Consultations according to the Environmental Code

Compilation 2009–2010

SKB

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Contents

A milestone for final disposal of spent nuclear fuel –

Site for final repository selected, consultations concluded and licence applications submitted!

The ambitious, broad-based and transparent work with consultations according to the Environmental Code which we have conducted for many years, mainly in the municipalities of Östhammar and Oskarshamn, are now concluded. After our decision to apply for licence for a final repository in Forsmark was reached in the summer of 2009, the consultations were concluded in May 2010. SKB's work preparing the licence applications under the Nuclear Activities Act and the Environmental Code then intensified.

We submitted a total of around 9,000 pages to the Swedish Radiation Safety Authority and the environmental court on 16 March 2011. This represented a milestone for SKB, for the Swedish nuclear waste programme and for the management of spent nuclear fuel in the world. The dialogue on the planned facilities and the applied-for activity will now continue under new forms, with the licence applications in the centre of attention for the next few years.

Now as we summarize our impressions in this last compilation of the consultations for 2009–2010, nearly ten years have passed since we initiated the site investigations and the formal consultations after a long period of preparations. For all of us at SKB who have been involved, just as for many of you who have participated, this has been a period of dedicated, patient and hard work. At the same time it has been extremely interesting, exciting and stimulating to be a part of this collective effort. It has been a privilege to get to know all of you who have contributed your knowledge, your questions and your viewpoints, as well as to work with your municipalities, your communities and your organizations.

Nearby residents, concerned landowners, private citizens, organizations and decision-makers in both municipalities as well as at the county administrative boards, the regional councils, the Swedish Radiation Safety Authority (SSM) and the Swedish National Council for Nuclear Waste and the environmental organizations that receive funding from the Nuclear Waste Fund have continued to follow our work right to the end. Since site selection and as we have approached the time for the licence applications, increasing interest has been shown by politicians, the media and other parties at the national and international level. This compilation presents viewpoints and questions from the consultations during the last two years, 2009–2010.

A virtually complete environmental impact statement (EIS) and a number of reports on planned water operations were compiled as a basis for the concluding consultation meetings. The concluding consultation meetings were held first in Östhammar and then in Oskarshamn in early February 2010 with presentations on the theme "Overall environmental consequences, including safety and radiation protection, and water operations". In response to the discussions, especially at the meeting in Östhammar, and the written viewpoints that were then submitted, a final extra consultation meeting was held in Östhammar on 3 May 2010 on the theme "The role of the safety assessment in the EIS".

As during the immediately preceding years, several separate consultation meetings were held in 2009–2010 as well with special groups such as nearby residents in Forsmark, Östhammar Municipality, the County Administrative Board in Uppsala County, the Misterhult Group in Oskarshamn and Oskarshamn Municipality, as well as SSM and the Swedish National Council for Nuclear Waste. Some examples of issues addressed at these separate consultations are facility design, local environmental consequences, water operations, safety and radiation protection with a focus on post-closure safety, the content and structure of the applications, and the handling of alternatives (particularly other methods than KBS-3) in the applications and the EIS. Two information meetings were also held in April 2010 – one for decision-makers and officials and one open to all interested parties – in Mariehamn on Åland, due to the attention the issue had attracted there.

The second and concluding part of the consultation on possible transboundary environmental impact according to the Espoo Convention, is now all that remains of the consultations.

In conclusion I would once again like to address myself to all of you who have taken part in the consultations and contributed to the work with the environmental impact assessment: Thank you for your commitment, your interest and your perseverance over the years! The knowledge and the questions and viewpoints you have contributed are invaluable to us in our continued efforts to realize the long-term safe final disposal of spent nuclear fuel necessary for man and the environment.

Wrapping up the consultations according to the Environmental Code is an important milestone, but will hardly be felt as any great change. A local presence, transparency, openness and a good dialogue will continue to be just as important for us at SKB after the consultations as they have been up to now, albeit under different forms.

We'll see you soon in Forsmark and Oskarshamn!

Erik Setzman
Head of the EIA Unit

Consultations according to the Environmental Code

The nuclear power utilities in Sweden joined forces in the 1970s to form Svensk Kärnbränslehantering AB (SKB, Swedish Nuclear Fuel and Waste Management Co). Our mission includes management and disposal of the spent nuclear fuel from the Swedish nuclear power plants. Within the framework of this work, we have held consultations according to the Environmental Code during the period 2002–2010.

SKB's proposal is that the spent nuclear fuel will be disposed of according to the KBS-3 method. This involves encapsulating the fuel in copper canisters with nodular iron inserts and depositing the canisters at a depth of 400–700 metres in the bedrock, where stable mechanical and chemical conditions prevail. The canisters are surrounded by bentonite clay, which constitutes a buffer against minor rock movements and prevents corrosive substances from getting into the canister. The clay also effectively absorbs radionuclides that are released if the canister is damaged. The key components for disposal according to the KBS-3 method are an encapsulation plant and a final repository.

Today he spent nuclear fuel is being temporarily stored in Clab (central interim storage facility for spent nuclear fuel) in Oskarshamn Municipality. In November 2006, SKB submitted an application under the Nuclear Activities Act for a licence to build and own an encapsulation plant for spent nuclear fuel and to operate it integrated with Clab. This means that the licences for Clab are also being reviewed.

Extensive site investigations in preparation for siting of the final repository have been conducted in both Oskarshamn and Östhammar municipalities. After the material had been reviewed, analyzed and evaluated, SKB selected Forsmark as the site for the application for licence under the Nuclear Activities Act for the final repository, which were submitted in March 2011. At the same time, SKB applied for licence under the Environmental Code for the interim storage facility, the encapsulation plant and the final repository. A joint environmental impact statement (EIS) was appended to the applications.

Consultations according to the Environmental Code

The consultation procedure for applications under both the Environmental Code and the Nuclear Activities Act is regulated by Chapter 6 of the Environmental Code. The consultations are supposed to deal with the siting and design of the applied-for activities as well as the form and content of the EIS. Consultations must be held with the County Administrative Board, the concerned national authorities, the municipalities, the public and the organizations that are likely to be affected. If an activity is likely to have a significant environmental impact in another country, the Swedish Environmental Protection Agency is required by the Espoo Convention, to inform and hold consultations with that country regarding any transboundary environmental impact.

The consultation process for the Spent Fuel Repository began in 2002 and was concluded in May 2010. Since the interim storage facility, the encapsulation plant and the final repository are parts of the system for final disposal of spent nuclear fuel, SKB coordinated the consultations and they were held simultaneously in Oskarshamn and Östhammar municipalities. An account of the proceedings, what questions were raised and how they have been dealt with is provided in the consultation report, which is an appendix to the EIS.

Previously held consultations have been compiled annually in "Consultations according to the Environmental Code", Compilation 2003, 2004, 2005, 2006, 2007 and 2008. This is the final compilation and covers the 2009 and 2010 consultations.

According to the Government decision from the review of SKB's supplement to the 2001 research programme, consultations have been held between SKB, the

Swedish Nuclear Power Inspectorate (SKI) and the Swedish Radiation Protection Authority (SSI) (subsequently the Swedish Radiation Safety Authority (SSM) after the merger of SKI and SSI). They dealt with questions relating to the site investigations and SKB's work with system analysis and safety assessment. These consultations were separate from the consultations according to the Environmental Code.

Remaining consultations

A second, and concluding, written consultation according to the Espoo Convention will be held, based mainly on the SR-Site safety assessment and the EIS. A meeting may be arranged in connection with this consultation. This is planned to take place in 2013.

Eight years of consultations concluded

SKB's objective for the consultations according to the Environmental Code was that everyone who wanted to get involved would have an opportunity to do so. The consultations lasted for more than eight years and were also a way for us to learn from other parties' knowledge and viewpoints. In the consultations we have received more than 3,000 questions and viewpoints from e.g. private persons, environmental organizations and regulatory authorities.

SKB initiated the consultations according to the Environmental Code in 2002 with early consultations for the final repository in both Oskarshamn and Östhammar and has since then conducted parallel consultations in the two municipalities. They have dealt with the environmental impact assessment for the licensing of the encapsulation plant and the final repository under both the Nuclear Activities Act and the Environmental Code.

Starting in May 2007 it was clearly underscored that the consultations also included Clab. The consultations were concluded in May 2010 and have included a total of 60 consultation occasions. More than 3,000 questions and viewpoints have been received. They have been answered or commented on by SKB in notes or minutes of meetings compiled annually.

Public meetings have been held with private citizens and organizations as the primary target group. There have also been written consultations with concerned government agencies, regional actors, organizations that receive funding from the Nuclear Waste Fund to follow the consultations, as well as with Oskarshamn and Östhammar municipalities. Meetings have also been specially arranged for nearby residents in Forsmark and Laxemar, Östhammar Municipality, the Swedish National Council for Nuclear Waste, national conservation and environmental organizations and concerned government agencies. Two road consultations were also held in Oskarshamn within the framework of the Public Road Act.

Another important feature of the consultations is the meetings held with the Oskarshamn EIA Forum and the Forsmark Consultation and EIA Group. These meetings were attended by representatives from SKB, SKI, SSI and the concerned county administrative board and municipality. SKI and SSI were replaced by SSM as of 1 July 2008.

Disposal of the spent nuclear fuel is a large project that has generated a great deal of material to be dealt with in the consultations. It was not possible to consult about everything involved in the project on a few isolated occasions. SKB has therefore held consultations on different themes as the relevant studies have been completed. The meetings with the Oskarshamn EIA Forum and the Forsmark Consultation and EIA Group have not had specific themes.

Questions and discussions at the consultation meetings have not been limited to one theme, however, but have focused on the participants' questions and viewpoints. All matters pertaining to interim storage, encapsulation and final disposal of spent nuclear fuel have been legitimate topics. In general it can be said that the participants have focused on different areas:

- Nearby residents: Traffic, noise, groundwater lowering.
- Municipalities: Infrastructure, local environmental issues, pre- and post-closure safety.
- Environmental organizations: Choice of site and method, long-term safety.
- Regulatory authorities: Environmental impact, long-term safety, criteria for site selection, opportunities for and effects of retrieval of canisters.
- Neighbouring countries: Transboundary environmental impact via air and water in connection with regular operation and accidents.

Because the consultations have been held for many years, SKB's replies to certain questions raised in the beginning are not longer valid. An example of the reasons for this is that we have changed the application procedure and modified the planning for certain work. Furthermore, we developed a more consistent and clear structure for where different studies and results will be reported. This means that

some results from studies that were originally supposed to have been described thoroughly in the EIS have been moved to other application documentation. Questions concerning formalities in the consultation process have been raised on numerous occasions and led to changes in the forms of the meetings.

The consultation report comments on certain matters that have been handled differently than SKB had said early in the consultations. Furthermore, there is a follow-up of questions that have occasioned supplementary studies. There are also some comments on the formalities in the consultation process that have been discussed in the consultations.

Themes and periods of consultations

Theme	Period
Scope, contents and form of EIS for the encapsulation plant and the final repository	November 2003 – May 2004
Siting and design of a final repository and an encapsulation plant in Forsmark versus Oskarshamn (the Simpevarp/Laxemar area)	November 2004 – July 2005
Preliminary EIS for the encapsulation plant	November 2005 – January 2006
Method, siting, future	May – August 2006
Safety and radiation protection	May – June 2007
Siting, aesthetics and transportation	October 2008 – February 2009
Preliminary EIS for the final repository system	December 2009 – March 2010
Water operations	December 2009 – April 2010
Role of the safety assessment in the environmental impact statement	May 2010

Local information

In addition to the formal consultations, there were extensive information activities in both Oskarshamn and Östhammar. Face-to-face contact has contributed to people's confidence in SKB in both municipalities. We will continue our local contact activities in various forms during the time the applications are being reviewed.

In addition to the consultations according to the Environmental Code, information and visitor activities have been pursued for some time in Oskarshamn and Östhammar. It is in SKB's interest to have transparency in all we do, and it is important to maintain contact with the public and municipal representatives who are involved in our work.

Two newsletters were sent in 2009 to everyone living in Misterhult parish in Oskarshamn. Three newsletters were sent to nearby and part-time residents in the Forsmark area. The newsletters provided information on the site investigation, our activities in the field and current events.

Contact with nearby residents is particularly important. We therefore regularly invite them to our facilities or arrange get-togethers out in the field. After SKB had selected the site for the Spent Fuel Repository in June 2009, we held a "Nearby Residents Day" in Forsmark, which was well attended. M/s Sigyn was docked in the harbour at Öregrund in July and received many visitors. We meet businessmen regularly, and they also participate in our study trips.

In the run-up to site selection in 2009, the outreach information service in Oskarshamn focused on politicians and NGOs in neighbouring municipalities. M/s Sigyn was docked in the harbour at Oskarshamn in July as well and received many visitors. "Geology Day" was held in September. We were represented at local events, and information was provided to school teachers and pupils as before.

On six Thursdays in the autumn of 2010, SKB had an Open House at our Trade and Industry Office in Östhammar. Topics that were touched upon included our efforts to protect the rare pool frog in connection with the construction of the final repository and the ambitious ice sheet programme, in which SKB is participating in Greenland in order to learn more about what might happen to the Spent Fuel Repository during the next ice age.

Information activities aimed at the schools in Oskarshamn Municipality continued in 2010, while the outreach programme diminished in scope. But we did participate in local events, such as the "Future Days" and the Latitud 57 festival.

Publications and the Web

Three issues per year of our information magazine Lagerbladet were published in 2009 and 2010. It is distributed to all households in the municipalities of Östhammar and Oskarshamn. In this magazine we discuss our activities and subjects that have a direct bearing on us, particularly on the local level.

The websites for Oskarshamn and Forsmark can be accessed via SKB's website. They are updated regularly with information on SKB's activities and on past and planned events in each municipality.

Visitor service

Visitors to the facilities in Forsmark and Oskarshamn come from near and far. Foreign delegations alternate with schoolchildren, local businessmen, politicians and university students.

Documentation of the consultations

The final documentation of completed consultations is the consultation report that was appended to the EIS for the licence applications. The annual compilations are published to provide a regular overview of questions and answers from the previous year's consultations.

All consultations, whether in the form of meetings or correspondence, have been documented. All minutes, notes and received viewpoints, as well as SKB's replies and comments, are available on SKB's website.

Meetings

Minutes were kept of meetings with the Oskarshamn EIA Forum and the Forsmark Consultation and EIA Group, which the participants checked and signed.

Minutes were also kept of public consultation meetings and were checked and signed by persons appointed by the meeting. After the public consultation meetings it was possible to submit questions and viewpoints relating to the meeting for another two weeks.

The questions and viewpoints that were discussed during a consultation meeting or received within the appointed period after the meeting were presented in the minutes. There SKB also answered those questions to which a direct answer could be given. Certain questions led to supplementary studies and further discussion. Some questions were judged to lie beyond the scope of the nuclear fuel project and the EIA work and were dismissed from the consultations.

The questions that were raised in the local information and visitor activities during the period for the consultations mainly had to do with local feedback from the ongoing site investigations. In cases where the questions concerned the activities at Clab, the encapsulation plant or the final repository, they were transferred to the consultation documentation.

Written viewpoints

The viewpoints that were received between consultation meetings and in the written consultations, including the Espoo consultations, were made available on SKB's website and in the annual compilations. Whenever possible, SKB responded to questions and viewpoints.

An account of the first part of the Espoo consultations and replies to received questions were sent via the Swedish Environmental Protection Agency to the participating countries.

Consultation report

An EIS to which a consultation report was appended was in turn appended to the 2006 application for the encapsulation plant under the Nuclear Activities Act. It provided an overall picture of those consultations that pertained to the encapsulation plant and/or the whole final repository system. In the applications submitted in 2011 it was replaced by a consultation report that includes all questions in all consultations.

Road and traffic matters were discussed a great deal in Oskarshamn, and the documentation from the two consultations under the Public Road Act has therefore been included for information purposes in the consultation report.

Annual compilation

SKB has compiled consultations in seven yearbooks starting in 2003 and ending with the consultations held in 2009 and 2010. The yearbooks contain an overview of each meeting, with target group and purpose as well as who attended the meeting. There is also an account of how the invitations have been sent, what background is available prior to or at the meeting, plus excerpts of questions and viewpoints from the minutes and SKB's replies and comments, grouped in the following categories:

- Interim storage facility and encapsulation plant (the interim storage facility was added to the category in 2007).
- Final repository.
- Common issues.

Completed consultations

The consultations lasted for more than eight years. The early consultations were conducted in separate meetings for the encapsulation plant and the final repository. In the continued consultations, joint meetings have been held for both facilities as well as the interim storage facility. The consultations were concluded with a meeting in Östhammar concerning the role of the safety assessment in the EIS.

Early consultations

Early consultations regarding the final repository and the encapsulation plant in Oskarshamn and in Forsmark were held during the period 2002–2003. Invitations were sent out to more households than just those who belonged to the category "likely to be affected".

Specially produced background material describing the project and the purpose of the meeting was enclosed with the invitation.

Early consultation	Date	Site
Final repository	10 January 2002	Oskarshamn
Encapsulation plant	8 March 2003	Oskarshamn
Final repository	15 June 2002	Forsmark
Encapsulation plant	29 October 2003	Forsmark

Continuation of the consultations

Changes were made in the Environmental Code in 2005. The terms "early consultations" and "extended consultations" were omitted and now only the term "consultations" is used. However, "extended consultations" for the final repository for spent nuclear fuel and the encapsulation plant began back in 2002 and 2003, respectively, and were conducted in the beginning under the old forms and using the terms early and extended consultations. These terms are therefore used in some contexts in this compilation as well as in older reports, notes and minutes.

SKB's consultation meetings consisted of a) public meetings mainly intended for private citizens and concerned organizations, and b) meetings with the Oskarshamn EIA Forum and the Forsmark Consultation and EIA Group. Initially, only occasional meetings with the Oskarshamn EIA Forum and the Forsmark Consultation and EIA Group were open to the public. Starting in the autumn of 2005, all meeting were open to anyone wishing to attend as a passive audience member. Some part of the meetings were set aside for public Q&A. Meetings with individual parties were also held. The consultations for the interim storage facility, the encapsulation plant and the final repository were coordinated in both Oskarshamn and Forsmark.

Completed consultations 2009 and 2010

2009	
29 January	Östhammar Municipality
4 February	Public meeting in Oskarshamn Municipality
13 June	Nearby resident meeting in Forsmark
8 July	Nearby resident meeting in Oskarshamn
30 September	Östhammar Municipality

During January and February, written consultations were held with concerned government agencies and municipalities and with organizations that receive funding from the Nuclear Waste Fund.

2010	
27 January	County Administrative Board in Uppsala County
6 February	Public meeting in Östhammar Municipality, theme water operations
6 February	Public meeting in Östhammar Municipality, theme EIS
9 February	Public meeting in Oskarshamn Municipality
18 February	Swedish Radiation Safety Authority
3 May	Public meeting in Östhammar Municipality
12 May	Swedish National Council for Nuclear Waste

During the period December 2009 to March 2010, written consultations were held with concerned government agencies and municipalities and with organizations that receive funding from the Nuclear Waste Fund.

Previously held consultations

2004	
19 January	Forsmark Consultation and EIA Group
5 February	Public meeting in Östhammar Municipality
24 March	Oskarshamn EIA Forum
22 April	Local conservation and environmental organizations in Oskarshamn Municipality
4 May	National conservation and environmental organizations
13 May	Local conservation and environmental organizations in Östhammar Municipality
14 May	Forsmark Consultation and EIA Group
26 May	Oskarshamn EIA Forum
1 October	Forsmark Consultation and EIA Group
6 October	Public meeting with Oskarshamn EIA Forum
25 November	Public meeting in Östhammar Municipality
8 December	Oskarshamn EIA Forum
10 December	Forsmark Consultation and EIA Group

Written consultations were held during the first quarter of 2004 with regional actors in Kalmar and Uppsala counties.

2005	
10 March	Forsmark Consultation and EIA Group
11 March	Oskarshamn EIA Forum
5 April	Public meeting in Oskarshamn Municipality
1 June	Oskarshamn EIA Forum
4 June	Public meeting in Östhammar Municipality
3 July	Public meeting in Oskarshamn Municipality
24 August	Joint meeting with Oskarshamn EIA Forum and Forsmark Consultation and EIA Group
14 November	Public meeting in Östhammar Municipality
17 November	Public meeting with Oskarshamn EIA Forum
17 November	Public meeting in Oskarshamn Municipality
18 November	Public meeting with Forsmark Consultation and EIA Group

At the end of 2005, written consultations were held with concerned government agencies.

2006

10 March	Forsmark Consultation and EIA Group
22 March	Oskarshamn EIA Forum
31 May	Public meeting in Oskarshamn Municipality
1 June	Public meeting in Östhammar Municipality
2 June	Forsmark Consultation and EIA Group
12 August	Open house in Östhammar Municipality
13 August	Open house in Oskarshamn Municipality
20 September	Forsmark Consultation and EIA Group
28 September	Oskarshamn EIA Forum
6 December	Joint meeting with Oskarshamn EIA Forum and Forsmark Consultation and EIA Group

In conjunction with the public meetings of 31 May and 1 June, written consultations were held with concerned government agencies and municipalities and with the organizations that receive funding from the Nuclear Waste Fund.

2007

28 May	Public meeting in Oskarshamn Municipality
31 May	Public meeting in Östhammar Municipality
8 September	Nearby resident meeting in Forsmark
12 September	Oskarshamn EIA Forum
13 September	Forsmark Consultation and EIA Group
13 September	Road consultation with regulatory authorities, Oskarshamn
8 October	Road consultation with private citizens, Oskarshamn
5 December	Joint meeting with Oskarshamn EIA Forum and Forsmark Consultation and EIA Group

In conjunction with the public meetings of 28 May and 31 June, written consultations were held with concerned government agencies and municipalities and with the organizations that receive funding from the Nuclear Waste Fund.

2008

27 February	Forsmark Consultation and EIA Group
12 March	Oskarshamn EIA Forum
23 May	Forsmark Consultation and EIA Group
28 May	Oskarshamn EIA Forum
23 August	Consultation meeting with nearby residents in Forsmark
6 October	Joint meeting with Oskarshamn EIA Forum and Forsmark Consultation and EIA Group
22 October	Public meeting in Östhammar Municipality

In conjunction with the public meeting of 22 October, written consultations were held with concerned government agencies and municipalities and with the organizations that receive funding Nuclear Waste Fund.

Written consultations with the countries around the Baltic Sea under the Espoo Convention were carried out during the first half of the year.

Excerpts from minutes

This section contains excerpts from the records of the consultations held in 2009 and 2010. In each excerpt, questions, viewpoints and topics have been grouped in the following categories:

- Interim storage facility and encapsulation plant
- Final repository
- Common issues

Questions and viewpoints have been expressed both orally at the consultation meeting and in the form of written submissions directly related to the meeting. The excerpts from the public consultation meetings do not show who posed a question or expressed a viewpoint at the meeting. In the case of written questions and viewpoints, however, there is a notation of who expressed the question or viewpoint.

The excerpts also show the target group for the meeting, who was present and the theme of the background material, as well as how the invitation took place.

The groups that receive money from the Nuclear Waste Fund to participate are:

MKG – the Swedish NGO Office for Nuclear Waste Review (collaboration between the Swedish Society for Nature Conservation, the Uppsala County Society for Nature Conservation, the Swedish Association of Field Biologists and Oss – Opinion Group for Safe Final Disposal).

Milkas – the Swedish Environmental Movement's Nuclear Waste Secretariat (represents the Swedish Anti Nuclear Movement and Friends of the Earth).

SERO – the Swedish Renewable Energies Association.

Furthermore, the Swedish National Council for Nuclear Waste and the various regional councils have taken an active part in the consultations.

Meeting with Östhammar Municipality	
Date	29 January 2009
Time	13:00–15:30 hrs
Place	Municipal office, Östhammar.
Target group	The municipality's working groups: Scientific Committee, Building Committee, Environment and Public Health Committee, Environment Office and Final Repository Project.
Background	On two occasions during 2008 – 19 May (questions 1–40) and 2 October (questions 41–71) – Östhammar Municipality has submitted written questions to SKB occasioned by studies of e.g. natural and cultural values in the Forsmark area. The studies/reports served as a basis for the environmental impact statement regarding the final repository system for the applications under the Nuclear Activities Act and the Environmental Code. The questions were answered in writing and followed up at this meeting with SKB's investigator and the municipality's working groups and committees for elaboration on the replies and further discussion.
Participants	Östhammar Municipality: *Bertil Alm, Barbro Andersson Öhrn, Lennart Andersson, Peter Andersson, Marie Berggren, Inger Börjesson, Sören Carlsson, Gunilla Delwall, Ingrid Gustafsson, Christina Haaga, Peggy Holmgren, Hans Jivander, Gunnar Lindberg, Virpi Lindfors, Ylva Lundh, Hans Norberg, Ingemar Nordin, Roger Norén, Lennart Sunnerholm* and *Arnold Unge*. SKB: *Erik Setzman, Kaj Ahlbom, Helén Andersson, Mikael Gontier, Jonas Nimfeldt* and *Sofie Tunbrant.*

Questions and answers from the consultation meeting are given below. Numbers in parentheses refer to the municipality's numbering of the questions (see page 72, where there is a compilation of all written questions received from Östhammar Municipality with SKB's replies).

1 Interim storage facility and encapsulation plant

No questions from the municipality pertained to the interim storage facility or the encapsulation plant for spent nuclear fuel.

2 Final repository

2.1 How extensive is the preliminary EIS?

(SKB) Approximately 400 pages, and a short summary will also be included. The goal is to make the preliminary EIS as complete as possible at this stage, but some material will still be preliminary and some will be lacking.

2.2 How long time does the municipality need to read and express viewpoints.

(SKB) Five weeks. Regulatory authorities and organizations will receive the material at the latest three weeks before the consultation meeting and will be able to submit viewpoints two weeks after the consultation meeting.

2.3 The situation will come to a head once the site is chosen, at which point five weeks is not much time for the municipality to deal with such an important and extensive document. Think about the possibility of giving the municipality more time.

(SKB) Yes, we will think about it, but it may be difficult to extend the time. The timetable for getting the applications ready is tight. Several background reports will be available before the preliminary EIS. Today's meeting also offers some insight into the contents of the EIS.

2.4 When will the hydrogeological study be ready?

(SKB) The hydrogeological study will not be printed before the summer. Many reports are in the final stages now, and it's a question of priorities and logistics.

2.5 It's too bad the report won't be printed before then, since the questions concerning groundwater lowering are of particular interest. It's easier to understand when you have a report to read.

(SKB) It's quite possible to be informed of the results as they become available, and SKB would be happy to help with a presentation of the results.

2.6 What are the plans for the Barracks Village?

(SKB) If the final repository is sited at Forsmark, the Barracks Village will be demolished and temporary housing will be built at Igelgrundet. The Barracks Village may be demolished in stages, and remaining parts may be used for temporary accommodation during the construction phase for the final repository.

2.7 Will the land where the Barracks Village is located be needed as industrial land?

(SKB) Parts of the land will be needed for the final repository's facilities, the rock heap, etc. Other parts will probably eventually be released for other purposes.

2.8 (Questions 13–14) Regarding reinfiltration of water. How and why is it done?

(SKB) There is a risk that the rich fens will be affected by a groundwater lowering in the area. Infiltration can be a way to prevent this. The situation will be followed via monitoring. We are currently examining the feasibility of infiltration, whether it is at all possible, what chemical properties are required, and where the water can be taken from. We already know that the drainage water is too saline and may contain nitrogen. One possibility may be to pump water from wells and discharge it about ten metres from the boundaries of the rich fens. Then the infiltration water will become saturated with lime when it percolates through the till.

All solutions will of course cost money, but it may be feasible to pay the cost for a limited number of fens.

2.9 Take water from wells?! We have to be sparing with fresh water.

(SKB) We haven't finished our studies. If we did take it from wells, they would be dug wells. It is technically feasible to use both surface water and lake water. The important thing is to use water with the right composition.

We won't know whether the scope of the groundwater lowering will require remedial action until we start building. Monitoring will begin six to twelve months before the start of construction. If we discover there is a risk of serious damage, we must be prepared to take action.

2.10 What are the alternatives to reinfiltration? Preserving rich fens somewhere else?

(SKB) Yes, we could invest in other rich fens, but the County Administrative Board is of another opinion and recommends compensatory measures in Forsmark. As regards harm to natural values caused by the establishment of the building site, however, the County Administrative Board requires compensatory measures somewhere else.

