I do not find that very probable.

Q: I meant that the question of repair is coming, because there is a safety breach, otherwise that question will not come. In absence of any active monitoring system, how we will know that a repair is necessary? It will be too late to know that a repair is indeed necessary and it will affect the future generation, that is my concern. I think there is a question of repair because of the breach.

A: I would think that repair can mean repair before closure as well as after closure. After closure, it is perhaps not very realistic to speak about repairing the system, but before closure, there has been backfilling etc. and it could be possible to take some actions to remediate the situation.

Chair: To take counter measures if there were any unforeseen, unexpected release, that is the first thing you would do before you would decide to retrieve.

Q: Yes, this is my concern and this is probably a question of whether there should be an active monitoring or passive monitoring. All the safety work is done on the basis of modelling but, from the general knowledge on this, I understand that for the modelling we are using imperfect data for the prediction of safety for 10 000 years. I see a conflict in that and I understand that there is a gap of communication between safety safeguards and public relations who really do not appreciate or do not understand it properly.

A: We have not discussed monitoring at all in our paper and the reason why we excluded that is because there are so many other papers discussing that. But of course you have to monitor the repository, and that will give you some information about the necessary actions to take.

Chair: There is quite a lot of information on the isolation capability of a given site, of a given rock formation. If you can demonstrate, for example, that for millions of years there was no interaction between water and the host rock, then you have a pretty good information that this will continue in the future, if you do not damage it by drilling too many holes in it. This is a good argument against your concern that geologists cannot predict sufficiently precisely what the future of a repository will be.

C: I have two comments. The first one is about your reasons for retrieval in part two. You do not mention a retrieval reason which could be that alternatives are found in the future. That might be mentioned. There might be other alternatives that might be considered better and then you would retrieve it. Secondly, you also said that the decision might be taken for purely political reasons. You say that it is to satisfy public opinion. I am surprised about that. But if this reflects what you perceive, then you are of course free to make such a statement.

In the last point of your last slide, you say that retrievability must always be discussed with caution so that it will not give the impression of doubts concerning the safety of the repository. I think this is quite an interesting aspect. I think you could also say — instead — that retrievability must be taken seriously, in order to actually penetrate all the issues that are involved. So it is, I understand, your point that you have to discuss it openly rather than with caution, in order to be able to actually get the public opinion that you would want for a repository.

A: I would say that is a matter of wording.

C: The possible reason for retrieval — that an alternative way to deal with the waste has been discovered — has now been mentioned several times, and you raise it again. I really do not think that this is a very realistic option. We have practically no example through history of decisions that are still believed to be acceptable being undone at very high cost simply because there is another way to deal with that particular problem now available. You will use the new better system to deal with the new waste that is produced, but I doubt very much that you will go back and retrieve from a closed repository. That would really not make any sense. Anyway, such a decision would always demand a cost benefit analysis and would be justified by very strong argument which I do not believe would be realistic.