2.11 How long would reinfiltration have to continue? The construction and operating period will last more than 50 years. This will cost money and resources over a long period of time. Isn't it more efficient to adopt compensatory measures somewhere else?

(SKB) The County Administrative Board recommends an investment in Forsmark. Rock excavation will take place over a long period, but the tunnels will be backfilled progressively, so only 10–20 percent of the total rock volume will be open at any given time. In view of this and the "dry" bedrock at repository depth, it is doubtful whether there will be such a significant groundwater lowering from the final repository that we will have to take action. But as mentioned above, we must be prepared. Furthermore, if there is any impact it will vary within the area as the underground part is built out and then backfilled.

2.12 How are birds and mammals affected by low-frequency noise?

(SKB) Investigations and experience from the site investigations show that it isn't the noise that disturbs them, but the physical intrusion.

2.13 Is the noise report that was supposed to be printed in January available?

(SKB) It's coming in a couple of weeks. (At the time these minutes are being written, the report has come from the printer and can be downloaded on SKB's website, report number P-08-64.)

2.14 (Question 16) Will crushing of the rock spoil under ground be done to fractions suitable for use or to fractions suitable for shipment?

(SKB) Crushing under ground will be done to fractions suitable for haulage to the surface. There the rock will be further crushed to fractions suitable for its intended use.

2.15 (Question 19) Will SKB or the regulatory authorities design the environmental monitoring programme?

SKB will submit a proposal for monitoring programmes and conditions along with the application under the Environmental Code. The environmental court and SSM will determine what is to be included in the monitoring programmes.

2.16 (Question 23) Is it true that the more tightly the rock is sealed, the less the groundwater will be lowered?

(SKB) Theoretically yes, but the rock also sets the limits for what is possible. We make predictions of groundwater lowering with reasonable sealing, possible sealing and completely watertight rock. It is the soil layers that determine how the water is conducted and what the change will be on the ground surface. In Forsmark there is a thick soil layer of dense calcareous till, which counteracts groundwater lowering in the upper soil where the plants get their water.

2.17 (Question 24) The answer to question 24 is difficult to understand. Can you explain?

(SKB) It was explained with the aid of a drawing that the rock at Söderviken is fractured down to about 100 metres, while at other places in Forsmark the rock is fractured down to about 200 metres. We will build a total of five kilometres of ramp and four shafts in the area. The smaller the fraction of these accesses that has to go through fractured water-conducting rock the better.

2.18 (Question 25) What experience exists of using the model MOUSE SHE for modelling of groundwater lowering?

(SKB) MOUSE SHE is an established tool and was not developed by SKB. It is a standard programme especially for the upper part of soil and rock strata. Other models are needed deeper down in the rock.

2.19 (Question 36) On what do you base the claim that the leachate from the rock heap will probably not contain heavy metals?

(SKB) The granite in Forsmark is largely free of heavy metals, so excavated rock is not expected to contain any significant concentrations of heavy metals that could be leached from the rock heap.

2.20 (Question 34) If the sealant were to cause contamination with foreign substances, would that be detected by the environmental monitoring programme?

(SKB) Development of sealants is under way, which includes checking their properties. They may, for example, contain particulate matter with an ecotoxic impact. The flow and pressure force the water into the tunnels, from which it is pumped up. The drainage water will be sampled.

2.21 Is sealant being developed hastily or carefully and conservatively?

(SKB) Sealant today is mainly based on cement. After the fiasco in Hallandsås there is great scepticism towards introducing foreign substances. Development of sealant is mainly being pursued by the Swedish Road Administration and the Swedish Rail Administration. At SKB we are developing methods for fine sealing of fractures at great depth with a sealant based on silicon (silica sol).

2.22 (Questions 29–31) A question about shared handling systems for different waters. How will snow be handled? The snow does not get mixed in with the stormwater and it doesn't end up on the rock heap.

(SKB) The question has been turned over to the design engineers. What does FKA do? It seems reasonable that snow management should be coordinated. We naturally have to make sure it is dumped on a suitable place.

2.23 (Question 38) Are there stoneworts in Tjärnpussen? Are they red-listed?

(SKB) Intermediate Stonewort (Chara intermedia) is found in the lake and is red-listed (near threatened, the lowest category in the classification).

2.24 (Question 29) Will sanitary sewage be conducted to a sewage treatment plant?

(SKB) Yes, to FKA's treatment plant, which is one of the two treatment plants in Uppland with treatment in four stages. If the final repository is sited at Söderviken, FKA will build a new sewage treatment plant, also with four stages in the treatment process.

2.25 (Question 37) Will the entire area for the Barracks Village be used for a rock heap?
(SKB) No, the part located nearest Söderviken will be needed. The rest can probably be used for other purposes.

2.26 (Question 45) There will be a peak in the transport load during the refuelling outages at FKA. Can SKB reduce its heavy shipments during this period? Above all past Norrskedika.
(SKB) The refuelling outage for FKA is fairly long, often from the end of May to the beginning of September. It's difficult to judge the feasibility of adapting our transport flows. However, SKB's transport needs are expected to decrease during the vacation periods, at least during the operating phase. The request is noted.

2.27 (Question 47) When will you decide which alternative for backfill will be used?
(SKB) The applications under the Environmental Code and the Nuclear Activities Act will be based on the "reference design" of the final repository. Then SKB wants to have flexibility in developing this design. In view of the long time between submission of the applications and commissioning of the facility, it is important to take advantage of the opportunity for technology development and therefore to avoid committing to designs and technology far in advance. If technology development should lead to major changes, this must of course be justified and approved by the regulatory authorities.

2.28 (Question 49) The economic aspects of the bulk shipments are one side of the question, but viewed from an environmental viewpoint isn't transport by barge preferable? Can't the materials be shipped in standard containers?
(SKB) The Port of Forsmark is not designed for large-scale bulk shipments. It would be necessary to expand both the port and the approach channels for this. It might be possible to ship rock spoil on small barges on a temporary basis, provided a suitable off-taker can be found. Another factor that speaks against sea transport of rock spoil is that there must be flexibility to adapt shipments to fluctuations in local demand over time. The clay materials needed at the final repository must be shipped in on ocean-going vessels that cannot dock at Forsmark. In view of the limited quantities involved, we believe it is best that these ships dock at Hargshamn and that the clay be stored there for subsequent daily road transport to Forsmark.

2.29 (Question 60) How will the noise from the ventilation stations affect the birds?
(SKB) Experience shows that it isn't noise in itself that disturbs birds, but the physical intrusion. The ventilation stations will consist of a 0.3 hectare large area. A road there must be built. It will go through the forest and have to be designed to cause as little disturbance as possible of existing natural values.

2.30 (Question 67) Will the accessibility of the area be affected?
SKB has purchased the area. A management plan to preserve existing natural values will be devised in dialogue with the County Administrative Board. Accessibility will probably not be affected, with the exception of the conditions for physical protection that will be stipulated by the Swedish Radiation Safety Authority. The management plan may also entail certain limitations, for example with regard to motor vehicle traffic. As far as we can tell today, it is only around the operations area that there will be a fence and vehicle barriers for physical protection according to regulations from the Swedish Radiation Safety Authority.

2.31 (Question 71) How will SKB carry out noise and vibration measurements after they have obtained a licence for the activity?

(SKB) It will be taken care of in the monitoring programme, which will probably include measurement of noise around the facility. Noise from motor vehicle traffic will also be measured.

2.32 Do you have any comments on the earthquake that occurred in Skåne recently?

(SKB) According to the newspapers there was only very limited damage to a few houses in Skåne. The general rule is that the damage decreases with depth, being greatest on the surface. As a curiosity, it is said that animals are sensitive to natural disasters such as earthquakes. Some measurement instruments were placed on a few cows near the earthquake. But according to the newspapers, the cows didn't react either before or during the earthquake.

3 Common issues

No questions were posed that were common to the interim storage facility, the encapsulation plant and the final repository.

Public meeting in Oskarshamn Municipality

Date	4 February 2009
Time	19:00–21:00 hrs
Place	Figeholms Fritid och Konferens (Figeholm Leisure and Conference), Hägnad, Figeholm.
Target group	Private citizens, organizations, government agencies.
Invitation	The meeting was advertised in Oskarshamns-Tidningen (17 and 31 January) and in Nyheterna (17 and 31 January). A written invitation went to the organizations that receive funding from the Nuclear Waste Fund to follow the consultations, Oskarshamn Municipality, the County Administrative Board in Kalmar County and to all government agencies.
Background material	Specially produced background material: Background material for consultations under Chapter 6 of the Environmental Code for licensing under the Environmental Code and the Nuclear Activities Act. Interim storage, encapsulation and final disposal of spent nuclear fuel. Oskarshamn – Siting, aesthetics and transportation. SKB, January 2009. The background material contained a brief description of SKB's work with siting, aesthetics and transportation for a final repository for spent nuclear fuel located in Laxemar, as well as for the existing interim storage facility for spent nuclear fuel (Clab) and an encapsulation plant on the Simpevarp Peninsula. The descriptions focused on the impact expected to occur. A brief description of environmental aspects associated with the operation of Clab was also provided. A draft of a general structure of the EIS was presented in an appendix. The material was available on SKB's website on 17 January 2009.
Presentations	The meeting was preceded by presentations where *Olle Zellman* (SKB) gave an overview of the siting in the Laxemar area. *Kjell Mårtensson* (SKB) provided information on planned activities and *Fredrik Lange* (Lange Art) on the architectural design of the facility. *Johan Molin* (SKB) gave an account of additional transport and its environmental impact.
Present	Total about 60 persons. Private citizens and organizations: About 50 persons. Representatives from: *SSM, OKG, the County Administrative Board in Kalmar County, Oskarshamn Municipality, the Regional Council in Kalmar County, the Döderhult Nature Conservation Society MKG, Milkas* and *SERO*. SKB: *Erik Setzman, Saida Laârouchi Engström, Olle Zellman, Fredrik Lange (Lange Art), Kjell Mårtensson, Johan Molin, Katarina Odéhn, Olle Olsson, Peter Wikberg* and others.
Moderator	*Ulf Färnhök*
Minutes checkers	*Kerstin Åbinger* and *Bengt-Åke Persson*.

Questions and answers from the consultation meeting are given in the following. For a separate compilation of written questions and viewpoints received within the framework of this meeting and SKB's replies, see page 35.

1 Interim storage facility and encapsulation plant

No questions or viewpoints were expressed pertaining solely to the interim storage facility or the encapsulation plant for spent nuclear fuel.

2 Final repository

2.1 Will the canisters be deposited vertically or horizontally?

(SKB) SKB has vertical deposition of canisters as the reference design. As part of the work of refining the KBS-3 method we are studying the feasibility of horizontal deposition. Depositing the canisters horizontally could entail an environmental advantage, since less rock would have to be excavated. However, a great deal of work remains to be done before it might be possible to switch from vertical to horizontal deposition, for example regarding the retrievability deposited canisters. The conclusion is therefore that horizontal deposition could be an interesting alternative to vertical deposition, among other things for environmental and economic reasons.

2.2 Has Finland decided on vertical or horizontal deposition of canisters?

(SKB) Finland also has vertical deposition as a reference design. Sweden and Finland are conducting a joint project to develop horizontal deposition.

Work will be pursued in the final repository for a long time, about 60 years, during which time the method will be refined. SKB will apply for a licence for disposal according to the KBS-3 method. The reference design that will be described in the applications is vertical deposition of the canisters. Horizontal deposition will be described in the applications as a variant of the KBS-3 method.

2.3 How will the energy supply to the final repository be arranged in the future?

(SKB) The question of how the infrastructure, e.g. the energy supply, will be designed is being examined in the design work for the facility. As far as electricity supply is concerned, we will be connected to the power grid. Furthermore, standby power will be available in the event of a power failure. There is nothing special about the final repository in this regard. The EIS will describe the management of natural resources, such as energy.

2.4 It has been said that disturbances, e.g. traffic noise, will be greatest during a limited period of time. How long is this limited period of time?

(SKB) The final repository will be in operation for a total of 60–70 years. The traffic increase and other disturbances will be greatest during the construction phase, which will last for 8–10 years. It was mentioned earlier during the meeting that the traffic increase may be up to 75%, but this is only true during the latter half of the construction phase, i.e. during a period of about 4 years. It can further be noted that all construction causes disturbances. It is therefore important to discuss with those who may be disturbed how the activity can be designed to limit the disturbance.

(Oskarshamn Municipality) A representative of the Misterhult Group said that 8–10 years should not be considered to be a limited period of time.

2.5 What compensatory measures are planned regarding the groundwater lowering? What will be done with the water that will be diverted?

(SKB) Studies of the impact on the groundwater level come late in the process. First the facility has to be designed; then studies of e.g. groundwater lowering can be conducted. The study for Forsmark will soon be finished, while the study for Laxemar won't be finished until this summer at the earliest. So it is too early to talk about what can be done. SKB will get back on this question, when a consultation on water operations is held. The consultation will be held in the autumn, after site selection, on the site selected for the final repository.

2.6 Researchers at KTH have performed experiments showing that corrosion of the copper canisters in the final repository may be considerably faster than SKB has figured on. Even though this has been known for 20 years, SKB has not taken the results seriously. How is it possible that SKB has not taken such an important question seriously, and how can other stakeholders and the public trust a research and development process that is under SKB's control where the difficult questions are not asked or investigated? SKB has projects in progress on Äspö (LOT) where it will be possible to look at corrosion of copper in oxygen-free water. When will the tests be interrupted and the parcels retrieved?

(SKB) The copper canister is one of the most important components in the final repository. It is therefore important to be able to make reliable assessments. The experiments that have been performed at KTH have not given SKB any reason to alter its assessment of how copper is altered with time. The question of copper corrosion in oxygen-free water is not new, it was first brought up 20 years ago. Despite several attempts by both SKB and others, it has not been possible to replicate the alleged results.

In the safety assessments we look at what the consequences would be if copper should corrode in oxygen-free water. We can conclude that there is so much hydrogen in the groundwater that corrosion does not occur. If corrosion should nevertheless occur, the bentonite clay will prevent the hydrogen formed in the reaction from being transported away, whereby the reaction will cease. If the bentonite buffer were to disappear, the copper canister would be affected. However, the corrosion process described by the researchers at KTH would not be the most serious threat in this case, but rather corrosion caused by sulphide reactions. SKB's conclusion is thus that corrosion of copper in oxygen-free water, if it can take place at all, would occur so slowly and to such a limited extent that it would not affect the repository's long-term safety.

Upcoming experiments on Äspö will look at corrosion of copper.

Another part of the question concerned whether SKB takes important findings seriously. SKB's research is open. We are always open to new knowledge and always make an assessment of whether new findings are relevant to our work. Every three years a research programme, RD&D programme, that describes the direction of our research is submitted to the Government. SKB is responsible for developing a method that is sustainable and based on the best available technology. We have developed a method that will soon be reviewed and are anxious to obtain answers to all questions.

2.7 Can SKB write into the record which research reports deal with copper corrosion?

(SKB) It is easier is to look in SKB's research programme, the RD&D programme. It contains compilations of results and references to various papers within the safety assessments, for example regarding copper corrosion.

2.8 Approximately 3.2 million cubic metres of rock will be taken out of the final repository, which is equivalent to 10 million tonnes. This amounts to more than 100,000 tonnes of rock per year. What will be done with the surplus rock? It may be difficult to find a buyer in the surrounding region.

(SKB) By way of comparison it can be mentioned that about 340,000 tonnes of rock per year are handled in Flivik. In the light of this, 100,000 tonnes per year is not very much. If the surplus rock cannot be disposed of in the region, it could be exported to the Baltic States or Northern Germany, for example.

2.9 More reports seem to have been produced about Forsmark than about Laxemar. Is this true? If so, is it possible to compare the sites and select one?

(SKB) There are roughly as many reports on Laxemar as on Forsmark, 500–600 per site. Laxemar is slightly behind Forsmark in the process, for example when it comes to the site descriptive model, but both sites will be fully comparable. Sufficient background material will be available when SKB selects a site.

2.10 Why will SKB announce the selected site long before the applications are submitted?

(SKB) To avoid the spreading of rumours, SKB will not try to keep the choice of site secret once it has been made, but will go out with information.

2.11 What will happen with the facility on the surface after the repository has been closed?

(SKB) The strategy is that the final repository will be backfilled and closed, and that the surface facility will be decommissioned and dismantled and the site restored.

2.12 Who is responsible for the final repository after closure?

SKB has furnished information to the effect that SKI and SSI (NB: SKI and SSI were merged in 2008 to SSM, the Swedish Radiation Safety Authority) have published a report on this where they point out that the state should assume responsibility for the final repository after closure.

SSM said that according to the legislation, the activity operator is responsible until the activity is concluded and can then apply to be discharged from responsibility. The law is not entirely clear, but the indications are that responsibility for the final repository for spent nuclear fuel will pass to the state after closure.

3 Common issues

3.1 Is it possible to transport canisters of encapsulated nuclear fuel from the encapsulation plant to the final repository in an underground tunnel?

(SKB) This question has been discussed before, and SKB has evaluated the possibility. Only about one canister will be transported per day, and the distance is only about two kilometres. Prior to transport, the canister will be placed in a transport cask that provides sufficient protection. Transporting the canisters in a tunnel would not offer any advantages in terms of safety. Building a tunnel would, on the other hand, entail considerable costs and environmental impact. SKB's assessment is therefore that the canisters do not need to be transported in a tunnel, nor along a grade-separated route.

3.2 If a tunnel were to be built from the encapsulation plant to the final repository for canister transport, would the canisters have to be transported to the final repository on the ground surface, or could they be taken directly down to repository level?

(SKB) The tunnel portal will be a nuclear facility. It is advantageous for the access to the underground part to be where the surface facilities are.

3.3 Milkas would like SKB to explain at the beginning of every report that the nuclear power plants produce waste that creates long-lasting problems. Spent nuclear fuel contains large quantities of uranium 238, which has a half-life of about 4.5 billion years. That means that half of its radioactivity will remain when the sun stops shining in about 5 billion years. Furthermore, a single reactor creates 200 kg of plutonium in 100,000 years. This can be compared with the fact that Neanderthals disappeared about 30,000 years ago and that human beings have existed for about 80,000 years. From a human time perspective, the waste will therefore be hazardous forever.

SKB notes the viewpoint. The waste that will be managed and disposed of is hazardous. That is why so much development work is being done to optimize the disposal of the waste. In the middle of 2010, SKB will submit applications for licences to build the final repository. The applications will be reviewed, and if the review shows that disposal cannot be done in a sufficiently safe manner they will be denied.

3.4 What guideline values have been used for noise? Are they adapted to the rural environment in question?

SKB uses the Swedish EPA's guideline values for noise. The guideline values in question are for traffic noise, noise from construction sites and external industrial noise. Guideline values for noise from traffic and construction sites are applied generally, regardless of the environment being considered. When it comes to guideline values for industrial noise, we use the values that apply to undisturbed environments. The guideline values for external industrial noise are lower than those for noise from construction sites.

SKB has a good dialogue with the Misterhult Group, which has resulted in clear reports of noise in the form of background levels, estimated changes, etc.

3.5 The background material for the consultations says that vibrations may be perceptible to those who live in the vicinity of the final repository. What does "perceptible" mean, and how near is "in the vicinity"?

(SKB) The vibration studies for Forsmark are finished. The results show that no problems will be created for residences or other sensitive environments. The studies for Oskarshamn are not quite finished, but vibrations there will probably not cause any problems either.

3.6 Whether or not one is disturbed is individual. Moreover, vibrations can be more disturbing during certain parts of the day.

(SKB) In order to mitigate the disturbances, SKB will carry out blasting and other work that causes vibration at optimal times. This will be dealt with in the environmental impact statement.

3.7 The traffic increase on highway 743 may be up to about 75%, which is a lot. How has the Swedish Road Administration calculated the background values? If OKG is shut down, how big will SKB's traffic increase be?

(SKB) If OKG is shut down, traffic to the facility will decrease and the traffic load as a whole in the area will decrease, unless OKG is replaced by another energy facility. The area is classified as being of national interest for energy production.

3.8 How much traffic is there to OKG?

A representative from OKG said that about 1,500 persons work at OKG.

3.9 I would like to comment on an earlier question concerning the energy supply for the final repository. SKB is owned by the nuclear power producers, and it is not likely that the owners would shut off the energy supply as long as the nuclear power plants are in operation. But if the nuclear power plants should be shut down, would there be any money for waste management?

SKB's mission is to bring about safe final disposal, even if the nuclear power plants were to be shut down tomorrow. Waste management is financed by the money set aside in the Nuclear Waste Fund.

3.10 Goods transport will continue for many years, so it would be preferable if the road from Clab to Laxemar could be grade-separated from highway 743.

(SKB) A few years ago, a conceptual study was done on a new route for highway 743. Since a conceptual study does not meet formal requirements, a feasibility study is now being conducted and will be finished by the summer. Issues such as grade-separated junctions may be addressed in the feasibility study.

3.11 According to the background material that has been compiled for consultations, a report on alternatives will be presented in Chapter 4 of the environmental impact statement. We in the environmental movement are anxious to make sure that the descriptions of dry disposal and deep boreholes will be detailed.

(SKB) The documentation accompanying the applications will explain why SKB has chosen the KBS-3 method and not another method such as dry disposal or deep boreholes. A report on alternatives and reasons for the choice of the KBS-3 method will be included in the EIS, but above all a detailed account will be provided in the appendix to the applications that deals with the activity and the general rules of consideration. This appendix will include the reasons why the KBS-3 method meets the requirement on best available technology.

3.12 It is possible to bicycle safely in the Ringhals area. Traffic has increased in the area, but not much has happened with the infrastructure. Why isn't anything being done to make highway 743 safer?

(SKB) If the final repository for spent nuclear fuel is sited in the Laxemar area, SKB will discuss with OKG how car traffic can be reduced, for example by more buses or bicycle lanes.

(Oskarshamn Municipality) Highway 743 has been discussed for a long time, and construction of new facilities in Simpevarp/Laxemar will provide an opportunity to issue requirements. A solution must be found to the road problem if the encapsulation plant and possibly the final repository are sited here. One possibility may be to use the surplus rock.

3.13 Is it possible to reduce the speed on the road to 50 km/h?

(Oskarshamn Municipality) The question should be put to the Technical Services Committee, which in turn has to put pressure on the Swedish Road Administration, since it is their road. But it is possible to reduce the speed, and it has been done earlier for a road section in the Laxemar area.

SKB said that bicycle lanes will be considered in the aforementioned feasibility study on highway 743 that will now be conducted. The feasibility study includes consultations, when it will be possible to offer viewpoints and influence the design.

3.14 How long will SKB's research continue? Progress marches on, and it is always possible to find a new subject for research.

(SKB) The KBS-3 method began to be developed at the end of the 1970s. Since then SKB has worked to develop the method, and there will be a need for further research as long as we work with safety assessments, which will be for a long time to come. The research will thus continue as long as it is needed. In this context it can be noted that SKB's research is largely guided by society/government via the RD&D process.

3.15 All reports are not finished yet, but SKB is going to submit its applications soon anyway!

(SKB) More than a year remains before SKB intends to submit the applications. The applications will not be submitted until the background reports that need to be finished are finished. This includes the safety assessment.

SSM pointed out that site selection is SKB's internal decision. SSM will state its position on site selection and other matters after the applications have been submitted.

3.16 It has been reported in the press that the final repository project has incurred a cost increase of SEK 23 billion. Is Finland having the same problems with costs?

SKB's previous cost calculations were made two years ago. The number of projected canisters to be disposed of then was 4,500, which has now increased to 6,000 canisters due to an extended operating time for the reactors. This has led to increased costs. Moreover, the backfilling method has been modified, which has also resulted in increased costs.

The decision process has not been as drawn-out in Finland. A site for the final repository has already been selected there. In Sweden we have been conducting feasibility studies for eight years and consultations for five years. The democratic consensus process has also taken a much longer time here, which has affected the costs.

SSM pointed out that new legislation on financing had entered into force in January 2008, entailing that SKB must now submit cost calculations every three years. The most recent report was submitted in January this year, and SSM plans to submit its statement of comment to the Government in October.

3.17 Cost calculations should be submitted every year. Is the waste fee included in the consumer's energy bill?

(SKB) The nuclear power plant owners pay the fee directly. The fee is based on installed capacity. The fee is about 0.8–0.9 öre (100 öre = 1 Swedish krona) per kWh.

SSM said that every power company pays its own fee, which varies.

Summary of written questions and viewpoints and SKB's replies from the public consultation meeting in Oskarshamn Municipality on 4 February 2009

Written invitations to participate at the consultation meeting and/or to submit written viewpoints were sent to the following organizations (which receive funding from the Nuclear Waste Fund to follow the consultations), government agencies and concerned municipalities. The table also shows who replied.

Along with an invitation, specially produced background material was sent as a basis for the consultation: Background material for consultations under Chapter 6 of the Environmental Code for licensing under the Environmental Code and the Nuclear Activities Act. Mellanlagring, inkapsling och slutförvaring av använt kärnbränsle. Oskarshamn – Siting, aesthetics and transportation. SKB, January 2009.
The material was available on SKB's website on 17 January 2009.

Swedish Work Environment Authority	No reply
National Board of Housing, Building and Planning	Viewpoints expressed
Swedish Energy Agency	No reply
National Board of Fisheries	Viewpoints expressed
Swedish Armed Forces	No reply
National Rural Development Agency	No reply
Swedish Board of Agriculture	No viewpoints
Legal, Financial and Administrative Services Agency	No reply
Swedish Chemicals Agency	No reply
Swedish Civil Contingencies Agency	Abstains
Swedish National Council for Nuclear Waste	No reply
Swedish Environmental Protection Agency	No reply
Swedish Agency for Economic and Regional Growth (Nutek)	No viewpoints
OKG AB	No reply
National Heritage Board	No reply
National Police Board	Viewpoints expressed
Geological Survey of Sweden (SGU)	No reply
Swedish Maritime Administration	No viewpoints
National Board of Forestry	No reply
National Board of Health and Welfare	Viewpoints expressed
National Institute of Public Health	Abstains
Swedish Radiation Safety Authority	No reply
Swedish National Grid	Viewpoints expressed
Swedish Road Administration	Viewpoints expressed
Oskarshamn Municipality	Viewpoints expressed
County Administrative Board in Kalmar County	No reply
Regional Council in Kalmar County	No reply
Swedish NGO Office for Nuclear Waste Review (MKG)	Viewpoints expressed
Döderhult Nature Conservation Society	Viewpoints expressed
Swedish Environmental Movement's Nuclear Waste Secretariat (Milkas)	Viewpoints expressed
Swedish Renewable Energies Association (SERO)	No reply

1 Interim storage facility and encapsulation plant

No questions or viewpoints were expressed pertaining solely to the interim storage facility or the encapsulation plant for spent nuclear fuel.

2 Final repository

2.1 The National Board of Fisheries assumes that affected aquatic environments will be described in terms of biology, fish and fishing. By fishing is meant both recreational fishing (sport and subsistence fishing) and commercial fishing.

The National Board of Fisheries wants any uses of drilling chemicals, injection grout (to prevent large seepage of groundwater), etc. to be reported in detail.

When rock is drilled out, different types of chemicals are normally added to the drilled-out material to achieve the desired consistency of the rock spoil, including foaming agents, tensides and glycols, polymers, oil and grease. If explosives are used, they introduce other substances such as ammonia, but also diesel oil. Residues of the additives, explosives etc. can contaminate the drainage water and adhere to the shot rock.

The drainage water from drilling may also contain high concentrations of rock flour, which must be separated before discharge to receiving water.

Drilling may also require diversion of groundwater from the area. Discharges of groundwater with high iron content to surface water may result in precipitation of iron and manganese compounds, which can cause sludge formation and harm fish and other aquatic organisms.

The dominant building material in many structures is concrete (comparable to limestone in terms of content). Concrete, but also other products that may be used, causes turbidity in water (suspended substance) and results in elevated pH.

It is important that materials be stored during the construction period in such a way that leachate from the materials does not contaminate surface water. Adequate treatment plants and monitoring/analysis programmes should be put in place to ensure that harmful substances in water diverted from the construction works does not pollute the receiving waters.

The risk of uplift of surrounding shore water areas due to the load exerted by the shot rock on the rock heap should also be described. (National Board of Fisheries)

(SKB) The possible impact of the activity on receiving waters in the area will be examined in the environmental impact statement, EIS.

In order to limit the seepage of water into the tunnel system, the rock will be sealed with injection grout. SKB is keeping close track of the development of grouting methods and grouts with a view to environmental impact.

Drainage water that is pumped up from the underground facility will undergo sedimentation and oil separation in several stages before being discharged to a suitable receiving water. Drainage water also contains a large fraction of groundwater that has seeped into the tunnel system. The monitoring programme will describe how the water's chemical (pH, nitrogen concentrations, etc.) and physical (temperature, flow, etc.) properties will be measured.

Leachate from the rock heap will be treated before being discharged to the receiving water.

There is no risk of uplift of surrounding shore. The rock heap will be located on solid ground (rock and till) at some distance from the coast.

2.2 We believe that, considering the overall safety and environmental aspects, the siting of the final repository at the proposed site in Laxemar satisfies the requirements of the Environmental Code that applicants shall select such a site for the activity that the purpose can be achieved with minimum damage and detriment to human health and the environment.

The results of the safety assessment performed by SKB regarding short- and long-term radiological risks show that the safety criteria are met by a siting at Laxemar. Furthermore, the site results in a coherent system for nuclear waste management from interim storage to final disposal and eliminates several steps, which must be advantageous from both the viewpoint of both safety and cost. (Oskarshamn Municipality)

SKB notes the municipality's viewpoints.

2.3 Traffic along highway 743 will increase by 75%, says the nuclear power industry in the background material to today's meeting. This is nearly a doubling of traffic compared to now. MKG thinks this is a rather big increase. How large a portion of the traffic that is not headed to a possible future final repository is headed to the Oskarshamn Nuclear Power Plant? When the nuclear power plant has been decommissioned, won't the final repository's percentage impact on highway 743 be much greater? How has the Swedish Road Administration calculated the baseline traffic you use in the calculations and in the comparison of transport volume with and without a final repository? (MKG)

(SKB) In view of the outcome of site selection, the question is no longer relevant.

2.4 The Swedish NGO Office for Nuclear Waste Review, MKG, would like to pose the following questions regarding the basic premises in order for the safety assessment for a final repository according to the KBS method to apply:

How long will it take after deposition for the environment around the copper canister, the bentonite clay and the rock around the clay to be oxygen-free? What scientifically verifiable basis is there for the answer? Is there other evidence supporting the answer? (MKG)

SKB's assessment is that the oxygen that is trapped on closure of the repository will be consumed in the course of a few months. This is accomplished by microbes and minerals in the rock and in the buffer/backfill that react with oxygen. We assume that the oxygen in the bentonite clay will disappear as the clay becomes water-saturated. Saturation and oxygen depletion take the longest time in the innermost part of the clay, next to the canister. Since the time it takes for the clay to become water-saturated varies, the time it takes for the oxygen to disappear also varies.

Several of the early experiments on Äspö aimed at finding out what happens to dissolved oxygen in the water. Today there are many evaluations that are based on these experiments, as well as on later experimental data. Data from the Prototype Repository experiment on Äspö are difficult to interpret, since the prototype is not completely isolated from gas exchange with the air in the tunnel. But here as well, diminishing oxygen concentrations can be seen in the backfill (see reference Eriksson (2007) below).

Below are some references with experimental data that support SKB's assessment regarding oxygen consumption after closure of the repository. The estimate of how long it takes for the oxygen in the repository to be consumed is based on model calculations using data from the references.

Peer-reviewed papers in scientific journals:

White, *A. F.* and *A. Yee* (1985). "Aqueous oxidation-reduction kinetics associated with coupled electron-cation transfer from iron-containing silicates at 25°C". Geochim. Cosmochim. Acta 49: 1263–1275.

Banwart, *S.*, *E.-L. Tullborg*, *K. Pedersen*, *E. Gustafsson*, *M. Laaksoharju*, *A.-C. Nilsson*, *B. Wallin* and *P. Wikberg* (1996). "Organic carbon oxidation induced by large-scale shallow water intrusion into a vertical fracture zone at the Äspö Hard Rock Laboratory (Sweden)". J. Contaminant Hydrol. 21: 115–125.

Gascoyne, *M.* (1997). "Evolution of redox conditions and groundwater composition in recharge-discharge environments on the Canadian Shield". Hydrogeol. J. 5: 4–18.

Manaka, *M.*, *M. Kawasaki* and *A. Honda* (2000). "Measurements of the effective diffusion coefficient of dissolved oxygen and oxidation rate of pyrite by dissolved oxygen in compacted sodium bentonite". Nucl. Technol. 130: 206–217.

Trotignon, *L.*, *V. Michaud*, *J.-E. Lartigue*, *J.-P. Ambrosi*, *L. Eisenlohr*, *L. Griffault*, *M. de Combarieu* and *S. Daumas* (2002). "Laboratory simulation of an oxidizing perturbation in a deep granite environment". Geochim. Cosmochim. Acta 66: 2583–2601.

Rivas Perez, *J.*, *E.-L. Tullborg* and *S. A. Banwart* (2003). "The kinetics of O2(aq) reduction during oxidative weathering of naturally occurring fracture minerals in groundwater". Mineral. Mag. 67: 399–414.

Rivas Perez, *J.*, *S. A. Banwartand I.* and *Puigdomenech* (2005). "The kinetics of O2(aq) reduction by structural ferrous iron in naturally occurring ferrous silicate minerals". Appl. Geochem. 20: 2003–2016.

Akagawa, *F.*, *H. Yoshida*, *S. Yogo* and *K. Yamamoto* (2006). "Redox front formation in fractured crystalline rock: an analogue of matrix diffusion in an oxidizing front along water-conducting fractures". Goechem. Explor. Environ. Anal. 6: 49–56.

Peer-reviewed papers at conferences:

Mäder, *U.* K. and *M. Mazurek* (1998). Oxidation phenomena and processes in Opalinus Clay: Evidence from the excavation-disturbed zones in Hauenstein and Mt. Terri tunnels, and Siblingen open clay pit. Scientific Basis for Nuclear Waste Management XXI. (*I. G. McKinley* and *C. McCombie eds.*). Symp. held in Davos, Switzerland, on Sept./Oct. 1997, Mater. Res. Soc., Pittsburgh, Penn. Mat. Res. Soc. Symp. Proc., 506: 731–739.

Puigdomenech, *I.*, *L. Trotignon*, *S. Kotelnikova*, *K. Pedersen*, *L. Griffault*, *V. Michaud*, *J.-E. Lartigue*, *K. Hama*, *H. Yoshida*, *J. M. West*, *K. Bateman*, *A. E. Milodowski*, *S. A. Banwart*, *J. Rivas Perez* and *E.-L. Tullborg* (2000). "O2 consumption in a granitic environment". In: Scientific Basis for Nuclear Waste Management XXIII. (*R. W. Smith* and *D. W. Shoesmith eds.*), Pittsburgh, PA. Mat. Res. Soc. Symp. Proc., 608: 179–184.

Lazo, *C.*, *O. Karnland*, *E.-L. Tullborg* and *I. Puigdomenech* (2003). Redox properties of MX-80 and Montigel bentonite-water systems. In: Scientific Basis for Nuclear Waste Management XXVI. (*R. J. Finch* and *D. B. Bullen eds.*), Mater. Res. Soc., Pittsburgh, Penn. Mat. Res. Soc. Symp. Proc., 757: 643–648.

Carlsson, *T.* and *A. Muurinen* (2009). Identification of oxygen-depleting components in MX-80 bentonite. In: Scientific Basis for Nuclear Waste Management XXXII. (*R. B. Rebak*, *N. C. Hyatt* and *D. A. Pickett eds.*), Mater. Res. Soc., Pittsburgh, Penn. Mat. Res. Soc. Symp. Proc., 1124.

SKB reports:

Kotelnikova, *S.* and *K. Pedersen* (1999). The Microbe-REX project. Microbial O2 consumption in the Äspö tunnel. SKB TR-99-17, Swedish Nucl. Fuel Waste Manag. Co.

Kotelnikova, *S.* and *K. Pedersen* (2000). Microbial oxygen consumption during the REX field experiment. SKB IPR-00-19, Swedish Nucl. Fuel Waste Manag. Co.

Puigdomenech, *I.*, *S. Kotelnikova*, *K. Pedersen* and *E.-L. Tullborg* (2000). In-Situ determination of O2 uptake by geologic media: Field data for the redox experiment in detailed scale (REX). SKB IPR-00-23, Swedish Nucl. Fuel Waste Manag. Co.

Puigdomenech, *I.*, *J.-P. Ambrosi*, *L. Eisenlohr*, *J.-E. Lartigue*, *S. A. Banwart*, *K. Bateman*, *A. E. Milodowski*, *J. M. West*, *L. Griffault*, *E. Gustafsson*, *K. Hama*, *H. Yoshida*, *S. Kotelnikova*, *K. Pedersen*, *V. Michaud*, *L. Trotignon*, *J. Rivas Perez* and *E.-L. Tullborg* (2001). O2 depletion in granitic media: The REX project. SKB TR-01-05, Swedish Nucl. Fuel Waste Manag. Co.

Eriksson, *S.* (2007). Prototype Repository. Analysis of microorganisms, gases, and water chemistry in buffer and backfill, 2004 – 2007. SKB IPR-08-01, Svensk Kärnbränslehantering AB.

2.5 Have copper corrosion rates at the level required to satisfy the criteria for long-term safety (tens of nanometres per year) every been measured in realistic environments? (MKG)

SKB has performed measurements of copper corrosion under the oxygen-free conditions that will prevail in a final repository. In these measurements, which have been done both in free water and in bentonite clay, no net reactions have been observed. There are residues of oxygen in the initial phase of all these experiments. Reactions have also been observed initially. Soon after that an equilibrium is reached when the oxygen has been consumed.

The life of the copper canisters is determined by the amount of sulphide they come into contact with. Copper reacts with sulphide, so the supply of sulphide determines canister life.

2.6 The results of the LOT A2 test in the underground Äspö laboratory show indications that there is a flow of water between the copper canister and the rock. There is therefore a flow through the clay after it has been saturated with water. Copper that has corroded from the canister is also present in the space between clay and rock. Nickel that may come from corroded instruments between clay and rock is present in the clay next to the copper. Is there any scientifically verified basis for claiming that the clay creates a barrier between the copper canister and the rock, even in the short term? Is there other evidence supporting the answer? (MKG)

(SKB) In addition to the fact that the flow in the rock is slow, the bentonite barrier prevents water from flowing between the rock and the canister. Substances such as sulphide must be transported through the clay via diffusion. Diffusion entails that a substance migrates from higher to lower concentration thanks to molecular movements. This transport is therefore slow and the quantity of substance transported is very small. Over the decades, SKB and other nuclear waste organizations have carried out diffusion experiments with different radionuclides in different clay formations. In the Äspö HRL, experiments have been conducted in situ in the rock.

2.7 The Swedish NGO Office for Nuclear Waste Review, MKG, has, in cooperation with different researchers, studied the question of whether the copper canisters will rust/corrode faster in a final repository than has been assumed in the safety assessments for the nuclear power industry's KBS method. After reviewing the matter, MKG fears that corrosion will be far too high and that the canisters may be destroyed in a thousand-year perspective. MKG has noted that the problem has been examined in various studies for nearly 20 years without the nuclear power industry taking it seriously. How is it possible that the industry has not taken such an important question seriously, and how can other stakeholders and the public trust a research and development process that is under the industry's control where the difficult questions are not asked or investigated? (MKG)

(SKB) The copper canister is one of the most important components in the KBS-3 method. It is therefore important to be able to make reliable assessments of what happens to the canisters. Researchers at KTH have done experiments indicating that copper corrodes under oxygen-free conditions, something that has previously been unknown. The alleged reaction between copper and water generates hydrogen gas. The hydrogen quickly builds up an equilibrium pressure (1 mbar), after which the reaction ceases.

In the safety assessments we look at what the consequences would be if copper should corrode in oxygen-free water. We can conclude that there is so much hydrogen in the groundwater that corrosion does not occur. SKB has calculated what this corrosion reaction would mean for the repository's safety and arrived at the conclusion that it is of no importance. If corrosion should nevertheless occur, the bentonite buffer will prevent the hydrogen formed in the reaction from being transported away, whereby the reaction will cease. If the bentonite buffer were to disappear, the copper canister would be affected. However, the corrosion process described by the researchers at KTH would not be the most serious threat in this case, but rather corrosion caused by sulphide reactions. SKB's conclusion is thus that corrosion of copper in oxygen-free water, if it can take place at all, would occur so slowly and to such a limited extent that it would not affect the repository's long-term safety.

2.8 What is the industry planning to do from now on to study corrosion processes in oxygen-free water and the consequences for the long-term safety of the final repository? At the consultation meeting in Forsmark the industry said that they had their own experiments to study the question. In subsequent conversations MKG has had with the industry's research director, we have been given to understand that this is not the case. Has the industry initiated any new experiments to specifically study the question of copper corrosion in oxygen-free water? (MKG)

SKB is planning experiments where copper coupons are placed in water-filled Erlenmeyer flasks of the kind described by the researchers at KTH. The flasks are sealed in a similar manner and placed in a safe place where they can stand so the effects can be determined. If there are corrosion attacks of the kind found by the KTH researchers in their experiments, we will analyze the copper surfaces very carefully. We are conducting a thorough literature review to see if similar observations (that copper reacts with water in a completely oxygen-free environment) have been reported.

2.9 In its own experiments in the Äspö HRL, the industry could probably see whether copper corrosion actually occurs in oxygen-free environments. In a special project called LOT, there is a test parcel called S2. If the parcel is retrieved in the right way, the question of copper corrosion in oxygen-free water can be decided quickly.

When will the parcel be retrieved? Will it be retrieved out in a way that will provide an answer to this important question? How can the industry guarantee that the information contained originally in the parcel will be made available to independent experts? (MKG)

(SKB) In previous experiments at the Äspö HRL, copper corrosion has been studied for the purpose of determining the scope of the corrosion that occurs during the initial phase, when there is still oxygen present. To shed light on the question of possible corrosion in an oxygen-free environment, when retrieving LOT and other tests where copper is present we will give priority to the handling of copper specimens.

If it is a question of determining the presence or absence of corrosion under oxygen-free conditions, it is better to conduct experiments in the laboratory under controlled forms.

2.10 **The Swedish NGO Office for Nuclear Waste Review, MKG, has received from the nuclear power industry's nuclear waste company SKB a draft of the report, including appendices, of the results from the retrieval of the parcel LOT A2 in the Äspö HRL. Retrieval took place in January 2006 and the publication of the report is now more than two years late.**

On page 73 in the draft report on the LOT A2 results, it says regarding the concentrations of copper that have been measured in the bentonite clay around the central copper tube:

"The Cu concentrations of the A2 blocks, i.e. after a test period of 5 years, are, however, not significantly higher (15% at a maximum) than those of the equivalent blocks of the 1-year LOT test /Karnland et al. 2000/. This fact suggests that mobilization of Cu was most intense during an early stage of the test period, possibly before the bentonite had been completely saturated with water".

Appendix 6 to the report says that the concentration of copper in the bentonite clay is about 5,000 ppm in the first centimetre and is down to 50 ppm at a depth of 4 cm in the bentonite in sections of the test where the temperature is high.

The report SKB TR-00-22, "Long Term Test of Buffer Material, Final report on the pilot parcels" /Karnland et al. 2000/, which is the report on the retrieval of the parcels LOT S1 and A1 and the report referred to above, says on page 73:

"The maximum copper content close to the central copper tube was around 100 ppm in the total material and dropped to a mean value of around 25 ppm at a distance of 3 cm from the tube. The copper content was only slightly lower in the clay fraction, indicating that the copper was incorporated in the montmorillonite structure likely as exchangeable ions or as central ions in the octahedral layer".

Similar information is repeated at several of places in the A1/S1 report SKB TR-00-22.

MKG finds it difficult to understand that copper concentrations in LOT A2, which are 50 times higher than those in LOT A1/S1, can be characterized as "not significantly higher (15% at a maximum) than those of the equivalent blocks of the 1-year LOT test" and that "this fact suggests that mobilization of Cu was most intense during an early stage of the test period".

Can the nuclear power industry explain the formulations? If the KBS method is used, how will the bentonite clay behave if the copper content in all of the clay is 5,000 ppm? (MKG)

SKB has discussed these matters with Johan Swahn at MKG. There is nothing more to be added to that discussion now. We will have to await the final compilation of the material. The report is expected to be ready at the end of 2009.

2.11 Were any clay samples taken in connection with the Canister Retrieval Test in the Äspö HRL before all the clay was washed away? If so, have measurements been made of the copper concentration at different distances from the copper canister? (MKG)

(SKB) Yes, clay samples were taken in conjunction with the Canister Retrieval Test in the Äspö HRL. The results are expected to be reported at the end of 2009.

2.12 MKG reads a large number of reports published by the industry. It is our perception that reports of results from Laxemar are no longer produced. A search on SKB's website turns up 60 reports with Forsmark in the title in 2008, but only 17 with Laxemar. In 2007 there were 131 Forsmark reports and 53 from Laxemar. In 2006 there were 156 and 55, respectively. Why is that? How can the industry make fair comparisons between Laxemar and Forsmark prior to site selection if much more information is available on Forsmark than on Laxemar? (MKG)

(SKB) There are roughly as many reports on Laxemar as on Forsmark. But Laxemar has lagged slightly behind Forsmark in the process, for example when it comes to the site descriptive model. A sufficient body of material was available when SKB selected the site for the final repository.

2.13 SKB should respond to KTH's findings regarding copper corrosion. SKB should explain the differences in KTH's investigations compared with its own. The KTH researchers have explained that the experiments performed in the early 1990s, which SKB claims contradict the researchers' findings, were not done in the right way. How does SKB respond to this? Why aren't the KTH results representative of a possible final repository in Laxemar? (Döderhult Nature Conservation Society)

(SKB) The questions concerning copper corrosion in an oxygen-free environment have two sides, a scientific side and a safety side. When it comes to the issue of safety, SKB has calculated what it would mean for safety if the postulated reaction between copper and water actually occurs. The answer is that this is of no importance for the repository's protective capability, since other reactions are crucial for the durability of the copper canisters.

The scientific question is still unanswered. SKB is sceptical towards the claim, but cannot entirely rule out the possibility of a reaction either. The debate is still under way in the scientific community. SKB will commission experiments similar to those carried out at KTH.

2.14 During the operating time for the final repository, blasting will be done to excavate additional space for the final repository. How will SKB ensure that blasting does not impact the final repository? The blasting at Clab for the encapsulation plant must be done with great caution due to closeness of the facilities. (Döderhult Nature Conservation Society)

SKB plans to separate the areas for construction and deposition activities down in the facility so that the distance between the blasting work and the operational deposition area is sufficient.

2.15 When the repository is decommissioned, if everything on the ground surface is removed, how will SKB ensure that knowledge will exist about the repository in e.g. 200 years, 500 years, etc.? (Döderhult Nature Conservation Society)

(SKB) In order that future generations will be able to make well founded decisions and avoid inadvertent intrusion, SKB is working to ensure that information on the final repository for spent nuclear fuel will be preserved in the future.

There are two fundamental principles for how information can be passed on to future generations: successive information transfer, and information transfer directly to a distant future. Successive information transfer involves human participation and can be exemplified by archives. Markers are a way to transfer information directly to a distant future.

SKB will draft a proposal for a plan of action, within the framework of international cooperation, in order to preserve information on the final repository in the long term. It is worth noting that other organizations are also working with this question. For example, the Swedish Radiation Safety Authority proposes that a national register be created for long-term preservation of information on shallow burial sites and final repositories for long-lived radioactive waste.

The issue of information preservation far into the future will, however, not become urgent until the final repository is to be closed, which is expected to be in around 2085 at the earliest. Then society can decide which type of information it wants to preserve and how.

2.16 Why is it not realistic to transport the bentonite to the harbour at Simpevarp, since SKB is clearly considering receiving the copper canisters there? (Döderhult Nature Conservation Society)

After the question was asked, SKB decided that the applications for the final repository for spent nuclear fuel would pertain to an establishment in Forsmark. The harbour at Simpevarp is not designed in such a way that ships carrying bentonite can put in there. For one thing it is not deep enough. Furthermore, the harbour is unprotected, and building a protective pier entails a severe encroachment on the natural environment.

2.17 Bentonite can be affected by salt water, pH and how it is stored before use, and the degree of compaction affects its density. How will SKB prevent the negative consequences of such effects? (Döderhult Nature Conservation Society)

SKB has good knowledge of the properties of the bentonite. Like many other natural materials, it must be handled and stored in such a way that its properties are not degraded.

2.18 SKB describes two alternatives for backfilling the underground openings. What are the advantages and disadvantages of the alternatives? How does crushed rock affect the sealing capacity of the bentonite? In other mixtures with bentonite and other inorganic materials with a smaller particle size than is normally associated with crushed rock, it is of vital importance how mixing is done and what the concentrations of the different parts are. (Döderhult Nature Conservation Society)

(SKB) The advantage of using a mixture of bentonite and crushed rock, instead of only bentonite, is that the number of shipments of bentonite to, and excavated rock from, the facility is reduced. With bentonite alone it is easier to achieve low hydraulic conductivity, i.e. a denser material.

The crushed rock intended to be mixed with bentonite is a material with a maximum particle size of 5 mm and thereby a large content of fine material. Crushed rock is made from the rock removed by rock excavation in the facility and stored on the rock heap.

2.19 How is the dust created by rock crushing managed? How much dust is created on the ground surface? (Döderhult Nature Conservation Society)

(SKB) Rock crushing on the ground surface will be limited. If dust problems are created around the rock heap, watering will be done on and around the rock heap. Dust-binding agent may be used as needed on gravel surfaces within the construction sites.

2.20 What will the consequences be of groundwater lowering in conjunction with construction of the final repository? What compensatory measures does SKB plan to adopt to mitigate the consequences of groundwater lowering? (Döderhult Nature Conservation Society)

(SKB) The consequences of groundwater lowering, or drawdown, in Forsmark will be described in the preliminary EIS that will be circulated for consultations in early 2010. In brief, it is above all the area's natural values that may be affected by groundwater lowering. To limit the consequences of groundwater lowering, preventive and damage-mitigating measures are proposed to avoid or limit negative consequences on sensitive natural attractions. Compensatory measures are proposed for the natural values that will be affected when consequences cannot be avoided.

2.21 Radon will be ventilated out of the final repository during construction (page 45 in the background material). How will this affect the air around the final repository? (Döderhult Nature Conservation Society)

(SKB) Radon that occurs naturally in the rock must be ventilated away so that it doesn't constitute an occupational hazard. The ventilation air will pass via ventilation buildings on the ground out into the ambient air. Thanks to dilution in the air, the radon from the hard rock facility will not constitute a problem for the surrounding area.

2.22 After 100,000 years, the radioactivity is about 230,000 Mb/t, of which 90% consists of uranium 238. Is it safe to drill a well down to a depth of 500 metres and drink the water from the final repository? (Milkas)

(SKB) The consequences of someone inadvertently drilling through the repository are addressed in the safety assessments.

2.23 Microbes can adapt to the environment in which they live. Two billion years ago their nitrogen atom could make use of an oxygen atom even though there were no free oxygen molecules. How can SKB guarantee that microbes will not mutate in the final repository? If they should mutate and develop unknown corrosive properties, radioactive substances could rapidly poison the groundwater and all biological life. (Milkas)

SKB cannot, nor does it need to be able to, guarantee that microbes will not mutate in the final repository. This is because even mutated microbes will require nutrients, and there are clear limitations on the availability of nutrients in the rock and the groundwater, which puts limits on potential microbial activity. Furthermore, consequences of extreme assumptions, such as that some unknown or currently non-existent microbe (or other process) will eventually damage the canisters, can be explored in the safety assessment. This has been done in SR-Can.

2.24 If a radioactive leak is discovered in the final repository in 150 years, can SKB guarantee that humans will be able to repair the damage without risk to their health? (Milkas)

(SKB) Final disposal of spent nuclear fuel according to the KBS-3 method will be designed in such a manner that the repository does not need to be monitored or

repaired. If this is nevertheless necessary for some reason unknown today, it will be possible to do so.

2.25 Milkas wants an indicator to be buried next to every canister showing if and where a radioactive leak occurs if the KBS-3 method is chosen. (Milkas)

SKB has no plans to bury any indicators next to the canisters, nor does it see any benefit of doing so. SKB will never get a licence to build a final repository if we cannot show that it will be safe in the long term with a view to man and environment.

2.26 Milkas wants a dry repository to be tested before the wet final repository is built, which will contaminate the groundwater with radionuclides. (Milkas)

SKB sees no reason to build a dry repository after having spent a long time developing the KBS-3 method, where deposition takes place below the groundwater table in a manner that ensures long-term safety.

3 Common issues

3.1 From a police viewpoint, it is important in connection with the described process to prevent unauthorized dealings with spent nuclear fuel. From this perspective, we can see the importance of thorough evaluation of whether a tunnel alternative can be considered safer than road transport. (National Police Board)

After the question was asked, SKB decided that the applications for the final repository for spent nuclear fuel will pertain to an establishment in Forsmark. If the final repository had been sited in the Laxemar area, roughly one canister per day would have been transported along the two kilometre route between the encapsulation plant and the final repository. Prior to shipment the canister would have been placed in a transport cask. Protection on multiple levels is provided during transport. The exact nature of this protection is classified. SKB does not see that canister transport would have had to take place in a tunnel from a safety point of view.

3.2 The National Board of Health and Welfare has no comments on the background material presented, but offers the following guidance for the continued work.

Environmental impact statement

Chapter 6, Section 3 of the Environmental Code contains no express requirement on a report of the impact on the environmental quality objectives in an environmental impact statement. However, the objectives shall guide the application of the Environmental Code. According to Chapter 6, Section 7, point 3 of the Environmental Code, an environmental impact statement shall contain "the information that is needed to establish and assess the main impact on human health, the environment and management of land, water and other resources that the activity or measure is likely to have". The National Board of Health and Welfare believes that a report of the impact on the environmental quality objectives is a good instrument that can contribute to compliance with Chap. 6, Sec. 7, point 3 of the Environmental Code.

The Board notes that effects and consequences for the residential environment and health will be dealt with in the continued work. In this context, reference is made to the special step model developed by the Board for environmental health assessments. This model can be used to describe the impact on human health more clearly in the environmental impact statement.

- **Step 1 – Describe the activity with a focus on the impact on human health, including what knowledge is available regarding the environmental impact in question (what, how long, how often) and its acute and chronic health effects.**

- **Step 2 – Describe the surrounding environment, e.g. whether the area is already exposed to environmental factors. Describe what people are present within the geographic area who will be affected by the project. An inventory should be made of the population that might be exposed, including whether there are particularly sensitive individuals (children, elderly persons with disabilities, etc.).**
- **Step 3 – Describe the impact on human health. This step is the actual environmental health assessment. The assessment of the health aspects in the environmental impact statement can be facilitated by showing how the exposure affects the concerned population. (National Board of Health and Welfare)**

SKB will report impacts on the national and regional environmental quality objectives. SKB has already been working according to the step model developed by the National Board of Health and Welfare for environmental health assessments. In the EIA work, SKB's point of departure for the impact assessment is the activity and the local premises.

3.3 Construction of facilities for interim storage, encapsulation and final disposal of spent nuclear fuel is a large undertaking that will take a long time. The National Board of Health and Welfare is therefore of the opinion that the facilities' impact on the surrounding area should be studied and measures proposed to reduce this impact. (National Board of Health and Welfare)

SKB has studied and will submit a report on both the impact on the surrounding area and possible measures to reduce this impact.

3.4 Swedish National Grid is planning a new 400 kV power line from Simpevarp to Nässjö. The line will probably be installed between Svenska Kraftnät's existing 400 kV lines. The line will then be located north of the planned rock heap. (Swedish National Grid)

SKB notes Swedish National Grid's plans for a new power line.

3.5 The background material explains that there will be substantial traffic increases on highway 743 for a long time, particularly of heavy vehicles. A future road system in the area must be designed for the large volumes of heavy shipments that are expected during construction phases 1 and 2, with up to a 100% increase. A separate walk/cycle path between Figeholm Simpevarp will be needed. A future road system must be adapted to the requirements and rules that apply for noise and transport of dangerous goods with the requisite protection zones. (National Road Administration)

A conceptual study was published by SKB in 2005, and now a feasibility study for highway 743 in accordance with the provisions of the Public Road Act will be undertaken for SKB. The next step in the planning work is to conduct a road study as a basis for the selection of a road corridor and a road design standard. In the continued work with road studies and work plans, the estimated transport volumes of rock and building materials as well as passenger traffic are important parameters for assessment of the future road standard.

With the increased traffic volumes expected in the nearby area, there may be a need for other road investments. Rebuilding and improvement of interchanges, junctions/intersections, the street network in Oskarshamn and bearing capacity improvements are examples of areas where measures could be needed, which should be taken into account in the continued work. (National Road Administration)

SKB agrees that a future road system must be adapted to the requirements and rules that apply to noise and transport of dangerous goods with the requisite protection zones. The issue of bicycle lanes will be addressed in the ongoing feasibility

study. With regard to other road investments such as rebuilding and improvement of interchanges, junctions/intersections, the street network in Oskarshamn and bearing capacity improvements, SKB believes that the existing road network is adequate for SKB's planned transport.

3.6 **Signal control activated during canister transport is proposed at the intersection with highway 743/Clab and the road to the final repository. Our opinion now, which we have stated previously as well, is that this intersection should be grade-separated for the highest possible safety.**

It is our firm conviction that canister transport traffic should not be mixed with general traffic on highway 743. We presume that there will also be some daily transport need between Clab and the final repository, which would be smoother and safer with a grade-separated intersection at highway 743. (National Road Administration)

After the question was asked, SKB decided that the applications for the final repository for spent nuclear fuel will pertain to an establishment in Forsmark. If the final repository had been sited in the Laxemar area, roughly one canister per day would have been transported along the two kilometre route between the encapsulation plant and the final repository. Prior to shipment the canister would have been placed in a transport cask, which would have provided adequate protection. SKB's assessment is that it would not have been necessary for the transport route to be grade-separated.

3.7 **The final repository for spent nuclear fuel is one of Sweden's biggest environmental projects. The municipality's general attitude is to ensure that the facilities, if they are sited in Oskarshamn, will be an asset in the municipality via good design, high safety, good environment and a high technical standard and serve as a technical and environmental model.**

It is thus of the utmost importance that the EIS that will be submitted by SKB with the application be grounded in high ambitions with regard to environment and technology and provide all parties in the process with broad and adequate information where nothing of value is omitted. (Oskarshamn Municipality)

SKB agrees with the municipality's opinion that the facilities should be characterized by good design, high safety, good environment and a high technical standard and serve as a technical and environmental model. SKB's intention is that the EIS that will be appended to the applications will provide broad and adequate information where the environmental consequences are described and suitable measures are proposed to avoid or limit these consequences.

3.8 **In the brochure published by MILKO in 2008 ("The Misterhult district – a vision of a district characterized by consideration for human health and the environment", in Swedish only), we identify concrete environmental needs which we want to be met in the future development of the district. Our ambition is to create a modern community under the motto "use, but don't misuse, the district's resources". The brochure explains our positions on human health and the environment and what principles we believe should guide new enterprises in the district. (Oskarshamn Municipality)**

SKB has read MILKO's brochure and will take into account the viewpoints presented regarding human health and the environment.

3.9 **At previous meetings, e.g. EIA Forum on 12 March 2008, we have explained how we think the environmental consequences should be analyzed and assessed. The appendix is attached to this statement. It is important to us that all parts of the EIA**

be examined, i.e. the activities that cause impact (the environmental aspects), their effects (various kinds of measured values) and the consequences based on various interests in the district. In the appendix we have given examples of some interests connected with e.g. the canister shipments. (Oskarshamn Municipality)

SKB agrees that it is important to analyze all parts of the EIA.

In carrying out the environmental impact assessment, SKB has worked methodically from the environmental impact caused by the activity to the effects and consequences caused by the impact with a view to conditions on the site (what or who is exposed).

3.10 We also believe that an EIS should contain a discussion of protective measures linked to the environmental aspects that can cause damage or detriment. In this way, both impact assessments and measures aimed at preventing and mitigating undesirable consequences are clear. (Oskarshamn Municipality)

(SKB) The EIS will include a discussion of preventive measures linked to important environmental aspects. Information will be provided both in the chapters on the different activities and collected at the end of the document. The compilation at the end of the EIS is done for the reader's convenience and to underscore the importance of the proposed preventive, consequence-mitigating and compensatory measures in the impact assessment.

3.11 According to the heading, the consultation includes the siting (the place), the aesthetics (the design of the facilities) and transportation (all transportation occasioned by the activity).

According to SKB, the consultation also includes environmental aspects associated with the entire project ("activities during construction, operation and decommissioning of the encapsulation plant and final disposal, including transportation"), i.e. environmental aspects associated with the entire final repository system.

By environmental aspects is meant, according to the definition in the ISO standard, "those parts of an organization's activities/operations, products or services that might have an environmental impact". Since SKB is certified to the environmental standard ISO 14001, we understand that the definition applies in this case. (Oskarshamn Municipality)

(SKB) ISO certification and EIA legislation have different purposes. ISO certification is applied to existing organizations or activities, while the EIA legislation is applied to planned activities. There are, however, certain points of intersection between the environmental work under ISO 14000 and the EIA work, and most environmental aspects are the same. But the EIA work is well regulated with its own definitions and practice, so that mixing in definitions from ISO certification would be confusing.

3.12 In each consultation and contact with nearby residents, demands for a better road are brought up. The municipality's position is that the road must be improved as soon as possible, and the rock spoil from the encapsulation plant or the final repository should be used for this purpose.

Highway 743 is heavily trafficked at times, and the municipality finds the increase in traffic resulting from the encapsulation plant alone, or to an even greater degree in combination with the final repository, to be unacceptable. Financing has not yet been found for road improvement, but the municipality would like SKB to be clearer with regard to its participation in the road improvement work. (Oskarshamn Municipality)

SKB is willing to discuss a solution together with the Swedish Road Administration, Oskarshamn Municipality and other actors. Today the road is used to a great extent by companies operating on the Simpevarp Peninsula.

3.13 **In the background material, SKB has identified and reported at the meeting the actual impact as an environmental aspect, rather than the activity or activities that cause the environmental impact. We consider it more instructive to stick to the definition of environmental aspect and identify the activities that are conducted – e.g. transport, blasting, rock storage, etc. – and the impact, effects and consequences they cause.**

"Environmental aspects" identified by SKB are noise and vibration, emissions to air and water, impact on groundwater levels, land use and light pollution. These are undoubtedly important, but there are more. In our presentation at the EIA Forum in March 2008, we brought up additional impacts that we have identified, such as accident risks, barrier effects and concern about radioactive releases. Another impact of a more global nature is management of natural resources (e.g. choice of materials), which is growing in importance. In view of the intention to report environmental aspects for the entire final repository system, we find that what is reported is not a complete picture.

In Chapter 8, a priori impact assessments are done (which according to the background material were supposed to wait until an upcoming consultation on the EIS) that are not based on local conditions and interests. Some examples are given below.

General guideline values for noise are held up as criteria for detriment, where the equivalent level is usually a basis for the guideline value. We believe that noise cannot always be regarded in the form of equivalent noise values and that the noise should be analyzed from the viewpoint of different interests in the district, where tourism, outdoor activities and recreational interests are important to take into account. A discussion is thus needed of how the noise should be measured and what consequences it can have in different contexts for different interests.

We would like to make reference to the Swedish EPA's report "Good acoustic environment…". (Report 5708, 2007), where a nuanced picture is given of noise including threshold values in different environments, noise events and duration of excessive noise. (Oskarshamn Municipality)

(SKB) The accounts of environmental aspects included in the consultation material and given at the consultation meeting are general, and other aspects than those mentioned in the consultation material have been studied in the process of producing a preliminary EIS. Environmental aspects will be included in the next consultation on the preliminary EIS, which is planned to be held in 2010.

SKB uses the Swedish EPA's guideline values for noise. The guideline values in question are for traffic noise, noise from construction sites and external industrial noise. Guideline values for noise from traffic and construction sites, are applied generally, regardless of the environment being considered. When it comes to guideline values for industrial noise, we use the values that apply to undisturbed environments. The guideline values for external industrial noise are lower than those for noise from construction sites. Furthermore, SKB has taken into account local conditions in the impact assessment in order to be able to propose suitable preventive and damage-mitigating measures.

3.14 **SKB says about the vibrations that "They will hardly be perceived as disturbing". MILKO has previously expressed viewpoints on SKB's application where we point out that the vibration levels indicated by SKB will be perceptible (the vibrations from**

the blasts at the encapsulation plant can cause an oscillation rate of 2.9 mm/s with a charge of 1 kg at a distance of 700 metres, and 9.2 mm/s with a charge of 10 kg).

Man is sensitive to vibration (perception threshold equal to or lower than 0.4 mm/s), and the blasts will be perceptible at distances of several kilometres. Since the effect of the vibrations on man are dependent on a number of circumstances, e.g. duration and when they occur, MILKO calls for site-specific analysis. Such an analysis will probably provide answers to how the disturbances can be limited, e.g. by restricting them to certain days and certain times during the day. (Oskarshamn Municipality)

(SKB) The vibration studies show that no problems will be created for residences or other sensitive environments around the encapsulation plant. The criterion governing the blasts planned for the encapsulation plant has been the nearness to Clab, and the charges are thereby relatively small. The maximum oscillation rate at the nearest housing has been calculated to be 0.7 mm/s. At these levels there is no risk of building damages. Furthermore, people living in the nearest residences will probably not perceive the vibrations from most of the blasting rounds.

Whether or not one is disturbed is individual. Moreover, vibrations can be more disturbing during certain parts of the day. In order to mitigate the disturbances, SKB will carry out blasting and other work that causes vibration at optimal times. This will be dealt with in the environmental impact statement.

3.15 The background material says that recovery of the groundwater levels around the encapsulation plant will take about 10 years. We believe that it should also be mentioned that the recovery time around the final repository is many decades, perhaps 100 years. (Oskarshamn Municipality)

SKB says in the consultation material that the groundwater level around the final repository will be lowered and that a recovery of the groundwater level will take place after closure and site remediation.

After closure is finished, the groundwater table will recover in about 1–2 years. In reality, recovery will proceed gradually as the different parts of the final repository are backfilled and groundwater drainage ceases. Closure in itself takes a number of years. Resaturation of the repository is another matter, and the pressure in the rock around the repository may have recovered completely while resaturation of the repository is still taking place. Pressure recovery at depth therefore takes more time, and earlier estimates for Laxemar are that it would take 10 to 20 years for the final repository to be resaturated.

3.16 We support SKB's attitude that uses should preferably be found for rock spoil that is not needed for SKB's own purposes in the district, then in the municipality and finally in the region. (Oskarshamn Municipality)

SKB notes the viewpoint.

3.17 SKB's clear position that rail will not be an alternative for transport of rock spoil and clay material in the foreseeable future surprises us. Even though it is not reasonable to demand that SKB alone should bear responsibility for such a solution, the alternative could be realistic in the future. Shipments to the repository will take place up to the 2080s, with large shipments of clay and bentonite at the end of the period.

It is our firm conviction that the question of rail as a means of transport for rock spoil and clay material needs to be described in an EIS in order to provide an adequate basis for a decision. (Oskarshamn Municipality)

After the question was asked, SKB decided that the applications for the final repository for spent nuclear fuel will pertain to an establishment in Forsmark. A rail connection is often seen as an environmentally friendly alternative to road transport, but building a railway to Laxemar entails a very large encroachment on the landscape, at the same time as only a limited portion of the transport need could met by rail. The environmental benefit of a railway would therefore have been highly dubious.

3.18 **Canister transport is an important environmental aspect. We find canister transport on public roads with signal control to be unsuitable. An alternative we would like to discuss is grade-separated junctions or a tunnel. It should be borne in mind that canister shipments will continue up until the end of this century. The means of canister transport is therefore more than just an economic or technical issue; it is also a long-term societal issue with an element uncertainty when it comes to the evolution of society and future requirements on physical protection.**

Can the tunnel portal for transport underground be located close to the encapsulation plant (within the final repository's protection area), or do the canisters have to be transported via the final repository's surface facility? A tunnel from the encapsulation plant would not be longer than a tunnel from the surface facility. Nor should the surface facility be subject to the same protection requirements if the canister goes directly in a tunnel from the encapsulation plant to the underground repository.

We would like to know SKB's thinking regarding alternative means of canister transport. (Oskarshamn Municipality)

After the question was asked, SKB decided that the applications for the final repository for spent nuclear fuel will pertain to an establishment in Forsmark. If the final repository had been sited in the Laxemar area, roughly one canister per day would have been transported along the two kilometre route between the encapsulation plant and the final repository. Prior to shipment the canister would have been placed in a transport cask, which would have provided adequate protection. Transporting the canisters in a tunnel would not have offered any advantages in terms of safety. Building a tunnel would, however, have entailed considerable costs and environmental impact. SKB's assessment is therefore that it would not have been necessary to transport the canisters in a tunnel, nor along a grade-separated route.

3.19 **We think it is important to "leave no stone unturned" when it comes to describing the impact of the activities involved in final disposal and to analyze each activity with regard to its environmental impact and effect. Furthermore, the consequences must be assessed from the viewpoint of the interests that exist in the district and that are affected by the particular environmental aspect. This is, as we see it, the basis of the EIA work – providing information that enables those affected to evaluate for themselves whether a particular aspect entails a risk of detriment or damage. Opinions may then differ as to how the consequence is evaluated, and these differences of opinion should be respected in a serious assessment.**

We at MILKO would be happy to assist and offer viewpoints that can then be taken into account in the preliminary EIS on which SKB will hold consultations in the autumn. Our intention is that the final repository system should represent the "cutting edge" of technology and environment. (Oskarshamn Municipality)

SKB agrees with the municipality that it is important to "leave no stone unturned". SKB has already been collaborating with MILKO, which has contributed valuable viewpoints with regard to the EIA work. In conjunction with the upcoming consultations on a preliminary EIS, there will be further opportunities to express viewpoints and contribute to the EIA work.

3.20 When it comes to noise in connection with the construction of the final repository, the nuclear power industry's nuclear waste company, SKB, writes in the background material to the consultation meeting that no relevant guideline values are exceeded. The Swedish NGO Office for Nuclear Waste Review, MKG, wonders what type of guideline values these are? Aren't they guideline values that are meant for an urban environment with lots of traffic and industry and not for a peaceful, quite and beautiful rural environment? A similar question concerns noise from traffic. Is it acceptable for humans even if the noise level is kept below 55 dBA? In other words: Are the limit values you use for noise and vibration as relevant in the relatively quiet environment in the area along highway 743 as they are, for example, on Hornsgatan in Stockholm? (MKG)

SKB uses the Swedish EPA's guideline values for noise. The guideline values in question are for traffic noise, noise from construction sites and external industrial noise. Guideline values for noise from traffic and construction sites are applied generally, regardless of the environment being considered. When it comes to guideline values for industrial noise, we use the values that apply for undisturbed environments. The guideline values for external industrial noise are lower than those for noise from construction sites.

3.21 It also says in the background material to the consultation that vibrations may be perceptible to people living in the vicinity of the final repository. What does "perceptible" mean, and how near is "in the vicinity"? (MKG)

(SKB) Information on vibrations and consequences for residents will be presented in the preliminary EIS which will serve as a basis for the consultations that are planned to be held in early 2010. In view of the choice of Forsmark for the applications for siting of the final repository, only vibrations caused by blasting for the encapsulation plant are relevant for Oskarshamn. The results of completed studies show that no problems will be created for residences or other sensitive environments around the encapsulation plant. The criterion governing the blasts for the encapsulation plant has been nearness to Clab, and the charges are thereby relatively small. The maximum oscillation rate at the nearest housing has been calculated to be 0.7 mm/s. At these levels there is no risk of building damages. Furthermore, people living in the nearest residences will probably not perceive the vibrations from most of the blasting rounds.

3.22 How will SKB comply with the noise guideline values in the nearest housing 500 m from the activity? According to the Swedish EPA's guideline values for industrial noise, the noise levels at the nearest house should, as a guideline value, not exceed 50 dB(A) weekdays between 0700 and 0600 hrs, 45 dB(A) between 0800 and 1000 hrs, and Sundays and holidays between 0700 and 0600 hrs, and 40 dB(A) between 1000 and 0700 hrs.

- **Will SKB strive for lower limit values considering the sensitive environment in which the activity is planned to be located?**
- **Will SKB apply "the guideline values for pristine nature and holiday accommodation" for noise from the encapsulation plant and the final repository area? (Döderhult Nature Conservation Society)**

SKB uses the Swedish EPA's guideline values for noise. The guideline values in question are for traffic noise, noise from construction sites and external industrial noise. Guideline values for noise from traffic and construction sites are applied generally, regardless of the environment being considered. When it comes to

guideline values for industrial noise, we use the values that apply to undisturbed environments. The guideline values for external industrial noise are lower than those for noise from construction sites.

During the construction of the encapsulation plant, the guideline value for construction noise in the daytime will be complied with, but protective measures are required to comply with the guideline value for construction noise in the evening and at night. The guideline values during the encapsulation plant's operating phase will be complied with, i.e. the guideline values for external industrial noise in undisturbed environments.

3.23 How does SKB plan to guarantee the best available technology and environmental choice for transportation? (Döderhult Nature Conservation Society)

SKB has an integrated management system for quality, environmental, safety and occupational safety issues. The system is certified to ISO 9001:2000 and 14001:2004.

The management system has two purposes. The first is that the company should have a planned and quality-assured mode of working. The second is to serve as a tool for effective support in the daily work.

With the support of the management system, SKB will draft an environmental programme stipulating environmental requirements on e.g. transportation and vehicles.

3.24 What initiatives and what responsibility does SKB plan to take to solve the road problem from E22 to the Simpevarp/Laxemar area (bypassing both Figeholm and Misterhult)? Will SKB work actively to ensure that protected walking and cycle paths are built along these routes? (Döderhult Nature Conservation Society)

After the question was asked, SKB decided that the applications for the final repository for spent nuclear fuel will pertain to an establishment in Forsmark. SKB has earlier had a conceptual study done of the road between Figeholm and Simpevarp. This conceptual study will be transformed into a formal feasibility study according to the Swedish Road Administration's standards. Today and in the foreseeable future, SKB is not the big user of this road. We have taken several initiatives to improve the road. But the Swedish Road Administration is responsible for the roads.

3.25 SKB has previously suggested that the rock spoil could be used to build railways for future shipments to and from the final repository, but no longer considers railway transport realistic. Why this change of mind? (Döderhult Nature Conservation Society)

After the question was asked, SKB decided that the applications for the final repository for spent nuclear fuel will pertain to an establishment in Forsmark. A rail connection is often seen as an environmentally friendly alternative to road transport, but building a railway to Laxemar entails a very large encroachment on the landscape, at the same time as only a limited portion of the transport need could met by rail. The environmental benefit of a railway would therefore have been highly dubious.

3.26 SKB ought to make a comparison between rail transport and road transport from an environmental viewpoint. (Döderhult Nature Conservation Society)

After the question was asked, SKB decided that the applications for the final repository for spent nuclear fuel will pertain to an establishment in Forsmark. A rail con-

nection is often seen as an environmentally friendly alternative to road transport, but building a railway to Laxemar entails a very large encroachment on the landscape, at the same time as only a limited portion of the transport need could met by rail. The environmental benefit of a railway would therefore have been highly dubious.

3.27 We call for a clear account in the EIS of all the consequences resulting from all the effects described in the EIS that the encapsulation plant and the final repository will have on the environment in both the short (0–100 years) and long (100–100,000 years) term. (Döderhult Nature Conservation Society)

(SKB) The EIS will contain a clear account of all the consequences resulting from all the effects that the encapsulation plant and the final repository will have on the environment in both the short (0–100 years) and long (100–100,000 years) term.

3.28 It is believed that the vibration disturbances during the first construction stages of the final repository may be perceptible to nearby residents, but, says SKB, "they will hardly be perceived as disturbing" (page 44 in the background material). In our opinion, what is perceived as disturbing is highly individual and hardly an assessment that SKB can make in general terms. (Döderhult Nature Conservation Society)

(SKB) In view of the choice of site, only vibrations caused by blasting for the encapsulation plant are relevant for Oskarshamn. Calculation results show that there is no risk of building damages. Furthermore, people living in the nearest residences will probably not perceive the vibrations from most of the blasting rounds. The criterion governing the blasts for the encapsulation plant has been nearness to Clab, and the charges are thereby relatively small.

However, whether or not one is disturbed is individual. Moreover, vibrations can be more disturbing during certain parts of the day. In order to mitigate the disturbances, SKB will carry out blasting and other work that cause vibration at optimal times. This will be dealt with in the environmental impact statement.

3.29 It is important that SKB stick to its present ideas that all buildings should be designed to blend in with the sensitive environment. We do not want any spectacular buildings "that stick out". Similarly, outdoor lighting should be arranged so that there is as little light pollution as possible in the area. (Döderhult Nature Conservation Society)

SKB's point of departure in designing the buildings is that they should indeed blend in with the environment as well as possible. How this is done is described in the sections in the consultation material dealing with aesthetics.

3.30 The introduction to the background material for the consultation with the general public provides minimal information on what the nuclear fuel consists of. The Swedish Environmental Movement's Nuclear Waste Secretariat, Milkas, demands a brief declaration of what chemical substances are contained in the nuclear fuel, and in what quantities, and what different types of radioactivity they contain from the start up until the sun burns out.

This declaration of contents should be included in the introduction to all reports aimed at the general public, regulatory authorities and politicians. Illustrations of a few decay chains should be included, showing the amount and type of radiation emitted by the nuclides. An explanation should be included that gamma radiation is hazardous for external exposure and decays more rapidly than alpha radiation, but that alpha radiation is hazardous if it is ingested, drunk or inhaled.

The following facts will thus be included in the declaration of contents:

- **The nuclear fuel in Sweden's 10 reactors generates about 67 TWh of electricity and 124 TWh of heat to the seas annually. The electricity is also converted to heat.**
- **Ordinary nuclear fuel contains 85,000 Mb/t of radioactivity.**
- **A reactor needs approximately 200 tonnes of new fuel every year.**
- **The radioactivity in spent fuel has risen to 335,000,000,000 Mb/t.**
- **It takes virtually forever for the main ingredient, uranium 238, to decay to stable lead, Pb 206.**
- **The half-life of uranium 238 is about 4.5 billion years, so when the sun stops shining in 5 billion years nearly half of the radioactivity will be left.**
- **A single reactor has created about 200 kg of plutonium after 100,000 years.**
- **A timeline should also be included in the introduction: Man with our intelligence has existed for 80,000 years, and Neanderthals went extinct about 30,000 years ago. (Milkas)**

SKB notes the viewpoint. The waste that will be managed and disposed of is hazardous. That is why so much development work is being done to optimize the disposal of the waste. During 2010, SKB plans to submit applications for licences to build the final repository for spent nuclear fuel. The applications will be reviewed, and if the review shows that disposal cannot be done in a sufficiently safe manner they will be denied.

3.31 Is it true that a handful of plutonium could wipe out the human race? (Milkas)

(SKB) Plutonium is mainly an alpha emitter and can only harm a human if it gets into the body. Uptake via the skin or the gastrointestinal tract (i.e. via food or drink) is very low (less than 0.1% except in special cases), so the most dangerous scenario is if plutonium dust gets into the lungs by inhalation.

Radioactive substances that enter the human body can, depending on their quantity, cause acute or chronic health effects. Acute effects occur if the quantity ingested is so great that a number of cells in vital organs are destroyed. The acute toxicity of different substances is often given in LD50 values, which refers to the amount of the substance that leads to acute death for 50% of the people who ingest this amount. You could say that an individual has only a 50% chance of surviving if he ingests an LD50 dose. The following table shows LD50 in mg/kg of body weight for a number of substances.

LD50 values in milligrams per kilogram of body weight for some different substances and for plutonium-239, based on animal tests.

Substance	LD50 (mg/kg)	Mode of intake
Pure alcohol	10,000	Abdominal injection
Morphine	900	Abdominal injection
Nicotine	1	Abdominal injection
Cadmium	1	Inhalation
Plutonium-239	0.3	Abdominal injection
Plutonium-239	1.3	Inhalation
Dioxin	0.001	Abdominal injection
Botulin	0.00001	Abdominal injection

The LD50 value is controversial; it applies to acute effects within a short period of time and does not take chronic effects into account. Since different substances act slower or faster on the organism, it is difficult to make fair comparisons. The values in the table are obtained from animal tests on small rodents and, in the case of plutonium, on dogs. If it is assumed that they also apply to man, this means that in the case of an adult, the probability that inhalation of approximately 90 mg of plutonium-239 (or injection in the bloodstream of about 20 mg) will lead to acute death is 50%. The equivalent value for intake with food is about 20 g.

Text and table are based on SKB Report R-97-10 "Plutonium – data, egenskaper m m" ("Plutonium – data, properties, etc", in Swedish only).

3.32 How many TWh of energy is left in the nuclear fuel when it is taken out of the pool in the nuclear power plant? (Milkas)

(SKB) When the fuel is taken out of the pools in the nuclear power plants, energy remains in the form of heat, and the fuel can be used in other types of nuclear reactors to extract more energy.

When the nuclear fuel is taken out of the pools for encapsulation, a decay heat of about 100 W per assembly, or 1.7 kW per canister, remains. The entire repository is planned for 6,000 canisters, which means 10 MW of heat. This figure can be compared with the smallest nuclear power reactors of about 600 MW.

Only a small portion of the energy content in the nuclear fuel has been utilized when it is taken out of the reactors we use today in Sweden. If more energy is to be extracted, the spent nuclear fuel must be reprocessed and interesting nuclides separated. Then these nuclides can be used as new fuel in another type of nuclear reactor.

Nearby resident meeting in Forsmark

Date	13 June 2009
Time	12:00–14:15 hrs.
Place	The Inn in Forsmark.
Target group	Nearby residents. The consultation meeting was scheduled in conjunction with the annual nearby resident meeting, which was held by reason of SKB's selection of Forsmark as the site for the licence applications to build a final repository for spent nuclear fuel in Forsmark.
Invitation	A written invitation was sent to about 250 households within a radius of about ten kilometres from the Forsmark NPP.
Background material	No material was compiled specially for the meeting.
Present	Total about 100 persons. Private citizens and organizations: About 90 persons. SKB: *Kaj Ahlbom, Jerker Tengman, Gerd Nirvin, Inger Nordholm, Erik Setzman, Claes Thegerström* and *Sofie Tunbrant.*

1 Interim storage facility and encapsulation plant

No questions or viewpoints were expressed pertaining solely to the interim storage facility or the encapsulation plant for spent nuclear fuel.

2 Final repository

2.1 What will happen with highway 76? Won't the improvement be started before SKB has obtained a licence for the final repository? Who is responsible?

(SKB) The Swedish Road Administration is responsible for the road. SKB is trying to speed up the work, since we are also interested in a good road.

2.2 Can't the money for the road improvements be taken from the cooperation agreement?

(SKB) That might be possible.

2.3 How many more vehicles will there be? How many will be heavy vehicles?

(SKB) We don't have any exact figures with us today. The peak will come during the construction phase, which will last about eight years. Traffic may double on the road out of Forsmark, ten percent of which will be heavy vehicles.

2.4 Why does clay have to be shipped to the Port of Hargshamn and driven by truck to Forsmark? It would be much better to ship it to the Port of Forsmark.

(SKB) The Port of Forsmark is too small to handle ships of the size needed for the clay shipments. The Port of Hargshamn is better suited for this. Expanding and dredging the harbour at Forsmark would have relatively great environmental consequences.

2.5 How much will the groundwater level be lowered and in how big an area?

(SKB) This is still being studied. We haven't had enough information to analyze this more thoroughly until recently, since Söderviken was selected as the site of the final repository. About thirty wells at the most will be affected. Fewer than half of these wells are in use. If the amount or quality of the water in a well is affected, SKB will take responsibility for an alternative supply of fresh water.

2.6 How big will the repository be? Is there a map?

(SKB) SKB did not have such a map with them, but has since sent one to the person who posed the question, see Appendix C (to the minutes from the meeting).

2.7 How large are the water-conducting fractures? How will you handle them?

(SKB) The length of the fractures varies from millimetres to tens of kilometres. There are water-conducting fractures approximately every hundred metres at repository depth. We will avoid the large fracture zones.

2.8 How large volumes of rock spoil will be extracted?

(SKB) Approximately 2,300,000 cubic metres of loose rock will be brought up during the period up to 2070. Most of it will be sold.

2.9 Will you insist on Swedish labour?

SKB recommends local establishment, and we would prefer local recruitment of labour. But the project will be contracted out, so we cannot dictate where the labour will come from.

2.10 How do other countries dispose of their spent nuclear fuel?

(SKB) No country has a finished repository for high-level waste, but all are planning to dispose of their own waste. There is a repository for long-lived waste in New Mexico in the USA.

All countries with nuclear power are planning on geological disposal. Sweden, Finland and France have come farthest in their work on a final repository for high-level waste. France has established an underground laboratory. Finland has made a decision in principle on a site and a method. They have selected a site and are in the process of building a ramp down into the rock. As of last week they had reached down to 370 metres. Finland will submit its licence applications in 2012 and we in 2010. We will probably start deposition of waste at roughly the same time.

2.11 Has Germany given up its salt mine?

(SKB) The investigations in Gorleben were begun in 1977. They were stopped in 2000, as a part of the agreement with the nuclear power industry to phase out nuclear power. Discussions are now being held on a "restart", whereby other geological environments than the salt mine are being studied.

2.12 How much spent nuclear fuel will be buried?

(SKB) The planning premise is that the reactors in Ringhals and Forsmark have an operating time of 50 years and the reactors in Oskarshamn 60 years. This means that the quantity to be disposed of amounts to about 12,000 tonnes of uranium, equivalent to around 6,000 canisters.

2.13 Is there room for more waste in Forsmark if Sweden's nuclear power capacity is expanded?

(SKB) We can't answer that for certain today. There is potential for building two levels or extending the repository laterally. Further investigations of the rock are needed to determine whether this is possible.

2.14 Will only Swedish waste be disposed of? On your website you say that two countries can cooperate?

(SKB) According to Swedish law, Sweden may not receive waste from other countries. I am not aware of anything else being said on our website. I will have a look at that.

2.15 The law prohibits it today, but what will happen in the future?

(SKB) The Riksdag can change laws. We don't see that there would be any strong reasons for putting other countries' waste in Sweden. All countries with nuclear power are capable of disposing of their own waste. Some countries on the continent have such small quantities that cooperation would be a reasonable option. The Netherlands and Slovakia, for example, are open to such cooperation. Nothing can force a country to receive another country's nuclear waste.

2.16 What preparedness do you have for dealing with unforeseen problems during deposition? Do you plan to bury the waste at any cost?

(SKB) Both construction of the final repository and deposition of the spent nuclear fuel are stepwise processes. We have conducted very thorough investigations of all imaginable eventualities. But this has never been done before, so we have to be prepared to make adjustments if something doesn't go as planned.

2.17 You say that the water flow in the rock is low, which is good. What happens if the temperature around the canisters rises to more than 100°C? How can you keep this from happening? How can heat be dissipated from the bentonite?

(SKB) We have done calculations based on the assumption that we always have a hot copper canister, dry bentonite and an air gap, i.e. conditions that give the highest temperatures. The results show that the temperature will not exceed 100°C. We have also performed experiments at the Äspö HRL showing that the temperature around the canisters agrees well with the calculated temperature. We therefore feel certain that the temperature will not exceed 100°C.

2.18 You are building at about 500 metres depth because there is no oxygen in the water, right? Will the canisters corrode anyway?

(SKB) The groundwater contains sulphide, which can cause corrosion. With a copper canister with five centimetre thick walls surrounded by bentonite clay, this corrosion process will proceed very slowly and the canisters will remain intact for a very long time.

2.19 How much waste will be transported daily to Forsmark?

(SKB) All spent nuclear fuel is currently being stored in Clab and will remain there for 30 years before being encapsulated. At that time it will be removed from the pool and encapsulated and then transported to Forsmark on a ship equivalent to m/s Sigyn, about ten canisters at a time. The copper canisters will be placed in steel

transport casks with 30 centimetre thick walls, if future transport casks have the same design as today's. The transport casks provide good protection against radiation and are stable. They withstand immersion in water in the event of an accident, and there is plenty of time to salvage them. The transport casks are equipped with emergency transmitters that enable them to be traced.

2.20 When you have buried 6,000 canisters and the temperature exceeds 150°C, what will happen then?

(SKB) Not much, if anything. What we want to avoid is a change in the properties of the clay. We know that these properties begin to change at temperatures above 200°C. Even at 150°C there is ample margin.

2.21 How is Sigyn prepared for an attack?

(SKB) The shipments are guarded, and the police are informed prior to each shipment. A potential "kidnapper" would find it difficult to do anything with the material. He would have to force open the transport cask and the copper canister under radiation-protected conditions and then process the fuel, which is a ceramic material. Neither the canisters nor the fuel are flammable. There are simpler ways to wreak havoc on society.

2.22 How will the canisters be monitored after closure? What type of sensor equipment will be left in place?

(SKB) A programme for monitoring will be developed in consensus with the regulatory authorities. The repository is designed to be safe without monitoring. We will not install equipment that might interfere with safety. There will be no sensor by each canister; we don't want lots of cables up to the surface.

2.23 Will the Sigyn be replaced?

(SKB) Yes, the Sigyn has been in service for about 25 years and we are planning to replace her eventually.

2.24 How will backfilling be done?

(SKB) The deposition tunnels will be backfilled as soon as deposition is concluded in each tunnel. Shafts and descents will remain open until 2070. At that time it will be decided how they are to be backfilled and how the repository itself will be sealed and closed. The safest alternative is to backfill and seal everything tight.

2.25 Are you planning to open the repository again if you come up with a better solution? There has recently been talk about bacteria that could eat up the waste.

(SKB) Even if the waste is eaten up by bacteria, it will still be radioactive. A more realistic possibility is transmutation so that the fuel can be utilized again. It is technically possible to retrieve the waste even after closure, but this is a major project.

2.26 How do you intend to seal the tunnel? Gravel doesn't seal.

(SKB) We plan to seal the tunnels with bentonite as well.

2.27 Will the safety zone increase, compared with the nuclear power plant today?

(SKB) No, it won't increase. There is a greater risk of radioactivity escaping from the power plant than from the spent fuel repository.

2.28 Will you continue arranging study trips to Clab and Äspö? They provide a good learning experience.

(SKB) Yes, absolutely!

2.29 Is there enough copper and bentonite?

(SKB) The total quantity of copper needed per year is a few percent of what is used in Sweden in a year.

2.30 Subsidence in the rock will cause it to move. You have iron in the canister, which will ruse.

(SKB) The corrosion protection is the copper canister. The canister will be exposed to high pressure: 500 metres under ground, swelling clay and an ice sheet. The iron provides strength to resist these loads.

2.31 How will you reduce the noise impact from the traffic? Quiet asphalt?

(SKB) We have measured current noise levels, and there are buildings where the guideline values are exceeded. We have to discuss this with the Swedish Road Administration.

2.32 The Swedish Road Administration disclaims responsibility for the situation today. What is going to happen?

(SKB) We want to minimize the environmental consequences as much as possible. The Swedish Road Administration is responsible for building roads and making sure they can take the traffic they have to bear. SKB can point out the risks, just as you can, and put pressure on the Swedish Road Administration.

2.33 Would all private persons have to take action against the Swedish Road Administration in the matter of noise?

(SKB) We are fully aware of the importance of this issue. The municipality has brought it up, we have heard about it before in the consultations, and you have brought it up again here today. Your reactions strengthen us in our resolve.

2.34 I live in Johannisfors and have attended consultation meetings where you promised to look at the noise issue a long time ago.

(SKB) That is precisely what we have done. We have measured today's noise levels and calculated changes in the future with more traffic. The results form the basis for our discussions with the Swedish Road Administration, among others.

2.35 Why isn't the Swedish Road Administration at this meeting? The regulatory authorities have to attend.

(SKB) The purpose of this meeting was not to discuss environmental consequences. The Swedish Road Administration is The Swedish Road Administration has its eye on the matter, and now that the site has been selected they can take action. We will examine the possibilities of a meeting where the Swedish Road Administration is present.

2.36 How high is the noise issue on SKB's agenda?

(SKB) The Swedish Road Administration is an important actor, and we have regular contacts with them. We once again note that this is an important issue!

Comment from participant: If noise problems exist today, it isn't SKB's problem. I would like to point out that we have started a development group in Norrskedika and that we will take action in the matter of noise.

Comment from participant: The trucks won't start rolling for at least another eight years. There is plenty of time to find an acceptable solution to this problem.

3 Common issues

No questions or viewpoints were expressed that were common issues for the interim storage facility, the encapsulation plant and the final repository for spent nuclear fuel.

Nearby resident meeting in Oskarshamn	
Date	8 July 2009
Time	18:00–19:30 hrs
Place	Figeholms Fritid och Konferens (Figeholm Leisure and Conference), Hägnad, Figeholm.
Target group	Nearby residents. The consultation meeting was held by reason of SKB's licence application for construction of an encapsulation plant adjacent to the interim storage facility Clab.
Invitation	A written invitation was sent to residents of Misterhult parish, including part-time residents.
Background material	No material was compiled especially for the meeting.
Present	Total about 30 persons. Private citizens: About 25 persons. SKB: *Olle Zellman, Katarina Odéhn, Erik Setzman* and *Lars Birgersson.*

1 Interim storage facility and encapsulation plant

1.1 Will the encapsulation plant and the canister factory be built adjacent to Clab?

(SKB) The encapsulation plant will be built directly adjacent to Clab. The canister factory will be built somewhere in the municipality.

2 Final repository

2.1 What is the cause of the high rock stresses in Forsmark? Is it land uplift?

(SKB) The situation in Forsmark is special. The area in question consists of a constrained lens, which causes high rock stresses. In general, rock stresses increase with depth, due to the static load from the overlying rock.

2.2 The bedrock in Forsmark is not the same as in Laxemar. Why then does SKB continue its experiments at Äspö when the final repository will be located in Forsmark?

(SKB) Much of the work in the Äspö HRL concerns development of technology that can be used at other places as well. A lot of basic research is also conducted. But not everything being done on Äspö can be applied at Forsmark.

2.3 How is rock sealed?

(SKB) We have looked at different methods, and one that appears promising is to use silica sol. But not so much grouting will be needed in Forsmark, since the rock is relatively dry at repository depth. However, there are shallower zones at a depth of about 150–200 metres where sealing measures will be needed.

2.4 What is the long-term effect of silica sol?

(SKB) Silica sol is a natural material. We now have about five years of experience using silica sol.

2.5 Is the space available for a final repository smaller in Forsmark than in Laxemar?

(SKB) The available space in Forsmark is limited by the extent of the lens. There is no equivalent limitation in Laxemar.

2.6 If SKB doesn't get permission to build the final repository in Forsmark, will you then apply for a licence to build it in Oskarshamn?

(SKB) In that case we don't think we will apply for a licence to build the final repository in Oskarshamn. We would probably have to redo the entire siting process. But that would naturally depend on why we didn't get permission. Maybe supplementing the applications would be enough.

2.7 Copper, which will be used in the canisters, is a non-renewable resource, isn't it? What does SKB have to say about this?

(SKB) We will use only a small fraction of the world's total copper production. A total of 6,000 canisters will be needed. Each canister weighs about 24 tonnes, of which 2 tonnes is spent nuclear fuel and 7 tonnes is copper. Canister production will be spread out over a long time, about 50 years, so the quantities of copper SKB needed will scarcely be noticed compared with the world's total production. If, however, all countries were to utilize the same concept as SKB, a considerable quantity of copper would be needed. This is not likely, however.

2.8 There are 44 tonnes of German fuel in Clab. Will it be disposed of in the same way as the rest of the spent nuclear fuel?

(SKB) Yes, the German MOX fuel will be disposed of using the same method, canisters of the same size, etc. as other spent nuclear fuel. (Note: The amount of MOX fuel that is stored in Clab was discussed. Later on during the meeting it emerged that 217 fuel assemblies are being stored.)

2.9 How did SKB calculate the risks of copper corrosion in oxygen-free water prior to site selection? Were analyses of this done for both sites, and what was the outcome? (The question was posed orally during the meeting and submitted in writing after the meeting, see Appendix C.)

(SKB) Researchers at KTH in Stockholm have conducted experiments showing that copper can corrode in an oxygen-free environment. The regulatory authorities' expert panel have since looked at this, but have been unable to corroborate the results. In our safety assessments we have arrived at the conclusion that even if the phenomenon did occur it would not affect long-term safety or site selection.

At the meeting SKB promised a more complete answer to the question, which is that:
In the safety assessment, SKB has considered the risk of copper corrosion in oxygen-free water and found that, even based on pessimistic assumptions, it makes a negligible contribution to the total corrosion of the copper canister. It is sulphide corrosion that is the limiting factor, and calculations of its effect on the copper canister have been included in the analyses of the two sites on which site selection is based.

2.10 When will SKB report the results of retrieved tests in the LOT project? What is the timetable for retrieving and reporting the results for the LOT S2 test parcel? (The question was posed orally during the meeting and submitted in writing after the meeting, see Appendix C)

SKB is open with results from experiments, but a great deal of work (quality control, review etc.) remains to be done before the reports are finished.

At the meeting SKB promised a more complete answer to the question, which is that:
The work with the LOT project will not be over after the parcels are retrieved, quite the contrary. Retrieval will be followed by extensive sampling and analysis work, with the participation of many laboratories and researchers. As a result, coordination, compilation, integrated analysis and reporting of the results takes a long time. A draft final report from LOT A2 was ready in the autumn of 2008 and has been made available to MKG, but unfortunately the final review of the report has been delayed. The final report from the A2 test is expected to be finished in the autumn of 2009, as is the reporting of results of the LOT A0 test. The results will then be available to other actors as well.

The time of retrieval of the LOT S2 test has not been determined, but will probably not be before 2009–2010.

2.11 Is the copper that will be used of any particular grade?

(SKB) High-purity copper will be used.

3 Common issues

3.1 Will SKB sell its technology for waste disposal to other countries?

(SKB) This is already being done via SKB IC. Technology is being sold to Russia, the Baltic countries and Asian countries. Furthermore, the final repository project has created spin-offs, such as technology for locating from the ground surface where people are under ground. The mining industry has shown an interest in this technology.

3.2 What is SKB's plan if nuclear power continues to be used? This would mean that the quantity of waste to be disposed of would be greater than you are currently planning for.

SKB's mission is to dispose of the waste from the nuclear power plants according to present-day plans, i.e. about 12,000 tonnes of spent nuclear fuel, equivalent to about 6,000 canisters. If nuclear power is expanded, it is possible that another type of fuel will be used and will need to be disposed of. SKB has no alternative plan.

3.3 It was mentioned earlier that boreholes will be restored in consultation with the landowners. What does this mean?

SKB will discuss with the landowners how best to do this. Certain holes may be filled up, while others may remain open to enable the landowner to withdraw water.

3.4 Oskarshamn Municipality will obtain funds from SKB to create added value. How will these investments be regulated?

(SKB) The investments in added value in question are ones that create added value for both the municipality and SKB.

3.5 Could this include investments in bicycle lanes?

(SKB) It will mainly be other types of added value that will be created, for example investments that generate knowledge.

3.6 Has the money SKB is now planning to invest in added value been included in the planning?

It is important for SKB to create added value, for example in the form of education and knowledge, since SKB will be established in both municipalities for many years.

3.7 It has been said highly qualified people are needed and will be needed. What kinds of qualifications are needed?

(SKB) Highly qualified people are needed in many areas. Many people have obtained doctorates in engineering, process technology, rock mechanics etc. within the framework of the final repository project. So we are mainly talking about high qualifications in science.

3.8 Is any education provided here in the Oskarshamn district, considering the qualifications SKB needs and will need?

(SKB) No, but perhaps an educational programme could be established, for example at Nova. At present we have 4–5 doctoral candidates working for us. This is an example of what investments in added value could entail, i.e. attracting educational opportunities and qualified people.

3.9 There is a school in Forsmark that is associated with Forsmarks Kraftgrupp AB. Is it possible something similar could be set up here?

(SKB) Setting up something similar here is being considered.

3.10 How will SKB's existing and future facilities affect the infrastructure? Will new roads be built?

(SKB) SKB's activities will not entail any great burden on the infrastructure. SKB will be a small player compared with OKG, for example.

3.11 Will the road at Misterhult be improved?

Members of the audience pointed out that the Swedish Road Administration has been contacted regarding the road at Misterhult.

3.12 Is there or will there by a report that summarizes the results of e.g. the nature studies in an easy-to-grasp fashion?

(SKB) The nature studies will be summarized in the environmental impact statement, EIS. The background reports to the EIS are published on SKB's website. The work with the nature studies in Oskarshamn will be finished even though Forsmark has been selected for the final repository.

3.13 Have the inventories revealed that the wild boar population has increased, for example?

(SKB) I don't know about the wild boar population, but the inventories have brought us into contact with persons who are well acquainted with the fauna in the area, such as hunters.

3.14 How will the background material to this autumn's consultations be made available?

(SKB) The material will be posted on SKB's website.

3.15 How will the transport of encapsulated fuel to Forsmark be carried out? Will there be a steady stream of shipments?

(SKB) There will be a steady stream of shipments for several decades. SKB's ship m/s Sigyn can carry 10 transport casks at a time with one canister each.

3.16 Will the Newsletter be discontinued now that the site has been selected?

(SKB) The Newsletter will not be discontinued, but it won't come out as often as before. Lagerbladet will also continue to be published.

Meeting with Östhammar Municipality

Date	30 September 2009
Time	13:00–16:00 hrs
Place	Municipal office, Östhammar.
Target group	The municipality's working groups: Representatives from the Safety Group, the EIA Group and the Reference Group.
Background	On two occasions during 2009 – 27 January (questions 72–126) and 6 June (questions 127–152) – Östhammar Municipality submitted written questions to SKB in response to SKI's and SSI's joint review of SKB's safety report SR-Can and the municipality's review of RD&D Programme 2007. The questions were answered in writing and followed up at this meeting.
Participants	Östhammar Municipality: *Barbro Andersson Öhrn, Peter Andersson, Inger Arvidsson, Marie Berggren, Lars-Erik Berglund, Anders Bäckström, Inger Börjesson, Sanne Eriksson, Ingrid Gustavsson, Christina Haaga, Leif Hägg, Ylva Lundh, Rune Nilsson, Lennart Norén, Tomas Näslund, Pär-Olof Olsson, Sune Pettersson, Hans Roos, Jacob Spangenberg* (part of the time) and *Arno Unge.* SKB: *Erik Setzman, Peter Wikberg, Lars Birgersson* and *Sofie Tunbrant.*

Questions and answers from the consultation meeting are given below. Numbers in parentheses refer to the municipality's numbering of the questions (see page 72, where there is a compilation of all written questions received from Östhammar Municipality with SKB's replies).

1 Interim storage facility and encapsulation plant

No questions from the municipality pertained to the interim storage facility or the encapsulation plant for spent nuclear fuel.

2 Final repository

Discussion of quality issues (72–76)

2.1 It is difficult for laymen to understand these matters, so we have to rely on the experts, which in turn means we have to rely on the existence of a system that ensures order and method. But we must not be a slave under the system and lose touch with reality. Keywords in this context are: knowledge, credibility, integrity, loyalty and objectivity. We must be able to rely on SKB! Even if the quality system is good, it is the people behind it who count. How does SKB judge its personnel's credibility?

(SKB) In order for us to be confident that our people do their best, we must create a good working climate and good relations between employees. This is in turn a balance between allowing people individual freedom and a "do what you have to do" mentality. SKB has a tool, which it shares with Vattenfall, for all employees called "My opinion". It is a form that all employees are urged to complete annually, and people seem to give honest answers regarding how they view their superiors and the executive management. "My opinion" shows that SKB is in good shape with regard to both employee relations and working climate. People feel free to discuss solutions, technology, working environment, etc.

2.2 Have you removed people from their duties? Reassigned people to other positions?

(SKB) It has happened that SKB has reassigned personnel. Reassignment of personnel is, however, not a big problem within SKB.

2.3 A relevant comparison may be what was noticed at FKA in 2006. They found themselves in "pass the buck" culture that could prove disastrous for safety. People have to be willing to take responsibility instead of passing it to someone else. The leadership can be changed, which is vital in order for all to be well. Is there any guarantee that something similar won't happen within SKB, and that things will remain good at SKB? (Östhammar Municipality)

(SKB) It is not possible to provide any guarantees that SKB will continue performing optimally. However, SKB is an attractive employer, which makes it easier to recruit the best qualified people.

2.4 How does SKB work with experience feedback and transfer?

(SKB) In formal terms, it takes place within the framework of the management system in our project model. This includes experience transfer between different projects and initiatives within SKB. SKB is working actively with strategic recruitment in order to meet skills requirements for the next 20 years.

Reflection by the municipality: It is important to have time for thought, and to understand how one's own work fits in with the whole.

2.5 Will the final repository be safe?

(SKB) The answer is provided in the analyses of long-term safety, which will be finished at the end of 2010. Predicting events that might occur in the near future is relatively easy. Predicting what will happen after an ice age is more difficult. The greatest uncertainties concern what will happen during and after the next ice age.

During the first ice age the ice cover was about three kilometres thick in this part of Sweden. We have assumed that the ice cover during the next ice age will be about three kilometres over northern Europe. Pressure changes as the ice sheet advances and retreats will lead to earthquakes and stress changes. By studying fracturing during previous ice ages, we now know in what types of structures new fracturing can be expected in connection with future ice ages. The spent fuel repository will not be built in such rock.

A steep ice front during deglaciation means that meltwater, with low salinity, can be pressed down to repository depth. The water then comes back up. This can lead to bentonite erosion, i.e. the bentonite is washed away and the canisters are freed. If this happens, water will reach the copper canisters, which can then corrode. A reasonable scenario may be that 1 or 2 of the freed canisters corrode apart over a period of 100,000 years. Over a period of 100,000 years, this would mean in the case of Forsmark that even though some canisters corrode apart, the risk would still be lower than SSM's criterion by a factor of 100.

Possible copper corrosion is of no importance. A great deal has been written in the press recently about researchers at KTH who have performed tests indicating that copper would corrode under oxygen-free conditions, which has previously been unknown. If corrosion should occur, the bentonite buffer will prevent the hydrogen formed in the reaction from being transported away, whereby the reaction will cease. If the bentonite buffer were to disappear, the copper canister would be affected. However, the corrosion process described by the researchers at KTH

would not be the most serious threat in this case, but rather corrosion caused by sulphide reactions. SKB's conclusion is thus that corrosion of copper in oxygen-free water, if it can take place at all, would occur so slowly and to such a limited extent that it would not affect the repository's long-term safety.

Discussion of uncertainties (81–82)

2.6 SSM gets different results than SKB. Why is that?

(SKB) Different experts belong to different "schools" and base their judgements on different assumptions. The results would be similar if we worked side by side. One of the regulatory authorities' functions is to challenge and question.

2.7 You write that you make conservative (cautious, pessimistic) assessments. What does this mean?

(SKB) We try to make strict assessments, and in cases where knowledge is lacking we make conservative (cautious, pessimistic) assumptions to "be on the safe side". An example of this is the sulphide concentrations in the groundwater we use when calculating corrosion of the copper canister. We use concentrations that are five times greater than those measured, to be on the safe side.

2.8 How do the "plugs" (the backfill) affect safety during the meltwater phase?

(SKB) Not at all, since the tunnels will be backfilled with material that has the same properties as the rock.

2.9 Scientists in Finland have assumed a certain water flow through the buffer in their calculations. Sweden takes another approach and makes assumptions regarding the fuel, fuel dissolution, transport through the buffer etc. This is more logical.

(SKB) It is correct that we have slightly different approaches in Sweden and Finland.

2.10 Are the properties of the bentonite dependent on where it comes from?

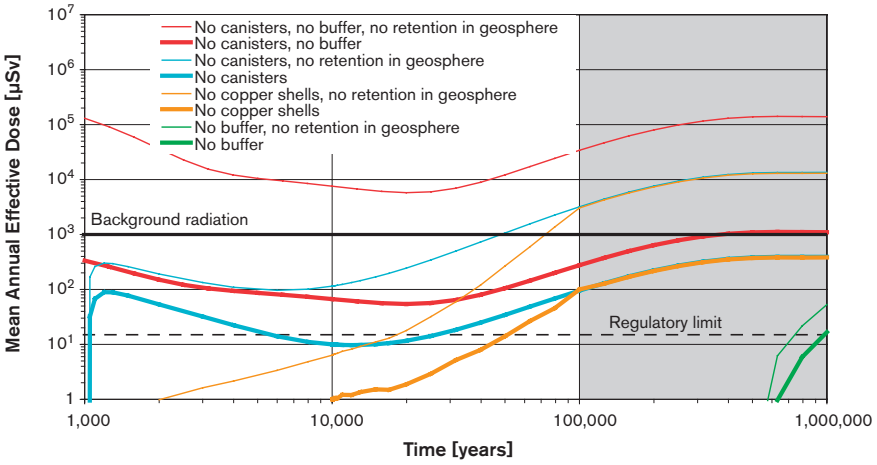
(SKB) Yes, the properties can vary for bentonite of different origins. We may use a mixture of materials from different sources.

2.11 It would be good to have an illustration of what would happen if there were no barriers. Which substances will escape when and where will they go? If something should happen early, it is likely that iodine and cesium will escape into the environment and then into man. What does the curve look like?

SKB has made calculations and illustrations of what would happen if there were no barriers. The thick red curve in the figure on page 70 shows what happens if the fuel lies naked in the rock. Appendix C from the meeting contains an excerpt from the Swedish summary of SR-Can describing results, in the form of annual doses, of calculations of different cases of defects in the barriers.

2.12 What happens with the radioactive waste from medical care when SFR is closed? That type of waste will exist even after the nuclear power plants are shut down.

(SKB) Then another solution will have to be found to manage and dispose of the radioactive waste from medical care. That is not a part of SKB's mission. We receive it now because it's practical. Once the waste from nuclear power has been deposited in SFR, the repository will be closed, regardless of new waste generated by medical care.



2.13 The capacity increases at the nuclear power plants will result in other types of spent nuclear fuel, other temperatures and other burnups. How will you take this into account when you fill the canisters?

(SKB) The governing criterion when the canisters are filled with fuel assemblies is that the decay heat may not exceed 1,600 watts in each canister. Different compositions of the spent fuel have been taken into account.

2.14 If the use of nuclear power is prolonged, there will be even more canisters. What are your plans for disposing of them?

SKB's mission now is quite clear. It is to manage and dispose of the spent nuclear fuel from the "first generation" of nuclear power plants that exist now, with an operating time of 50 years for the reactors in Forsmark and Ringhals and 60 years for Oskarshamn. This results in about 6,000 canisters that need to be disposed of.

No one knows today whether nuclear power capacity will expanded, and if so what type of reactors will be built. The political door has been opened, but a decision is still far off.

2.15 SFR is an established concept, but what does SKB call the final repository for spent nuclear fuel? It is important that a name be established soon. Many strange variants exist now, such as final repository for spent nuclear fuel…

(SKB) We call it the Spent Fuel Repository, to distinguish it from the final repository for short-lived radioactive waste (SFR). On drawings, where space may be limited, we write SFK (abbreviation of the Swedish for "final repository for spent nuclear fuel"). We know that SFR is established, and we think it may be difficult to keep the two abbreviations separate when only one letter differentiates them.

2.16 How many final repositories will there be in Forsmark in the future?

(SKB) At least two: SFR and the Spent Fuel Repository.

2.17 How is SKB working now with the issue of copper corrosion?

(SKB) Tests are being conducted at Äspö where copper corrosion is one of the components. Important answers when it comes to copper corrosion will be provided in SR-Site.

2.18 How long will the Swedish version of SR-Site be circulated for comment?

(SKB) SSM sends out SKB's applications, including SR-Site, for consideration and comment. It is thus SSM who determines how long the referral period will be, but an estimate is that it will be a matter of months.

2.19 There are issues where uncertainties still exist. Does it present a hindrance to the answers SKB can give when the meeting is a part of the consultation process?

It doesn't matter to SKB whether meetings with the municipality are a part of the consultation process or not. Ask all the questions you want to have answers to! We can always discuss them. If we feel we cannot answer we will say so.

2.20 For us in the municipality who work with the final repository question, it is important to be able to provide a simple description of which radionuclides may leak out, how people might ingest them and what effects they then have.

(SKB) We will do our best to provide such a description.

3 Common issues

No questions were posed that were common to the interim storage facility, the encapsulation plant and the final repository.

Compilation of written questions received from Östhammar Municipality with SKB's replies

Östhammar Municipality has submitted written questions to SKB on four occasions:

2008 – 19 May (questions 1–40) and 2 October (questions 41–71). In response to studies of cultural and natural values in the Forsmark area, among other things.

2009 – 27 January (questions 72–126) and 6 June (questions 127–152). In response to SKI's and SSI's joint review of SKB's safety report SR-Can and the municipality's review of RD&D programme 2007.

All questions come under the heading of the Final Repository and thereby have the same numbering as the original questions from the municipality.

1 Interim storage facility and encapsulation plant

No questions from the municipality pertained to the interim storage facility or the encapsulation plant for spent nuclear fuel.

2 Final repository

P-06-101 Naturmiljöbeskrivning och preliminär bedömning av konsekvenser för naturmiljö. Slutförvar för använt kärnbränsle vid Forsmark ("Description of natural environment and preliminary assessment of environmental impact. Final repository for spent nuclear fuel at Forsmark", in Swedish only)

2.1 An update of report P-06-101 is promised in Nov/Dec. What updates will it contain?

(SKB) Supplementary inventories of both terrestrial and aquatic environments were carried out during the summer and autumn of 2008 by the Ecology Group. The inventories were more specific and site-specific in view of new locations for the final repository and new results from the groundwater modelling. Results and impact assessments based on design stage D2 will be presented in several reports during the spring of 2009, which will then be used as a basis for the environmental impact statement.

2.2 At the beginning of the year, SKB bought about 625 ha of forest in the Forsmark area. According to report P-06-101, there is a planned nature reserve in the area. Will SKB ask the County Administrative Board's nature conservation function for advice concerning care and management of the area?

(SKB) There are no plans for a nature reserve today, regardless of whether the final repository ends up in Forsmark or not. With the assistance of Sveaskog, SKB plans to draw up a management plan for the purchased land to preserve and strengthen the area's natural values. The management plan will be discussed with the County Administrative Board. If SKB doesn't select Forsmark, Sveaskog has the option of buying back the land purchased by SKB.

2.2.2 Alternative locations

2.3 According to the latest information from SKB, the entrance tunnel to a possible final repository will be located next to FKA's sewage treatment plant. Will this affect natural values in the marine environment more than previously assumed?

(SKB) The shoreline will not be changed, so no intrusion will take place in the marine environment. The impact that can be linked to marine environments is the

current proposal to discharge rock drainage water into Söderviken (see reply to question 29). However, this impact is considered to be limited, since the nitrogen concentrations will be relatively low and salinities will be equivalent to salinities in the receiving water.

2.4 It is noted in the report that "In order to assess the consequences for natural values in the marine environment outside Forsmark, supplementary investigations and sensitivity analyses are required". When will these investigations be published?

(SKB) All investigations were carried out during the summer and autumn of 2008 and the report will be published in the spring of 2009. Supplementary investigations in the marine environment were, however, planned to study the impact and consequences of a final repository at the SFR location, which is no longer an option. The assessments of impact in the marine environment currently being done will only investigate the impact of discharges of water from the final repository. The assessments are being done on existing material.

See also the reply to the preceding question.

3.1 General ecological inventory

2.5 How is the preliminary work done? How are the inventories quality-assured? Is it possible to produce a guide with instructions on how a general ecological inventory is done?

(SKB) Calluna AB, who did the inventory, first presented its plans in an activity plan, which is appended to the report. It explains how the preliminary work and quality assurance are done. The method for general ecological inventory has been developed by Calluna AB, and a description of the method is appended to this document.

2.6 *"For each habitat type and individual site, certain main components are required to achieve an ecologically functioning environment and value components that contribute to species diversity and variation in an area".* What are these components and how are they ranked?

(SKB) main components are, for example, old naturally regenerated forest with dead wood in various stages of decomposition. Value components are, for example, the size of the area, headwaters, vertical rock surfaces, lime deposits. Exactly how they are classified is not explained in the description; the judgement is made by the person performing the inventory.

2.7 The inventory area has been chosen so that a large portion of the wetlands around Bolundsfjärden are not inventoried. Does SKB believe that this area will not be affected or has everything already been surveyed in other reports?

(SKB) In order to permit an assessment of the impact of the final repository on the natural environment, a generously sized area within a radius of 1,500 metres from the alternative locations has been determined to constitute the impact area. The size of the area has been chosen based on noise impact and impact on the groundwater level. Watercourses and receiving bodies of water, lakes and sea bays that are located outside of the chosen radius of 1,500 metres and that risk being affected (for example by discharges and groundwater lowering) are included in the impact area.

A new definition of the impact area has been used in conjunction with the natural environment inventories done during the summer and autumn of 2008. The "new" impact area is linked to the maximum extent of the impact of groundwater lowering plus a buffer around this. Wetlands south of Bolundsfjärden were included in the 2008 inventory. Wetlands in the northern part of the Natura 2000 site Kallrigafjärden have also been visited to investigate whether there were sensitive rich fens in this area as well, which there weren't.

5.2.6 Mammals

2.8 *"It is important not to drain wetlands, fill in ditches, chop down broad-leaved trees and to make sure that hollow trees suitable for nesting are left in place".* Why is it important not to fill in ditches?

(SKB) The formulation in the report is unfortunate, since it can be interpreted as meaning that it is important to fill in ditches or that it is important not to fill in ditches. But the fact is that there are no plans to fill in ditches today.

6.3 Impact on air

2.9 Will SKB impose environmental requirements on contractors in the procurement process?

(SKB) Environmental requirements are already imposed on contractors today. SKB has general environmental requirements for heavy trucks and non-road mobile machinery, and requirements regarding environmental management systems for contractors whose work has a significant impact on SKB's environmental performance. A contractor must have a contract-specific environmental plan in order to get a contract. Additional specific requirements may be imposed.

Table 6-3. Protective measures to reduce noise impact.

2.10 Will disturbing low-frequency noise occur?

(SKB) Yes, low-frequency noise will be generated above all by heavy equipment (wheel loaders, excavators) and rock crushing. Low-frequency noise from heavy shipments on public roads already occurs. The disturbance will not be changed by the final repository. The low-frequency noise will be described in report P-08-64 (finished in January 2009).

2.11 What are the possible consequences of low-frequency noise?

(SKB) Report P-08-64 describes the consequences of low-frequency noise for humans. During the daytime, the sound level in dBA is more disturbing than the low-frequency sound, which is measured in dBC. In the evening and at night, however, the low-frequency sounds can be perceived as more disturbing than the sound measured in dBA. Since no people live in the affected area, no health effects are expected.

2.12 How will SKB protect against low-frequency noise and how will the protective measures be followed up?

(SKB) Low-frequency noise is difficult to screen off. Disturbing sound levels can instead by reduced by restricting the times when certain kinds of work can be done, for example by avoiding them in the evening and at night. In the case of the

final repository activity, a monitoring programme for the external environment will be drawn up including monitoring of noise from the facility. The monitoring programme will be planned in consultation with the regulatory authority.

6.5 Impact on groundwater and surface water levels

2.13 ***"Reinfiltration of pumped-up groundwater also affects the size of the groundwater lowering and thereby its effects".*** **What impurities will the infiltrating water contain and what will its salinity be?**

(SKB) The rock drainage water may have an elevated nitrogen concentration from explosives and some particulate matter, such as cement residues. The pumped water will contain relict sea water with a salinity of around 0.7 percent and with certain local variations equal to the salinity in Öregrundsgrepen and the Bothnian Sea. When the water is pumped up it will go through special basins for oil separation and sedimentation. According to the latest proposal, rock drainage water will not be infiltrated into the surrounding environment. If infiltration is considered, a requirement specification will be set up for what quality the water must have to be used for infiltration and what flow rates are suitable. Then a search will be conducted to find where water that meets the requirements can be obtained.

2.14 Where will reinfiltration take place?

(SKB) According to the latest proposal, rock drainage water will not be infiltrated into the surrounding environment. If infiltration is done, it will be into the rich fens that are predicted to be affected by a groundwater lowering.

7.5 Groundwater and surface water levels

2.15 ***"The shallower the lakes and ponds are, the faster they will become overgrown".*** **If the groundwater levels are lowered, the wet biotopes will become overgrown faster. If SKB furthermore uses wetlands for nitrogen removal, they will become overgrown even faster. How will SKB manage the affected areas?**

SKB has studied the possibility of using Tjärnpussen as the receiving water for treated leachate and waste water. Even though Tjärnpussen harbours certain natural values, it is not as valuable as surrounding wetlands and is already affected by previous activities. Studies are being conducted regarding which sites (shallow wetlands) can be affected by groundwater lowering. In conjunction with the study, data are being gathered on how these wetlands function hydrologically in order to study the possibilities of preventing changes in the water level caused by the final repository.

7.7 Cumulative effects and consequences

2.16 ***"An exception from the small consequences is if unscreened mobile crushing is chosen as a method for treating rock spoil. The crushing noise will in this case drown out the noise from the existing activity and lead to a cumulative noise effect".*** **What are the possible alternatives to an "unscreened mobile crusher"?**

(SKB) Rock crushing on the ground surface will only take place during the first construction stage and then in campaigns for a few weeks per year. By far most of the crushing will take place under ground. A mobile crusher permits manufacture of the rock material that is needed around the final repository. Without a mobile crusher, such material has to be shipped in, which involves a number of disadvantages such as more heavy truck shipments on the roads.

An embankment several metres high will be built around the rock heap where the mobile crusher is intended to be located. The embankment will suppress the noise from the rock heap. In order to further suppress noise from the rock heap, the embankment can be made higher, which must be weighed against the visual impact on the landscape, the impact on the natural environment (a larger area is required) and costs.

2.17 Will unscreened mobile crushing create more dust?

(SKB) Dust around the rock heap has been studied and the results presented in report P-08-66 (finished December 2008). According to the dispersion calculations presented in the report, dust emissions will be limited and the impact on man and the environment is judged to be very small.

2.18 Will dust from rock crushing affect natural values in the area?

(SKB) See reply to question in 2.17.

2.19 What is SKB's plan for environmental monitoring in the area? (Östhammar Municipality)

(SKB) A monitoring programme for the external environment will be prepared. The monitoring programme will be prepared in consultation with the regulatory authority.

2.20 It is important to look at changes in moisture over a larger area than has been discussed in the report. How large an area will SKB monitor?

(SKB) The monitoring programme is not ready, so neither parameters nor the area to be monitored have been determined. Different parameters have different ranges.

2.21 Bird inventories have been conducted in the area around Forsmark for a number of years. Will they continue?

(SKB) Extensive bird inventories were conducted to see how the bird fauna was affected during the site investigation. A monitoring programme is currently under way that includes a bird inventory. The inventory is now focused on certain species, mainly red-listed ones. The monitoring programme will continue up until site selection. If Forsmark is selected the monitoring will continue; if Oskarshamn is selected the monitoring will be discontinued.

R-98-04 Påverkan på växtligheten av sänkt grundvattenyta vid ett djupförvar ("Impact on vegetation of lowered groundwater table around a deep repository", in Swedish only)

R-00-21 *Grundvattensänkning och dess effekter vid byggnation och drift av ett djupförvar ("Groundwater lowering and its effects in connection with the operation of a deep repository", in Swedish only)*

2.22 Both reports are old and based on generalizations. What is the state of knowledge today?

(SKB) New modelling has been done for Forsmark. The modelling was based on the final results from site investigations and the layout for planning phase D2 that was presented during the consultations in October 2008. Furthermore, groundwater lowering was modelled for different sealing alternatives and different points in time. New reports are being compiled where SKB describes both the modelling and the effects of groundwater lowering. The material will be included as an appendix to the environmental impact statement. One of the studies focuses on the impact of groundwater lowering on the natural environment. The report is expected to be finished in the spring of 2009.

2.23 Passages will be sealed to reduce the inflow of groundwater. How will you seal:
- **The descent?**
- **The elevator shaft?**
- **Ventilation shafts?**

(SKB) In the case of the descent, the elevator shaft and ventilation shafts, different grouting measures with cementitious grouts are planned to reduce the inflow of groundwater. The grouting work will be most intensive in the first 50 to 100 metres, where the rock is more water-conducting.

2.24 Are there fractures in the rock between SFR and the final repository? Can they cause cumulative effects on the groundwater?

(SKB) The groundwater inflow from water-conducting fractures in SFR is small. The accumulated seepage is currently estimated at 5–6 litres per second. Level sensors are installed around SFR that are used to study groundwater lowering (drawdown) in the water-conducting fractures. These measurements show that the greatest drawdown is in the gently dipping zone H2, which is located ten or so metres below the so-called "sump" in SFR. The sump is located at the –140 level, and the drawdown in zone H2 relative to sea level is about 23 metres water gauge (mwg).

At the level of the steeply dipping Singö Zone, which separates the site investigation area from the SFR area, the drawdown on the north side of the zone (i.e. the same side on which SFR is located) is one or two metres, depending on the borehole. On the south side of the Singö Zone, it is highly uncertain today whether there is any drawdown, and if so what causes it. The boreholes nearest the Singö Zone do not exhibit any measurable effects.

The drawdown effects inside the site investigation area that could be linked to SFR are reported and discussed in the hydrogeological reports and have been estimated there to be one or two decimetres (see e.g. R-07-49 and R-08-33).

The interpretation of what causes the drawdown is not completely straightforward, however. For example, the interpretation is complicated by the fact that the groundwater beneath the nuclear power reactors is drained; they go down to the –20 level. Furthermore, several tunnels (cooling water tunnels from the reactors and operating tunnels to and from SFR) connect the "mainland groundwater" with the groundwater beneath the sea. In other words, it may be the seepage into the "mainland part" of the operating tunnels and not the drainage of SFR beneath the sea that causes the decimetre-sized drawdown effects.

2.25 There are plans to extend SFR. Does this, together with a possible final repository and the existing SFR, create cumulative effects on the groundwater?

(SKB) The simultaneous existence of both SFR (current plus extension) and the final repository is handled as a sensitivity case (i.e. to perform uncertainty analyses of the modelling results for the final repository). The tool for this is MOUSE SHE, which has been used to model the groundwater lowering in the superficial hydrogeological systems during the site investigation phase. The analysis of the sensitivity case will be completed in the spring of 2009 and should provide an indication of combined effects and the possible need for further study of the matter.

2.26 How big an area will be affected, and are there biotopes within this area that are sensitive to altered groundwater levels?

(SKB) Some natural values within the impact area are sensitive to groundwater lowering. The rich fens, and to an even greater degree the ponds (where the pool frog occurs) are sensitive to small changes in the water level. These environments have been inventoried specifically in ongoing studies. Furthermore, the function of the ponds from a hydrological viewpoint is also being studied to assess the risk of impact and the need and options for possible preventive measures.

See also reply to question 2.22.

P-07-147 Omhändertagande av förorenade vattenflöden från ett slutförvar i Forsmark ("Management of polluted water flows from a final repository in Forsmark", in Swedish only)

2.27 When will the ongoing update of report P-07-147 be available?

(SKB) A supplement to the report has been reviewed and some of the results were presented at a meeting with the County Administrative Board in Uppsala in the autumn. Small changes remain to be made in the report, which is expected to be published in the spring of 2009.

2.28 What types of permits are needed for managing the different polluted water flows?

(SKB) Management of polluted water flows is a consequence of SKB's activity at the final repository. A review of how they should be handled and managed will be included in the environmental court's review of protective measures for the activity as a whole. SKB will describe the discharges and their consequences in the environmental impact statement for the final repository system. The environmental court will probably stipulate special conditions on what may be discharged and execution of the monitoring programme.

Sanitary sewage

2.29 According to the plan sketched in "Site Investigation Forsmark 2002–2007", a new sewage treatment plant will be built. Will SKB design it to treat leachate, rock drainage and flushing water as well, as proposed in report P-07-147, pages 34 and 63?

(SKB) In the event the final repository is built in Forsmark, a new sewage treatment plant will be built and operated by FKA. SKB proposes that leachate from the rock heap (which has an elevated nitrogen content) be conducted to a broad irrigation area situated next to the sewage treatment plant, with Tjärnpussen as the common receiving body of water, before it is discharged into the cooling water channel. Stormwater is planned to be treated locally, while rock drainage and flushing water is proposed to be discharged into Söderviken after sedimentation and oil separation. Different proposals are currently being discussed.

2.30 If a new sewage treatment plant is built, will it be included in the EIS for a possible final repository?

(SKB) The actual sewage treatment plant will not be included as a part of the project, since FKA is responsible for it. However, the impact of SKB's contribution (leachate, etc.) on e.g. Tjärnpussen will be studied and described in the environmental impact statement.

Rock drainage

2.31 According to the report, the nitrogen content of the leachate will be affected by what type of explosive is used. Will SKB apply the principle of "best product choice" and choose an explosive that gives the lowest possible nitrogen input?

(SKB) Nitrogen input can vary between different explosives, which SKB is aware of and will take into account in accordance with the principle of best product choice. SKB will study the possibility of blasting with Site Sensitized Emulsion (SSE). According to the latest findings, SSE gives rise to less nitrogen.

2.32 Acid will be added to balance the pH of the rock drainage water. What will the target pH be and what is the pH of the surrounding wetlands?

(SKB) At the present time it is too early to answer exactly which method will be used or what the target pH will be. Different alternatives are available for balancing the pH. One way to limit the pH increase is to use low-pH cement (pH of between 14 and 11). Using low-pH cement is mainly done to meet the requirement on long-term safety, so the primary purpose is not to limit the pH increase for environmental reasons. Then the pH can be further adjusted by means of additives. Which substances will be used will be studied according to the best product choice principle.

Lime-rich wetlands probably have a pH of between 8 and 9. Rock drainage water will not be discharged into sensitive wetlands. After sedimentation and oil separation, it is planned to be discharged into Söderviken, where it will be diluted. Work is under way to come up with a draft decision in principle on how the water is to be managed.

2.33 Is it possible to keep inflowing groundwater and flushing water separated?

(SKB) No, it is not possible to keep them separated. Flushing water and groundwater will be mixed and undergo several sedimentation and oil separation steps before being discharged.

2.34 Will the sealant contain environmentally noxious substances?

(SKB) After extensive laboratory tests, SKB intends to use cementitious grouts for fractures wider than 0.1 millimetre and a grout based on colloidal particles for fractures smaller than 0.1 millimetre. Conventional cementitious grout, possibly with the addition of silica fume (finely divided silica powder) will presumably be used for larger fractures. These compounds consist mainly of silicon dioxide (silica), which is a natural component of ordinary sand. The use of equivalent sealants in other projects has not been judged to have any ecotoxicological effects on the surrounding environment. In the future, SKB will heed recommendations and findings concerning these products and continue to monitor the development of equivalent products in accordance with the best product choice principle and the precautionary principle.

2.35 The rock drainage water will be saline. How will wetlands in the area be affected if they are flooded with salt water, and what will the consequences be for the flora and fauna?

(SKB) We do *not* plan to discharge rock drainage water in surrounding wetlands, but rather into Söderviken. See also the reply to question 2.13.

Leachate

2.36 Could the leachate contain heavy metals?

(SKB) It is not likely that leachate from the rock heap will contain heavy metals.

2.37 Will the rock heap be located as described in report P-07-147 or as described in "Site Investigation Forsmark 2002–2007"?

(SKB) The rock heap will be located where the Barracks Village is located today.

2.38 Tjärnpussen Lake will be used as a receiving body of water. It says in the report that the area has not been designated as valuable in natural value inventories done in the Forsmark area. Which natural value inventories does this refer to?

(SKB) It has not yet been decided where the leachate and the drainage water will be discharged; a study is currently being conducted on this. Report P-07-147 has looked at the County Administrative Board's wetland inventory and SKB's own inventories. Tjärnpussen (and other wetlands in the area) were inventoried last summer. Tjärnpussen has natural values, but they are relatively limited compared with other small lakes, ponds and wetlands in the surrounding area. The lake has been investigated just like other aquatic environments, and the results will be presented in the reports that are in preparation.

2.39 Will SKB apply for a permit from the County Administrative Board for the rock heap or just give notice to the municipality (not little/little impact)?

(SKB) It has still not been decided how the rock heap will be handled in the application under the Environmental Code. Either it can be included in the licence application for the final repository or it can be handled separately, in which case a special permit is required from the County Administrative Board or notification must be made to the municipality. SKB's primary intention is to use the rock for its own needs, for e.g. backfilling, or to sell it for other use. The time for which the rock spoil is stored on the site before being reused or sold elsewhere affects the handling of the matter.

Stormwater

2.40 If trees are planted to absorb stormwater, will you then choose tree species that offer the most conservation benefit in the area, or are there certain tree species that are better at absorbing water?

(SKB) This is part of the detailed design, which we won't look at until the next phase.

R-08-49 Material och personaltransporter ("Material and passenger transport", in Swedish only)

1.3 Scope

"This study does not describe the environmental impact or environmental consequences of the reported transport activities and alternatives. The impact and consequences will be described in future reports, which will then serve as a basis for SKB's environmental impact statement for the final repository system".

2.41 When will SKB present reports describing the environmental impact or consequences of transport activities and alternatives?

(SKB) Disturbances from transport activities are described in the following reports: P-08-64 (noise), P-08-66 (air pollution) and P-08-78 (vibrations). The reports are expected to be finished around the end of 2008.

2.42 Will SKB describe the environmental consequences of the shipments between Hargshamn and Forsmark?

(SKB) Yes, environmental consequences are described in the aforementioned reports. The reports are expected to be finished around the end of 2008.

2.43 According to oral information from SKB, it is necessary to compensate for poor rock by planning for up to 30% more deposition holes. Will this lead to more rock shipments than are now included in the calculations?

(SKB) No, the increased number of shipments is included in the calculations.

3.2 Roads

"Traffic along the route exhibits large seasonal fluctuations due to the large number of summer residents in the area".

2.44 It would be desirable to have a graph showing seasonal fluctuations in the total transport volume.

(SKB) This viewpoint will be included in any update, but no update of the report is currently planned.

3.3 Traffic flows, predictions and method

"In addition, all the temporary labour employed in the annual refuelling outages and various development projects at the power plant must be taken into consideration. A normal refuelling outage involves around 500 persons and takes 2–3 weeks per reactor unit or a total of about two months. In the event of a turbine replacement, the workforce may number 700 persons. Most of them live out at the power plant in the barracks village".

2.45 Do the refuelling outages coincide with the tourist season when the traffic is heavier?

(SKB) Yes, the refuelling outages usually start in June and finish in August. The reason they are done during the summer is that the reactors need to be taken out of service for shorter or longer periods, and it is preferable to do this when the price of electricity is low.

4.2.2 Clay material for backfilling and closure

2.46 Has SKB made an environmental impact assessment of different siting alternatives for production of backfill blocks?

(SKB) No, aside from the study of the siting of the final repository at Forsmark versus Oskarshamn, no such environmental impact assessments have been made. SKB does not consider it reasonable to put a production building anywhere else than within the final repository's operations area. The advantages of such a siting include the following (not ranked):

- An operations area containing the functions required for the operation of the final repository will always be needed directly above the repository area. The operations area will function like a medium-sized industrial enterprise with production buildings, warehouses and offices. Locating the building for production of backfill blocks inside the operations area does not cause any additional environmental impact.
- Functions for security, inspection, transport, parking etc. can be coordinated with other functions in the final repository.
- It is positive that production will be close to the place of use. Production can thereby be regulated and adjusted to the need for backfill blocks in a natural way.
- No new land needs to be acquired, and no separate licence application needs to be prepared for this facility. Aside from saving time and resources, locating production within the final repository's operations area thus entails significant economic advantages.

2.47 The transport volume during the decommissioning phase is largely determined by which backfilling alternative is chosen. Which backfilling alternative will be used?

(SKB) A decision has not yet been made on a backfilling method. At present there are two alternatives for closure of the main and transport tunnels, the central area and the accesses to the underground part of the final repository.

Alternative A	Blocks consisting of 100 percent clay and pellets. The blocks are assumed to constitute 80 percent of the volume, and the rest is filled with clay pellets.
Alternative B	Blocks consisting of a mixture of 50 percent crushed rock and 50 percent bentonite. The blocks are assumed to constitute 80 percent of the volume, and the rest is filled out with clay pellets.

5.1 Rock spoil handling and shipments

2.48 Has SKB made an environmental impact assessment of the crushing and storage of the rock spoil from the extension of the SFR on the same place as the spoil from a possible final repository for spent nuclear fuel?

(SKB) It may be possible to crush and store rock from SFR on the rock heap next to the final repository. The consequences of crushing and storing rock from SFR on the final repository's rock heap will be examined in the licence application for the extension of SFR, if such an alternative should be implemented.

5.4 Traffic effects, construction stage 1

2.49 Has SKB made an environmental impact assessment of using barges for all transport between Hargshamn and Forsmark?

(SKB) No environmental impact assessment has been made of this. It is not considered to be economically viable to transport the materials by barge.

Appendix 2, On-site transport

2.50 Has SKB made an environmental impact assessment of these measures and transport activities, where emissions of greenhouse gases have been compared for alternative fuels?

(SKB) Atmospheric emissions have been calculated for 2018, 2030 and 2075, and the results are presented in report P-08-66. The calculations are based on a literature review of what vehicles and fuels are expected to be used in the future (this study is Appendix 8 to report P-08-66). The report contains a general discussion of how different fuels affect the emissions of various substances.

P-06-110 Buller under bygg- och driftskedet

2.51 When will SKB present studies of the consequences of noise?

SKB is in the process of compiling a new noise report ("Anläggning för inkapsling och slutförvar av använt kärnbränsle i Forsmark. Buller under bygg- och driftskedet", P-08-64). The report is expected to be finished in December 2008. The report includes an environmental health assessment prepared by Gösta Blum of Karolinska Institutet.

2.52 In the consequence analyses of disturbances caused by noise, will SKB address the question of what can be done to minimize the disturbances?

(SKB) Disturbance-mitigating measures will be described in the EIS. The environmental health assessment shows that it is particularly important to avoid noisy work and transport activities at night. For this reason, noisy nighttime work will be avoided and transport will be carried out at other times of the day.

2.53 The report shows that the number of households that will be exposed to noise above the guideline value of 55 dBA daily equivalent sound level will increase as a result of SKB's transport activities. What will SKB do to minimize the disturbances caused by exceeded noise standards?

(SKB) The residential environment along highway 76 is exposed to high noise levels from motor vehicle traffic at the present time, and if the traffic continues to increase the levels will increase further. According to calculations in report P-08-64, 182 residents will have noise levels above 55 dBA, 58 of whom will have noise levels above 60 dBA in 2018 with traffic according to the Swedish Road Administration's forecast. The traffic from SKB's facilities will cause 20–30 additional residents to be exposed to noise levels above the guideline value. The additional disturbance from SKB's activity is small in relation to existing noise levels, and the additional properties are residences that have noise levels close to 55 dBA at the present time and will have just over 55 dBA as a result of the operation of the final repository.

SKB considers that there is a need for noise suppression measures along highway 76 both with existing traffic and future traffic without a final repository, and with the addition of the final repository. Measures should primarily be aimed at the residences with the highest noise levels (e.g. above 60 dBA) and not just the additional residences with noise levels above 55 dBA.

The Swedish Road Administration, authority in charge of the public road network, is responsible for measures to reduce the noise along highway 76. But SKB is prepared to work together with the municipality to see to it that noise-mitigating measures are implemented.

2.54 Consequences of vibration from blasting and transport are not taken up. When will SKB publish a report addressing this problem?

(SKB) A new report about vibration is in preparation. The report, "Prognoser och restriktioner för vibrationer med mera från bergschaktning och transporter" ("Predictions and restrictions for vibrations etc. from rock excavation and transport", in Swedish only), has number P-08-78 and is expected to be finished at the end of 2008.

3.1.3 Road traffic noise

2.55 It is important to supplement the noise calculations with calculations based on in situ traffic noise measurements along the route Hargshamn–Forsmark.

SKB does not intend to perform traffic noise measurements along the route down to Hargshamn, but believes that the calculations that have been done provide a sufficiently good picture of the situation.

P-06-108 Miljöriskanalys för inkapslingsanläggning och slutförvar ("Environmental risk analysis for encapsulation plant and final repository", in Swedish only)

2.56 A revision of the protection regulations for the water protection area at Forsmark's ponds is under way. It is important that SKB keep informed about this revision.

(SKB) The water in Bruksdammen comes from the northwest and is therefore not affected by events at the final repository or traffic accidents on the road to Hargshamn. It is therefore of minor importance for the environmental risk analysis.

5.4.2 Traffic accidents in Forsmark

"In view of the above points, we judge the intersection with highway 76 to be the most sensitive point in the area under consideration. The main risk is for bodily injury. Rebuilding this intersection should therefore be regarded as a preventive measure".

2.57 SKB should identify risk points and risk sections along the Hargshamn–Forsmark route and plan for measures to minimize accidents.

(SKB) An update of the environmental risk analysis will be done in the autumn of 2008 and result in a new report. The description of the assignment includes studying accident risks along the Hargshamn–Forsmark route and proposing measures where needed.

5.7.2 Activities on the dismantling site

"Where chemical decontamination may be used in the future (for example in piping systems), it would be possible to use e.g. oxalic acid today (several cubic metres). Oxalic acid is broken down after use to a "harmless" product that can be immobilized in cement and removed from the site".

2.58 What does "harmless" mean in this context?

(SKB) Oxalic acid has a complexing effect (makes radionuclides more mobile) and must therefore be destroyed after use. The metal oxides that are washed away in the decontamination process are collected on ion exchange resins and the wash water is broken down by hydrogen peroxide and UV light. The end products are carbon dioxide and water. The carbon dioxide is degassed and exhausted with the ventilation. The water is handled as radioactive water and treated in a treatment plant before being discharged to receiving water.

P-04-07 Amphibians and reptiles. Forsmark site investigation

2.59 Does SKB assume that there are red-listed amphibians and reptiles everywhere suitable habitats exist?

(SKB) The entire affected area has been reinventoried for assessment of the consequences of a groundwater lowering, with a focus on the wetlands (rich fens) located within the impact area. Each site (wetland) has been inventoried and either the occurrence of red-listed species has been observed or the suitability of the habitat for them has been noted.

2.60 Can it be assumed that there are other suitable habitats than those located alongside roads? When SKB knows where the ventilation shafts come up it is important that these areas be well inventoried.

(SKB) See reply to question 2.59. Regarding the ventilation shafts and ventilation station, natural values will be taken into consideration and the impact of both the ventilation station and the access road will be reduced. The access road will be routed to avoid valuable natural values.

Compensatory measures?

2.61 Of the species taken up in the report as likely to occur in the area, three are red-listed (sand lizard, smooth snake and pool frog) and five are listed in the Habitats Directive (great crested newt, moor frog, pool frog, sand lizard and common lizard). It is of the greatest importance that SKB avoid wherever possible work that affects habitats and thereby species that live in inventoried and non-inventoried areas. What measures will SKB take to compensate for destroyed or degraded habitats?

(SKB) Detailed inventories (which are mentioned above and which have been supplemented by inventories of terrestrial environments) indicate that some of the above-mentioned species (sand lizard, smooth snake) do not occur within the impact area for the final repository. Suitable habitats for these species have not been observed, and previous occurrence of sand lizard or smooth snake in the area is not registered in the database of red-listed species kept by ArtDatabanken (the Swedish Species Information Centre). Other species such as moor frog and common lizard have not been specifically inventoried. The moor frog (not red-listed, but protected and included in the EU's Habitats Directive) is probably present within the area, in the same environments as the pool frog. The species will be treated in the same way as the pool frog in the impact statement and via impact-mitigating measures. The common lizard is a common species that is probably present within the area but is not specifically linked to wetlands, living mainly in the forest.

Habitats for pool frogs and great crested newts will not be affected by establishment of the final repository. The pool frog has been observed in several of the ponds that may be affected. The great crested newt has not been observed in the inventories, but may occur since it thrives in the same habitat as the pool frog.

A dialogue has been maintained since 2008 with the County Administrative Board in Uppsala County regarding impact on pool frog localities and the need/requirement to compensate for this impact.

2.62 Even though the pool frog was artificially introduced in the area (1993), its success in surviving and reproducing suggests that the conditions are right. The occurrence of pool frogs usually indicates high species diversity of other groups of organisms as well (e.g. great crested newt, green hawker, European medicinal leech (near threatened according to the red list), reed leopard and fen orchid (near threatened according to the red list). Has SKB investigated the occurrence of other organisms worthy of protection in the ponds south of Forsmark?

(SKB) During the summer and autumn, the Ecology Group has conducted thorough inventories of ponds that may be affected for SKB. The assignment included a flora inventory and inventories of dragonflies and land snails. The results will be presented in a special report that will also be used as a supporting document for the EIS.

2.63 It says in the report that Per Sjögren Gulve of the Swedish EPA runs a research programme in the area and that he should be consulted before major changes are made in the area. We assume that SKB will do this.

SKB has contacted Per Sjögren-Gulve and invited him to participate in the series of meetings between SKB and the County Administrative Board concerning the impact of a groundwater lowering on natural values.

P-05-256 Arkeologisk utredning (etapp 1) Forsmark ("Archaeological survey (stage 1) Forsmark", in Swedish only)

2.64 The report mentions (page 21) a need to supplement the survey of cultural values in Forsmark parish. Does SKB regard this as a problem? Will the poorly inventoried areas be reinventoried?

(SKB) Special supplementary inventories have been done in the area around Söderviken. The investigations are described in report P-08-63 (Kulturmiljöutredning Fas 2 Forsmark), which is expected to be published in December 2008.

The special inventory concluded that the potential for the occurrence of any concealed archaeological remains is very small, owing to the nature of the land, its height above sea level and previous development. Söderviken is isolated from valuable cultural environments, and the consequences for the cultural environment are therefore assessed to be non-existent or minor. Further surveys are not deemed to be needed.

"The risk of destroying undiscovered archaeological remains is deemed to be higher in Oskarshamn than in Forsmark, but the land has been thoroughly investigated in both cases". (P-06-108 Miljöriskanalys för inkapslingsanläggning och slutförvar, page 32)

2.65 Report P-06-108 points out that the land has been thoroughly investigated. Is there any information on possible supplementary investigations since the printing of report P-05-256?

(SKB) Stage 1 of the archaeological survey for Forsmark is described in the report P-05-256 and stage 2 in P-08-63. The formulation in the environmental risk analysis that the area has already been thoroughly investigated is misleading. If and when construction starts in Forsmark, full knowledge will exist of archaeological remains in the area.

2.66 Will SKB publish a summarizing and updated report on archaeological surveys?

(SKB) Yes, P-08-63 will be a summarizing and updated report on archaeological surveys.

P-07-150 Nulägesanalys samt bedömning av konsekvenser för rekreation och friluftsliv av ett slutförvar i Forsmark ("Current situation analysis and assessment of consequences of a final repository in Forsmark for recreation and outdoor activities", in Swedish only)

2.67 The report points out that *"The surface facilities will thus not occupy any new land"* (page 21). What does it look like with the current layout? The area is often used by ornithologists and is considered to be of high quality for birdwatching. Will accessibility be affected in any way?

(SKB) Accessibility will not be affected outside the facility at Söderviken, except for a limited area around a ventilation station that may be built east of the operations area. The ventilation station will be surrounded by a fence and entail a limited intrusion.

2.68 The report points out that *"If construction leads to a significant increase in shipments by large vessels to Forsmark, this may have negative consequences for e.g. bird life in the archipelago"* (page 23). What restrictions will SKB impose on sea transport to prevent the bird life in the archipelago from being disturbed?

(SKB) Hargshamn is SKB's main alternative for bentonite shipments. Bentonite shipments are planned to be most intensive during the decommissioning phase, with between 12 and 24 shipments per year, depending on the size of the vessel.

No shipments by large vessels (except m/s Sigyn) are currently planned to the Port of Forsmark, since the harbour is not considered suitable for the purpose. Bird life will thereby not be affected to a greater extent than it is today. Furthermore, environmental disturbances along the sea lane to the Port of Forsmark are being studied with respect to natural values. Details on sea shipments of bentonite are given in report R-08-49.

P-06-115 Inventory of vascular plants

2.69 The report describes many valuable extreme-rich fens, rich fens and mires. We cannot find any description of how these areas may be affected. Will SKB publish analyses of how valuable extreme-rich fens, rich fens and mires may be affected?

(SKB) Such a project is under way with a direct link to modelling of the groundwater lowering (drawdown) that could result from the establishment of a final repository in Forsmark. All valuable assets within the defined impact area for groundwater lowering have been inventoried or reinventoried, and the material will then be used for impact assessment. R-07-22 Slutförvar för använt kärnbränsle. Förstudie. Mottagningsanläggning för bentonit och lera i Hargshamn. ("Final repository for spent nuclear fuel. Feasibility study. Receiving facility for bentonite and clay in Hargshamn", in Swedish only).

2.70 SKB has assumed an annual increase in the amount of traffic by 1% without reference to any source. What is this assumption based on?

(SKB) It is based on the Swedish Road Administration's forecast presented in VV Publ 2006:127. According to the forecast, passenger car traffic in Uppsala county will increase by a total of nine percent between 2006 and 2015. Passenger car traffic comprises about 90 percent of the total traffic flow. The increase in heavy traffic is predicted to be greater: 25 percent between 2006 and 2015.

2.71 Hargs bruk is situated in an area of national interest for the cultural environment. Many of the buildings here lie near the road. Has SKB investigated how these buildings will be affected by periodically intensive traffic with heavy vehicles? This could probably be determined by an extended environmental risk analysis.

(SKB) The impact on buildings comes mainly from vibrations from the heavy traffic. In the work on the updated vibration study, P-08-78 (expected to be finished around the end of 2008), buildings along the Forsmark–Hargshamn route have been inventoried. The report observes that harmful vibrations are not expected to arise in surrounding buildings due to heavy vehicle transport, mainly due to the fact that the supporting ground along the transport routes consists of firm materials such as rock or till. An assumption in the calculations is that highway 76 remains in its current condition; if holes or bumps are created in the roadway, the vibration levels will increase.

4. Documentation and quality

Quality assurance is a vital concept for the final repository in all respects. Much of what concerns the final repository is based on documents that are difficult for laymen to understand. Much of the credibility of the concept is then dependent to a great degree on whether SKB has managed to show convincingly that what is presented in the safety report is grounded in reality. At the same time, the limitations of quality assurance must be recognized.

Quality assurance should include: The competence of experts, including SKB's own employees. Besides an evaluation of specialized knowledge, quality assurance should also include an evaluation of integrity, loyalty, objectivity and credibility. Political decision-makers do not possess the necessary specialized knowledge to evaluate all matters on their own. They have to rely on the facts being correct. It is then vital to be convinced of the credibility of the people and organizations who have gathered the material.

2.72 How will SKB handle quality assurance of the competence, integrity and credibility of outside experts and in-house personnel?

SKB has an integrated management system for quality, environmental, safety and occupational safety issues. The system is certified to ISO 9001:2000 and 14001:2004.

The management system is a body of rules governing how activities are to be carried out and documented, who carries out various activities where decisions are made. The management system has two purposes. The first is that the company should have a planned and quality-assured mode of working. The second is to serve as a tool for effective support in the daily work.

The management system is designed so that the management can – in a standard and documented way and with efficiency, safety and quality – steer the activity towards the fulfilment of SKB's mission, which is to manage and dispose of spent nuclear fuel and radioactive waste from the Swedish nuclear power plants in such a way that human health and the environment are protected in the short and long term.

The efficiency of the management system is checked during audits. DNV, Det Norske Veritas, carries out an annual external certification audit plus a follow-up. Internal audits are performed according to a fixed schedule, where all functional areas of importance for SKB's nuclear safety are audited at least once every four years.

Quality assurance of in-house personnel and outside experts is done by means of an assessment of documentation and qualifications and by a check of CVs. Credibility and integrity are assessed in conjunction with review of delivered results. Furthermore, SKB avoids using the same consultants as SSM, with a view to just credibility and integrity.

The organization's ability to handle the enormous quantity of data that is collected and from this data report what is relevant. The organization must be able to present documents that are comprehensible to both laymen and experts and have an ability to create a balanced picture.

2.73 In what way does SKB handle quality assurance of its own organization?

SKB's management system includes procedures for quality assurance of its own organization. See also reply to question 2.72.

Review of validity of models, input values for calculations and calculations.

2.74 How will SKB ensure that models, input values and calculations are relevant and describe a probable future reality?

SKB's management system (see reply to question 2.72) includes procedures for quality assurance of models, input values and calculations. There are also procedures for management of review, in accordance with review plans.

Furthermore, review is done in several steps, for example in the form of internal factual/primary safety review and quality review.

The main function of the Department of Nuclear Safety at SKB is to work to foster and develop the work with safety and radiation protection. The department carries out reviews, audits and follow-ups and makes sure that SSM's requirement on independent safety review is met.

SKB has a Site Investigation Expert Review Group (SIERG) with experts who are not directly involved in the project who review our calculations and results. Another important element in review is that the results are presented openly via conferences, scientific articles and reports and are thereby peer-reviewed by the scientific community in accordance with accepted standards, as well as by regulatory authorities and others.

2.75 How is quality assurance of design, fabrication, testing, construction and operation handled?

SKB's management system (see reply to question 2.72) includes procedures for quality assurance of design, fabrication, testing, construction and operation.

Conformance of fabrication to required standards will be carefully verified by both SKB and, in the case of certain components, by an independent inspection body that must be approved by SSM. Each component of importance to safety will be inspected very carefully so that we are sure that it meets the requirements on material composition and material structure and that there are no cracks or other defects. The suppliers will be obliged to perform certain inspections before their components may be delivered to SKB. We will have our own inspection programme under our own auspices. We will carefully determine the quality of all components of safety-related importance. The test methods will be qualified by a qualification body approved by the regulatory authorities. We use independent outside laboratories for certain types of testing.

The Department of Nuclear Safety at SKB works with independent safety review of nuclear safety matters relating to facilities in operation and development of nuclear safety.

Verification function to ensure that quality assurance leads to credible results that meet the quality requirements. There must be agreement between quality assurance and results.

2.76 How will SKB provide independent verification that quality assurance actually works?

SKB's management system (see reply to question 2.72) includes procedures for verification of quality assurance.

SKB has identified issues where the knowledge base for the safety assessment is inadequate, for example copper creep, glacial hydrology, buffer erosion, hydrogeological models and bentonite alterations. It is likely that knowledge gaps will remain even up to SR-Site. (Creep entails a slow deformation – usually ductile, under the influence of constant force – undergone by different materials over time.)

2.77 How will SKB handle the knowledge gaps that are found?

(SKB) The principle is to make conservative (pessimistic) assessments in cases where knowledge is lacking. This ensures good margins. As knowledge and experience are accumulated, the assessments can be made less conservative.

5. Safety functions

The most important safety-related properties can be summarized by the concepts of isolation and retardation. Safety functions are described in the four components: canister, buffer, backfilling of deposition tunnels and geosphere. The methodology is well suited for describing the safety-related properties. The methodology describes safety functions, performance indicators and performance indicator criteria (limit values).

The picture must be complete in order to be satisfactory. The regulatory authorities say that if there are factors that cannot be handled with this methodology, this must be clearly stated. Indicators and criteria for e.g. copper creep and stress corrosion cracking are lacking. Certain performance indicators are inadequately explained, for example the temperature criterion of 100 degrees for the buffer.

The regulatory authorities find that explanations that justify the chosen limit values are lacking.

2.78 Will SKB develop the method with safety functions so that it is complete?

(SKB) In SR-Site we handle the safety functions deemed to be necessary.

7. Geosphere conditions

SKB has not observed any indications of recent rock movements or earthquakes since the last glaciation in the candidate area (Forsmark) and its immediate environs. The rock stresses are relatively high.

SKB needs to show that confidence in the frequency and extent of the deformation zones is good. According to SKB, there may be undiscovered deformation zones. The models for discrete fracture networks are of central importance.

2.79 How credible are the models used for the rock, and what degree of uncertainty exists in the models?

(SKB) The models are credible, but can never be as detailed as reality. The results are reliable on the scale and for the purpose they have. When uncertainties exist in the data, conservative (cautious) assessments are used. The greatest uncertainties lie far in the future, after the next ice age.

The rock stresses are so high in Forsmark that it has been difficult to perform a sufficient number of reliable rock stress measurements

2.80 How does SKB handle the scarcity of reliable measurement values in cases where actual rock stresses are used as input values in models and calculations?

(SKB) The principle is to make conservative (pessimistic) assessments in cases where knowledge is lacking. This ensures good margins. As knowledge and experience are accumulated, the assessments can be made less conservative.

As far as hydrological models are concerned, SKB has used two types of models on a regional level and three types of detailed modelling. SKI's expert arrives at different results than SKB in some cases.

How groundwater movements are expected to occur is very important. Laymen must understand how uncertain the results are

2.81 How credible are the models for how the groundwater flows in the rock, and how uncertain are the results?

(SKB) The models are credible, but can never be as detailed as reality. The results are reliable on the scale and for the purpose they have. When uncertainties exist in the data, conservative (cautious) assessments are used. The biggest uncertainties lie far in the future, after the next ice age.

Calculations of transport of radionuclides from a damaged canister through the geosphere to the ground surface have been done with two models. The regulatory authorities have many viewpoints, e.g. on the link between parameters in the model and the properties of the rock

2.82 How credible are the models for transport of radionuclides through the rock and how uncertain are the results?

(SKB) The models are credible, but can never be as detailed as reality. The results are reliable on the scale and for the purpose they have.

When we model radionuclide transport, we start by measuring water flows in boreholes. This provides accurate input data. We input these data in models of the rock to describe the fracture system. We let the "water flow" in the models. The model reproduces data in the areas we have observed. However, there is an uncertainty as to whether the model also correctly describes the areas we have not observed.

In the next step we enter the Spent Fuel Repository in the model. We enter "particles" in the model to see how they flow with the water. Then we calculate what happens during an ice age.

The uncertainty increases with each step we take, and the greatest uncertainties concern what happens during and after the next ice age. In order to have good margins, conservative (cautious, pessimistic) assessments are made in cases where knowledge is lacking.

As regards transport of radionuclides through the rock, there are a number of natural analogues that we can use. For example, in Gabon, West Africa, there were natural nuclear reactors in the bedrock about two billion years ago. The decay products are still there, so scientists can study how the radionuclides have spread. Another example is Cigar Lake in Canada, where there is a uranium ore body embedded in clay – a natural analogue of the final repository. There scientists can study how the radionuclides have migrated in the clay.

8. Layout of final repository

A coherent strategy for choosing suitable positions for deposition holes is needed. Positions and properties are of great importance for the repository's safety. The regulatory authorities' calculations of the degree of utilization of the deposition positions points to considerably lower degrees of utilization than reported by SKB

2.83 What is the cause of the differences in the calculated degree of utilization? Which calculation is most correct when it comes to the degree of utilization of deposition hole positions?

(SKB) The difference in calculated degrees of utilization could be due to different strategies. SKB's strategy has been to make a realistic assessment of the degree of utilization,

while the regulatory authorities' strategy may have been conservative (cautious). It is important to emphasize that the degree of utilization in itself does not affect safety; rather, the crucial factor is the quality and location of the deposition holes.

SKB plans to use low-pH cement for grouting. The regulatory authorities do not think that SKB has convincingly shown that this cement can be used for all applications. Nor has SKB clearly specified the composition of this cement.

Bentonite alterations can occur if cement with a pH greater than 11 is used. The regulatory authorities' experts point out that alterations can occur even if low-pH cement is used.

2.84 Will rock grouting be done in certain parts of the repository when canisters and bentonite have already been placed in deposition holes in other parts of the repository? If so, can grout penetrate into the buffer and alter its stiffness and chemical properties in a way that reduces the protective capability of the buffer?

(SKB) Rock grouting may be done after canisters and bentonite have been placed in deposition holes.

The grout cannot penetrate into the buffer mechanically, but it can do so chemically. The quantity of grout (cement) that will be used in the Spent Fuel Repository is very small compared with the quantity of buffer (bentonite). Moreover, we will minimize the use of grout near the deposition areas.

The grout could not cause problems for the buffer even in relatively watertight bedrock. This is because the water runs in the fractures. If the rock is watertight, no water and no grout runs in the rock. The water in the grout can therefore not be sucked into the buffer.

The situation is different in SFR. More cement than bentonite is used there. The cement can then affect the buffer, which cannot happen in the Spent Fuel Repository.

10. Engineered barriers and spent fuel

The regulatory authorities say that more research is needed on whether the variation in the strength properties of the insert in the canister is acceptable and whether it also represents ingots (ingot: block of steel or other metal intended for further processing) with the poorest properties. Acceptance criteria for fabrication defects are needed.

According to the regulatory authorities, further study is needed of the reliability of the fabrication methods in serial production.

Experience of FSW shows that five types of welding defects have occurred. The regulatory authorities want SKB to clarify how the evolution of the canister could be affected. Conceivable effects on the safety functions should be discussed.

The regulatory authorities consider the design premises to be incomplete. Among other things, information is lacking on the largest permitted defects in different parts of the canister

2.85 Will SKB formulate criteria for acceptance of defects in connection with the fabrication of the insert and the canister? If so, when will they be presented?

Yes, SKB will formulate criteria for acceptance of defects in connection with the fabrication of the insert and the canister. Principles for inspection/qualification will be established in the application and implemented prior to commissioning.

SKB has presented a programme for nondestructive testing.

2.86 Has the effect of gamma radiation from the fuel been taken into account in radiographic testing?

(SKB) Yes, the effect of gamma radiation has been taken into account. Our interpretation is that the question concerns whether radiation from the fuel interferes

with the radiographic testing of the weld. If so, our reply is that no, it does not. The X-ray source used is a linear accelerator that gives a very high dose rate (300 Gy/h) when it has passed the weld, compared with the maximum surface dose rate (1 Gy/h) from the canister.

The regulatory authorities have indicated areas which SKB needs to further develop or clarify in its description of the qualification sequence for testing. 10 points are stipulated by the regulatory authorities.

2.87 How does SKB intend to show that the testing methods are capable of testing what needs to be tested?

(SKB) We are working on this issue in the Canister Laboratory. For many years, SKB has engaged the German Federal Institute for Materials Testing and Research, BAM, which is one of the world's leading authorities in this field, to obtain a scientific basis for determination of the reliability of nondestructive testing. BAM evaluates the methods we develop, and their results serve as a basis for the safety assessment's assumptions regarding canister quality.

Knowledge gaps exist for buffer erosion. Two types of bentonite are reference materials for the buffer. The regulatory authorities say that the effects of the rather large mineralogical differences between MX-80 and Deponit CA-N should be examined. SKB should formulate concrete requirements on mineralogical composition and chemical composition and state whether maximum permitted concentrations exist for components that can adversely affect the buffer. The regulatory authorities say that certain questions exist concerning whether SKB's requirement specification for the buffer is sufficiently detailed with regard to mechanical properties.

2.88 How will SKB learn more about buffer erosion and develop the requirement specification for the properties of the buffer, mechanical as well as chemical?

(SKB) Buffer erosion is a field of research where much work is being done that will improve our knowledge. The buffer has a safety function; the requirement specification is known and applies to the buffer's properties and function. We impose requirements on swelling capacity, sealing capacity and elasticity. The buffer's mineralogical composition is of less importance.

The regulatory authorities believe that trial fabrication may be needed to show that sufficient quality can be achieved under circumstances that resemble serial production.

The regulatory authorities believe that further work is needed to develop a quality programme for buffer fabrication. Possible nonconformances need to be discussed, for example heterogeneous conditions in the buffer.

The regulatory authorities say that SKB should address the difficulty of achieving high quality under the more demanding conditions that exist in routine operation, for example remote-controlled operation and the speed required for a deposition sequence.

The regulatory authorities believe that specified methods should exist to verify and ensure that a deposited package with buffer and canister is correctly emplaced within given geometric tolerances. The quality assurance is incomplete.

2.89 How does SKB intend to develop quality assurance of the buffer in connection with fabrication and installation?

(SKB) One important purpose of the line report that is being prepared, and that will be included in the applications planned to be submitted at the end of 2010, is to describe which of the buffer's properties have to be checked and quality-assured in connection with fabrication and installation.

11. Initial evolution of the repository

The buffer nearest the canister may not have a temperature in excess of 100 degrees Celsius, according to SKB's limit value. Temperatures in Forsmark, where the rock is very dry, may exceed 100 degrees, according to the regulatory authorities' experts. The calculations in SR-Can are based on a fuel burnup of 38 MWd/kgU. This burnup may increase. A more detailed analysis should be done that sheds light on the effects of this, for example temperature and activity. The maximum permitted temperature affects the distance (spacing) between the deposition holes.

2.90 What will happen to the buffer if the temperature exceeds 100 degrees?

(SKB) It can be noted initially that SKB has carried out calculations based on conservative assumptions and the results show that the temperature will not exceed 100°C (see question 2.91).

Bentonite exposed to a high temperature over a long time can be altered to a material that lacks swelling capacity. This is well known from nature and has also been demonstrated in laboratory studies. In order to study alteration on the time scales that are used in laboratories, temperatures above 200°C are needed. The model used in SR-Can shows that the buffer could withstand 170°C for 100 years or 130°C for 2,000 years without being affected (less than 1% alteration).

2.91 What safety margins exist for the buffer's temperature tolerance?

(SKB) The temperature in the buffer is determined by the decay heat in the encapsulated fuel. We will pack the canisters so that the decay heat in each canister will not exceed 1,600 watts, ensuring that the temperature in the buffer will not exceed 100°C. The temperature will reach a peak after about 100 years, after which it will fall. We want the temperature on the canisters to be less than 100°C so that the water will remain in the liquid phase. If the temperature exceeds 100°C, the water is vaporized.

We have done calculations based on the assumption that we always have a hot copper canister, dry bentonite and an air gap, i.e. conditions that give the highest temperatures. The results show that the safety margins are good. The temperature will be less than 100°C. We have also performed experiments at the Äspö HRL showing that the temperature around the canisters agrees well with the calculated temperature. We therefore feel certain that the temperature will not exceed 100°C. The model used in SR-Can shows that the buffer could withstand 170°C for 100 years or 130°C for 2,000 years without being affected (less than 1% alteration).

2.92 How does SKB take a higher burnup into account?

(SKB) A higher burnup would entail that fuel with a higher heat output must be handled. This does not directly affect the heat output from the canister, but may impose higher demands on the logistics in the encapsulation plant so that the canisters are packed with fuel in such a way that the temperature is not exceeded.

2.93 What will the consequences for the bentonite buffer be if the storage time in Clab is extended to allow the temperature of the fuel to decline?

(SKB) If the fuel is stored for a longer time in Clab, this will lead to a reduction in the heat output from the fuel. The heat output from the canister will depend on the logistics when it was packed with fuel assemblies. If the heat output from the canister is lower than SKB has assumed, this does not adversely affect the bentonite

buffer. It should be noted in this context that the heat output from the canister assumed by SKB is far less than what might be harmful for the bentonite buffer.

The regulatory authorities say that SKB should analyze in greater detail the resaturation process for the very tight rock types that exist in Forsmark. If a very slow resaturation occurs, it will take a long time for the buffer to achieve the desired properties. The consequences of this must be identified.

2.94 What are the consequences if the buffer stays dry for a long time? Does the risk of copper corrosion due to microbial activity increase?

(SKB) If the water flow is low, the sealing properties of the bentonite are not needed since there is no water to transport corrosive substances to the canister (or radioactive substances from the canister). The possibility that the buffer would remain dry for a long time has never been seen as a drawback for the concept. Sooner or later the clay becomes water-saturated. The risk of copper corrosion due to microbial activity does not increase if the buffer stays dry. See also reply to question 2.96.

Erosion can take place in buffer and backfill before sufficient swelling pressure has been established. SKB says that knowledge of erosion needs to be improved. SKB has used a rather ideal picture of the resaturation process. This entails that the duration of erosion has been assumed to be 100 days.

2.95 How will SKB improve its knowledge of erosion?

(SKB) An extensive project has been pursued under SKB's auspices to study the buffer erosion process and its consequences for the repository. The project started in January 2007 and was concluded at the end of 2008. A number of departments from KTH, Chalmers and Lund University took part in the project. The work is currently being continued in the Bentonite Laboratory.

2.96 What will the consequences be if the resaturation process proceeds much more slowly than SKB has assumed?

(SKB) If the water flow is low, the sealing properties of the bentonite are not needed since there is no water to transport corrosive substances to the canister or radioactive substances from the canister.

In the first report describing bentonite as a buffer material back in 1978, it was written: "In view of the very low groundwater flow and the low permeability of the buffer material and the surrounding, grouted rock, it will take a very long time (probably hundreds of years) before all bentonite is water-saturated" /KBS-2, 1978/. Thus, it was clear already in the original concept for disposal of spent nuclear fuel that it would take a very long time to saturate the buffer with water. This was not regarded then, and has never been regarded since, as a drawback for the concept. The results of the continued work will be presented in the SR-Site safety assessment, which will be published at the time of the applications.

Earthquake is the only process the was identified that could cause movements in the rock large enough to cause direct damage to the copper canisters. Thermal spalling around the deposition holes cannot be ruled out. Thermal stresses are expected to reach a peak before the swelling pressure is established. Spalling increases the permeability of the rock, which affects both copper corrosion and radionuclide transport.

2.97 How is the rock affected by the swelling pressure after thermal spalling if thermal spalling reaches its peak before the swelling pressure has been established?

(SKB) This is counteracted by measures in conjunction with deposition.

2.98 How does thermal spalling affect temperature conditions nearest the canister? Has this been taken into account in calculating the distance between the deposition holes?

(SKB) Thermal spalling has been taken into account in calculating the distance between the deposition holes. Thermal spalling does not have any effect.

The chemical variable that is probably most important in the risk analysis is the sulphide concentration.

2.99 How will SKB gain greater knowledge of the availability of sulphides?

(SKB) Initially, at temperatures below 100°C, sulphide is formed almost exclusively by microbial sulphate reduction. Microbial formation of sulphide requires that the bacteria have access to the substances that are required: sulphate and either organic compounds or hydrogen, and possibly methane.

Laboratory experiments have been conducted for the purpose of investigating how much sulphide is formed by sulphate-reducing bacteria and how rapidly under different conditions. Microbial processes such as sulphide formation are being studied on Äspö. SKB has carried out a special sampling programme at Äspö and Laxemar to clarify certain variations observed in measurement data. The aim is to improve the reliability of the data.

According to the regulatory authorities, considerable uncertainties exist regarding the effects of cementation of the buffer. Cementation of the buffer leads to higher stiffness in the buffer. This affects its capacity to dampen the effects of earthquakes.

2.100 Does SKB intend to improve its knowledge of cementation, and if so, how?

(SKB) Yes, among other things the results of the experiments on Äspö will be reported for the publication of the SR-Site safety assessment. Cementation of the buffer is being studied on Äspö in the LOT project (Long Term Tests of Buffer Materials).

2.101 Does SKB intend to study more calculation cases to determine the impact of earthquakes on the canister's capacity to withstand shear forces?

SKB is continuing its efforts to model in greater detail the stresses on the canister as well as to derive from this the quality requirements imposed on the canister. Different angles and points of attack for shear are being analyzed. Combinations of loads are being analyzed.

Stress corrosion cracking of copper is possible in principle in the presence of tensile stresses and an aggressive chemical environment. SKB has ruled out the possibility of stress corrosion cracking.

The regulatory authorities believe that gathering better data for corrosion mechanisms such as stress corrosion cracking should be a high priority.

2.102 On what grounds has SKB ruled out the possibility that stress corrosion cracking of the copper canister can occur?

(SKB) The following are required in order for stress corrosion cracking of copper to occur: oxidizing conditions, availability of one of the initiating ions nitrite, ammonium or acetate, and tensile stresses. Oxidizing conditions will only exist for a short time in the repository. Measured concentrations of the ions in the groundwater are well below the concentrations at which stress corrosion cracking has been seen to occur. It can therefore be concluded that stress corrosion cracking will not affect the life of the canister.

12. The long-term evolution of the repository

Glacial erosion can affect the depth of permafrost. Permafrost exerts pressure on the canister and surrounding rock. The function of the buffer is uncertain after freezing. A temperature of –5 degrees is needed for freezing of the buffer.

The regulatory authorities say that if significant glacial erosion cannot be ruled out, it should be taken into account in determining an appropriate repository depth.

The regulatory authorities say that uncertainties exist regarding models and calculations. The consequences of freezing of the buffer should be analyzed.

2.103 Will SKB investigate the consequences of freezing of the buffer, and if so when do they expect to be able to present their findings?

No, SKB will not investigate the consequences of freezing of the buffer, since it is of no importance. Our calculations show that the buffer will not freeze in conjunction with future ice ages. The properties of the bentonite clay are altered if it freezes, but less so than in the case of water that freezes. The swelling pressure declines at temperatures below zero, which means that a "frozen" buffer does not exert an increased pressure on the canister or the rock.

2.104 How does the ice pressure that arises in connection with permafrost affect uplift of the ground surface and pressure on the final repository?

(SKB) The ice pressure will not affect the final repository.

2.105 Can glacial meltwater penetrate down to the repository if there is permafrost?

(SKB) It is our assessment that glacial meltwater will not penetrate down to the repository.

It can be mentioned in this context that glacial meltwater has very low salinity compared with present-day groundwater at repository level. Glacial meltwater is comparable to deionized water.

2.106 Will SKB perform an analysis of the risk of freezing that takes into account uncertainties in the model and glacial erosion?

(SKB) We have already analyzed the risk of freezing taking into account glacial erosion.

Shear load from earthquakes. Rock movements in fractures may not exceed 10 cm without jeopardizing the integrity of the canister. Results obtained suggest that the canister can withstand a shear of 10 cm without the breaking strain of either the copper shell or the cast iron insert being exceeded. Material tests have shown lower values of breaking strain for the insert than the required 7%. Values down to 2% have occurred. SKB presumes that this is due to casting defects in the form of slag inclusions. The regulatory authorities state that SKB should present better analyses and investigations that verify that the actual breaking strain is not exceed for the cast iron insert at a shear of at least 10 cm. If this proves impossible, the criterion should be reconsidered.

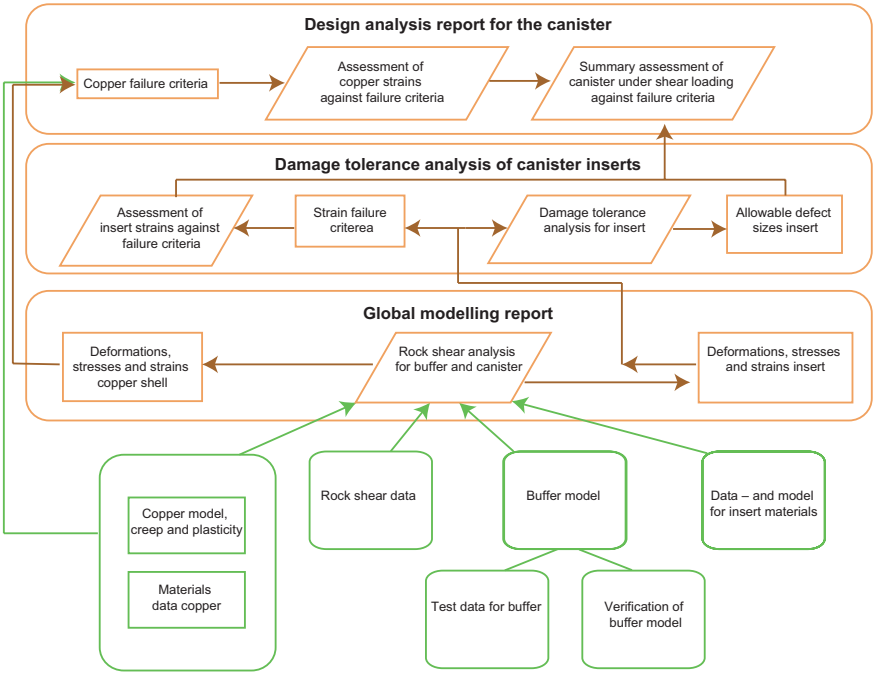
2.107 What requirements are made on defects in the form of slag inclusions? Are the requirements met in the material tests that have been performed? How do quality assurance and testing work in this case?

(SKB) According to SKB's plans, the requirements and how they are met will be presented in the line report for the canister, which will be included in the application documents. In general, however, it can be concluded that the canister will remain intact under the conditions prevailing in the final repository.

The shear rate can be of great importance for the breaking strain.

2.108 Will SKB investigate the impact of the shear rate on the copper canister and the cast iron insert?

(SKB) Yes, we will take a closer look at it. Analyses of the shear load case are included in the data reporting for the SR-Site safety assessment. The overall evaluation of the impact of shear on the long-term safety of the final repository is done in the safety assessment, which will be published at the time of the applications. The logic of the analyses (angular boxes) and different reports included in the analyses (rounded boxes) are shown below. Since the complication level in the analyses is high and the report structure, as shown below, is complicated, the overall analysis of the safety assessment is the most suitable way to present the results.



SKB says that combinations of simultaneous shear load and isostatic load from a glaciation do not have to be taken into account.

2.109 Will SKB analyze the case with simultaneous shear load and isostatic load?

(SKB) Yes, we are analyzing it more closely. The results will be presented in the SR-Site safety assessment, which will be published at the time of the applications.

2.110 Will SKB analyze the case with shear load at one glaciation and isostatic load at the next glaciation?

(SKB) One design premise is that the canisters that are subjected to a shear (according to the design requirements) must withstand a new glaciation. SKB's analyses of the canister are based on this requirement.

Models and parameters have been used to calculate the number of damaged canisters from an earthquake. SKB presents very exact results of the calculations that can scarcely represent reality.

2.111 Is this credible? There appear to be many uncertain factors in the calculations.

SKB's calculations of the number of cases are based on statistical data and probabilities and pessimistic assessments. As far as the canister is concerned, we have chosen to combine the most unfavourable assumptions for shear and have this as a design case.

2.112 Has SKB described the consequences of a canister being damaged by a shear failure?

(SKB) Yes, the consequences of a canister being damaged by a shear failure are included in the SR-Can safety assessment.

13. Consequence analysis and radionuclide transport

SKB presents calculations of radionuclide transport and dose for four different canister failure cases: initial defect (small hole in the canister), copper corrosion due to an eroded buffer, shear failure and isostatic collapse. SKB presents calculations from three different release points: a fracture intersecting the deposition hole, the excavation-disturbed zone along the floor of the deposition tunnel and a fracture intersecting the deposition tunnel.

This whole section is based on calculations based on models and input parameters in the models. It is very difficult for a layman to make a qualified assessment of the relevance of what is presented. The credibility of the experts is decisive.

There are great uncertainties in models and parameters. The regulatory authorities observe that it is necessary in virtually all parts of the safety assessment to evaluate and analyze different types of uncertainties.

SKB comments: We know from experience that it is difficult to make something as complicated as, for example, calculations of radionuclide transport comprehensible to laymen. Nevertheless, we will do our best to make the results comprehensible to a wide audience, by for example presenting SR-Site in an abridged version in Swedish.

14. Scenarios and risk analysis

SKB describes a main scenario based on the reference evolution and supplementary scenarios. Additional scenarios are chosen to illustrate uncertainties that are not covered in the main scenario. SKB has arrived at the conclusion that only the combination of "advective conditions in the deposition hole and "canister failure due to general corrosion" plus the shear failure case need to be included in the risk analysis. The regulatory authorities find that the principles for selection of scenarios that are presented comply with the regulations. Several factors may need to be taken into account to prove completeness in the choice of scenarios, for example deviations in the initial state with respect to fabrication, handling and operation. SKB should perform an extra check of the importance of excluded processes or combinations of process, such as glacial erosion and permafrost, buffer alterations and cementation processes, and downward penetration of oxygen-rich glacial meltwater.

SKB's principles for summarizing risk contributions are in agreement with the regulations. Design-basis mechanical load cases are identified for the canister. Well developed design-basis cases for canister and buffer relevant to the advection/corrosion scenario are, however, still lacking.

2.113 How will SKB develop the scenarios to increase confidence that all scenarios have been taken into account?

(SKB) In the work with SR-Site we take into account those viewpoints that we have received on SR-Can.

15. SKB's summary of results and compliance with requirements

SKB's own list of remaining work is very extensive.

2.114 What does the timetable for SR-Site look like? Will there be time for all remaining work?

(SKB) The safety assessment is our most important task. We cannot submit the applications based on incomplete material. If we see that we won't have time to finish within the allotted time, SKB will have to consider adjusting the timetable.

16. SKI's and SSI's concluding remarks

The regulatory authorities have conducted a review of SR-Can and have expressed lots of viewpoints that entail a great deal of work for SKB and many new documents.

2.115 How does SKB view the continued work with SR-Site in view of all the viewpoints expressed by the regulatory authorities on SR-Can?

(SKB) We read and consider all viewpoints received and will describe how we have responded to the regulatory authorities' viewpoints in an appendix to SR-Site.

Viewpoints not obtained from the authorities' review

Section 6.12 in SR-Can's Swedish translation. What happens if the barriers are lost?

SKB has analyzed some cases where barriers are lost.

Combination of all defective canisters and no buffer. Water can flow freely through all deposition holes and all canisters. Only the slow dissolution of the fuel and the bedrock's retarding capacity are able to limit the consequences. The calculations show that in this case, the radiation will not reach the level of the background radiation until after more than 100,000 years. The calculations are based on models of the rock and the local hydrology.

2.116 Will SKB deepen the analysis of this illustration?

(SKB) An analysis of cases where some of the barriers have been lost was done in SR-Can. The results show that if the nuclear fuel is not surrounded by any barriers, the Spent Fuel Repository will not fulfil SSM's risk criterion, but emit a dose equivalent to the natural background radiation. The analysis will only be deepened if there is reason to expect another result.

There is a natural analogue of fuel not surrounded by any barriers: The natural reactors in Gabon (West Central Africa) that were active about two billion years ago and at intervals of perhaps 100,000 years. The waste products (e.g. plutonium, strontium, cesium and krypton) that were formed have only moved a few metres from the core, despite the fact that they have not been surrounded by any barriers. This shows that the bedrock has a great capacity to retain substances. In Gabon, the natural reactors were created where a layer of uranium-bearing sandstone met an overlying layer of clay shale.

Important general questions

2.117 How does SKB make use of the expertise possessed by IAEA and European authorities to make short- and long-term assessments of the final repository?

(SKB) SKB is participating in a number of different activities run by the IAEA in order to share our own experience and learn from others. For the same reasons we are participating in the development work being pursued by e.g. the NEA. Other countries' regulatory authorities often participate in these contexts as well. On SKI's and SSI's behalf, international expert reviews have been done of SKB's safety assessments, which is a good way to profit from international experience.

2.118 How is the documentation of the repository passed on to future generations?

(SKB) Firstly, it can be noted that SKB's method for final disposal of the spent nuclear fuel does *not* require the repository to be inspected or monitored. The existence of the Spent Fuel Repository should not constitute a burden on future generations. At the same time as the information on the final repository should be passed on to future generations, it is important not to arouse too much interest or curiosity.

In order that future generations will be able to make well founded decisions and avoid inadvertent intrusion, SKB is working to ensure that information on the final repository for spent nuclear fuel will be preserved in the future.

There are two fundamental principles for how information can be passed on to future generations: successive information transfer, and information transfer directly to a distant future. Successive information transfer involves human participation and can be exemplified by archives. Markers are a way to transfer information directly to a distant future. International cooperation is taking place on this issue. A part of the solution may be to store the information at several places and in several languages.

SKB will draft a proposal for a plan of action, within the framework of international cooperation, in order to preserve information on the final repository in the long term. It is worth noting that other organizations are also working with this question. For example, the Swedish Radiation Safety Authority proposes that a national register be created for long-term preservation of information on shallow burial sites and final repositories for long-lived radioactive waste.

The issue of information preservation far into the future will, however, not become urgent until the final repository is to be closed, which is expected to be in around 2085 at the earliest. Then society can decide which type of information it wants to preserve and how.

Follow-up of the municipality's review of SR-Can

The canister

SKB has assumed that the heat from the canister is evenly distributed along the entire canister. However, the spent fuel exhibits the greatest burnup in the middle of the fuel rods, and this can locally lead to high temperatures in the environs. This can adversely affect the buffer.

2.119 Has SKB taken into account a greater burnup in the centre of the fuel rods in the safety calculation?

Yes, SKB has taken into account an uneven heat output from the canisters.

Climate and climate-related questions

Time increments of between 5,000 and 1,000 years have been used in modelling of land uplift over time. Climate change can lead to great changes in the ice in 1,000 years. The rate of change in the extent of the ice sheet can also be important when it comes to understanding the occurrence of postglacial faults.

2.120 Would a shorter time increment in the modelling runs lead to a better analysis of the physical process and thereby better exactness in the risk analysis?

(SKB) No, a shorter time increment would not improve the exactness in the risk analysis.

Earthquakes

N.B.! A meeting will be arranged to discuss the questions (121, 122, 123, 124, 125) linked to the consequences of earthquakes for safety. Marie Berggren will get back with a proposed date.

2.121 Viewpoint: In general, important studies done by researchers from Sweden, Norway and Finland are lacking in the background description in TR-06-19.

(SKB) It is not possible to comment on the viewpoint without clarification of which "important" studies are meant. Only then can it be determined whether they are relevant and why they are not included in TR-06-19. Moreover, TR-06-19 is a "top document" in a hierarchy of documents dealing with the subject. SKB refers in TR-06-19 to R-04-17 (describes background and principles, especially Appendix 3), which in turn refers to studies done in Finland, Norway, Canada, Scotland, Russia, Sweden and other countries. It cannot be determined whether these are the sought-after studies without more details. Another important study is TR-02-24, which refers to studies from Japan, Taiwan, China and other countries.

Respect distance

According to SKB, the size of movements of fractures caused by an earthquake of a given size are dependent on the distance. The conclusion is that only very short distances are risky. However, it must be pointed out that in connection with an earthquake, the whole area is under great stress and relatively small stress changes can trigger movements of fractures of many different sizes and distances from the main quake. It is well known that aftershocks can occur at greater distances from a magnitude 6 earthquake than reported in SKB's modelling. This is because the crust is presumably in a state of stress that is close to the critical state for an earthquake.

2.122 Viewpoint: This part of the earthquake risk must be more clearly divided into a near-field part (respect distance) and a part based on the general risk of earthquakes where holes are rejected with faults that are long enough to cause potential damage.

(SKB) These are complicated questions and have to do with whether it is possible to distinguish near-field from far-field and respect distance from canister hole criteria. Whether it's a question of aftershocks or not doesn't really matter in this context. This is fairly well described in report R-04-17. The simulation part of this report is in preparation and is expected to be in print before the end of the year. However, the background and principles described in R-04-17, especially Appendix 3, still apply.

Observations from near-field to final repository

Observational geological data regarding movements or no movements are very important for the safety assessment. Seismological observations, especially in the near-field of a planned final repository, can provide important information on whether movements have occurred previously.

2.123 Viewpoint: An estimation of risks from these types of observations should improve the safety assessment.

No, SKB doesn't think so. "Observational geological data regarding movements" are not important for the safety assessment other than indirectly. Ongoing movements are no guarantee that large future earthquakes will occur at that particular place. Nor is the absence of movements a guarantee. Even though there is much to suggest that we have not had large earthquakes since the last ice age in Forsmark (see e.g. SGU report C836), it must be assumed that earthquakes can occur (just as we did in SR-Can), since we cannot prove the opposite. Nor do we know what a future ice age will look like, whether it will even resemble the Weichselian, or whether it will come at all "as planned", due to the greenhouse effect and other

factors. Thus, analysis of ongoing movements does not influence the safety assessment. It does, however, contribute to a better understanding and thereby to whether we have formulated the problem correctly and whether we are making the right assumptions in SR-Site. Measurements (GPS) have been under way for a long time, and we plan to expand the seismic network in Forsmark.

General earthquake risk

The statistics that are available on earthquakes are based on observational data made from instruments during the 20th century, and for older periods written historical sources.

2.124 Have the magnitudes ML (local magnitude) and M (surface wave magnitude) been mixed in the earthquake analyses? This can give rise to incorrect estimates, since these two differ when it comes to the size of an earthquake.

(SKB) No, there is no mixing of different magnitudes. This will have to be discussed at the meeting.

Modelling of earthquakes and ice sheets

Modelling of ice age earthquakes where the data modelling package ABAQUS has been used

2.125 Viewpoint: Are you certain that the dispersion error that can occur in analyses done using finite element methods are not significant in the calculations?

Yes, SKB is certain that the dispersion error is not significant.

2.126 Which parts of the safety assessment will be finished in conjunction with site selection?

(SKB) The safety-related site characteristics have been evaluated for site selection, first factor by factor and then together in an integrated comparative assessment. The main purpose has been to compare the sites with respect to long-term safety.

Questions concerning RD&D 2007

Clab is designed for 8,000 tonnes of spent nuclear fuel, and the total quantity to be disposed of is 12,000 tonnes.

2.127 How does SKB plan to dispose of spent nuclear fuel if considerable delays occur before a final repository can be put into operation?

(SKB) Nearly 5,000 tonnes of spent nuclear fuel is being interim-stored today in Clab. The total storage capacity is 8,000 tonnes of fuel, which is sufficient up until about 2030. According to the timetable for the Spent Fuel Repository, regular operation can commence in the early 2020s, i.e. before the storage chambers in Clab are full. If the Spent Fuel Repository is delayed considerably, it is possible to increase the capacity of Clab by storing the fuel in compact storage canisters, and fuel can be stored at the nuclear power plants. Another possibility is to extend Clab.

SR-Site will be a very important document in SKB's application for a licence for the final repository. Consequently, it is important that SR-Site be as readily accessible as possible. It is essential that politicians and officials be able to form their own opinion for the decision process, and this is greatly facilitated if SR-Site is in Swedish.

2.128 Comment: The municipality assumes that SKB will publish SR-Site in its entirety in Swedish.

Yes, a Swedish version will be included in the licence applications, but it will probably be ready a couple of months after the English version.

The Government said in its statement of comment on RD&D 2004 that SKB should clarify its report on alternative methods and that a comparison should be made with the KBS-3 method by means of a safety assessment method. SKB has not carried out a safety evaluation, claiming that the uncertainties are so great that this is not meaningful.

2.129 Will SKB perform a safety evaluation in accordance with the Government's decision?

(SKB) The term "safety evaluation" is not clearly defined. The term is used in SKI's regulations in a way that appears to mean the same thing as safety assessment. In conjunction with discussions concerning the Deep Boreholes concept, for example the hearing arranged by the Swedish National Council for Nuclear Waste in March 2007, SSI and SKI have emphasized a softer character by adding qualifiers, such as "based on existing data" and "cannot be a question of a complete safety assessment".

SKI says at the same time that they want the "same systematics as SKB has developed for other final repositories" to be used. This leads in principle to the methodology used in the SR-Can study. The Government has in its decision further softened up the positions by instead using the term "safety assessment methodology".

This may seem to be splitting hairs, but SKB would like to point out that a safety assessment assesses the safety of a system. SKB has continuously adapted its safety assessment methodology to the information that has emerged and to the stage of the work. If the KBS-3 method is to be compared with another method, the input data for both methods must be of the same quality and level. Performing a safety assessment for disposal in deep boreholes is then not possible, since the concept has not been sufficiently developed to permit a description of how such a system is designed.

The Deep Boreholes concept has fundamental weaknesses, and we therefore do not consider it justified to perform studies and research on this concept to the same level as for KBS-3. A comparison on a more general level of KBS-3 and Deep Boreholes is in preparation. It naturally includes safety and radiation protection aspects.

Methodology and criteria for final selection of a site for the final repository

In selecting a site for the final repository, SKB should clearly indicate which methodology and which criteria have been applied and guided site selection. The rejected site needs to be described in such a way that the regulatory authorities can make their own independent assessment compared with the selected site.

2.130 What documentation will SKB present regarding site selection?

(SKB) The documentation presented included "Final repository for spent nuclear fuel in Forsmark – basis of decision and reasons for site selection" (available on the website), which contains a review of the premises for site selection, siting factors and evaluation methodology, evaluation of siting factors and SKB's overall evaluation and choice. Furthermore, a special appendix will be attached to the licence applications describing the entire siting process.

Geosphere: *SKB needs to present its viewpoints on what they think about the possibility that the repository itself may constitute a plane of weakness and thereby serve as a fracture initiator in connection with future earthquakes.*

2.131 How does SKB handle this?

(SKB) This involves a rock mechanics analysis of the spacing required between the tunnels so that they will not affect each other with regard to stress. The question is being studied within SR-Site. Of the load cases being studied (earthquake, ice load during ice age, etc.), no case has emerged that could cause the repository itself to constitute a plane of weakness and thereby serve as a fracture initiator.

Account of alternative methods: *The Swedish National Council for Nuclear Waste notes that SKB has chosen in RD&D Programme 2007 not to discuss in any coherent fashion the possible merits of other alternatives than the KBS-3 method. SKB says that they will give an account of Deep Boreholes no later than in the application. The Swedish National Council for Nuclear Waste says that SKB's choice of method is of great importance for instilling confidence in SKB's work.*

2.132 Does SKB recognize the risk that its credibility may be damaged if the account is not perceived as being sufficiently thorough?

(SKB) We recognize the risk of presenting inferior material and our ambition is to provide a thorough account. If the KBS-3 method is to be compared with another method, the input data for both methods must be of the same quality and level. Since SKB has not found that any other method meets the requirements on a final repository for spent nuclear fuel, it has not been meaningful to gather data for a more thorough analysis and comparison.

Site selection: *The Swedish National Council for Nuclear Waste emphasizes the importance of making a scientifically correct comparison between the sites for the purpose of site selection. The Council believes that two SR-Site reports are required: one for Forsmark and one for Laxemar. SKB has said that site selection will not take place until SR-Site has been reported and that only one SR-Site will be reported.*

2.133 Comment: Östhammar Municipality says that this may be criticized later in the review of the application.

(SKB) It is our opinion that the material that was presented – "Final repository for spent nuclear fuel in Forsmark – basis of decision and reasons for site selection" – in conjunction with site selection was fully adequate for site selection. The SR-Site safety assessment is being compiled for the selected site. The licence applications will include an account of the comparative assessments of safety-related site characteristics that have guided site selection.

Site selection: *The Council is troubled by the fact that successful rock stress measurements performed so far in Forsmark are too few in number and uncertain at planned repository depth. The far-reaching conclusions drawn from the results can affect both site selection and the design and construction process, as well as in the longer term the durability of the repository. The Council considers it imperative that knowledge of the rock stresses, particularly at repository depth, be considerably improved before selection of a site.*

SKB comments: Although the number of successful rock stress measurements at repository depth is few, their potential size can be bounded by means of indirect methods. For example, it can be seen that the drill cores exhibit little "core disking" (cracking due to destressing) down to the deepest parts of the boreholes or about 1,000 metres depth. Similarly, there is no increased tendency towards borehole breakouts down to this

depth. The maximum values of the rock stresses indicated by these indirect methods pose no obstacle to construction and operation of the final repository. Reliable values of rock stresses are relatively simple to obtain when tunnels and shafts are driven down to repository level and measurements can be made of how the tunnels are deformed at this depth. Such measurements will be made during the tunnelling work.

2.134 Does SKB believe that its knowledge of the rock stresses in Forsmark is sufficient to make a credible site selection, or are you drawing much too far-reaching conclusions on a much too limited basis?

(SKB) We believe that the material that existed and was presented in conjunction with site selection was fully adequate.

Geosphere: *There are few credible results for rock stresses at 500 m depth in Forsmark. According to the Swedish National Council for Nuclear Waste, the rock stress measurements are somewhat contradictory and furthermore uncertain. This is a very troublesome situation for SKB. SKB intends to wait to obtain further information on the stress state in conjunction with the tunnelling work. Today the site has already been selected.*

2.135 What will the consequences be if the actual rock stresses deviate from the results measured thus far in Forsmark?

(SKB) Rock stresses increase with depth. High rock stresses cause pieces of rock to break off to a greater extent. It is therefore important to be aware of the rock stress, especially in the deposition holes.

We have analyzed several cases with higher and lower rock stresses that can be considered likely. In none of the cases can the consequences be seen to pose any obstacle to building and operating a final repository.

The safety assessment: *SKB gives the safety assessment a double role: an internal role as a management tool within SKB and an external role in society's licensing process. By "management tool", the Swedish National Council for Nuclear Waste means the role the safety assessment plays for SKB in the planning of research, technology development and further site investigations. In unfortunate cases the two roles can conflict with each other. For example, the safety assessment in its internal role for research planning aims at finding relevant weak points in the programme, while the safety assessment in its external role aims at showing that the repository meets the requirements.*

The Council stresses the necessity of handling the safety assessment in a transparent and quality-assured manner in SKB's entire organization.

2.136 How does SKB handle the possible conflict between the safety assessment's two roles?

(SKB) We cannot see that the safety assessment's two roles constitute a ground for conflict. The weak points that are identified will be highlighted and evaluated against the requirements for safe final disposal. SKB also makes great efforts to document in a traceable manner how the different parts of the safety assessment are reviewed.

The safety assessment: *The Swedish National Council for Nuclear Waste asserts that the safety assessment is a part of the body of material which the politicians need to examine themselves, instead of just accepting SKB's safety assessment and SSM's review of it as facts that cannot be questioned. For this reason the safety assessment must be transparent so it can be understood by laymen. If awareness of the nuclear power issue is not raised among laymen, the political decision process will be susceptible to manoeuvring and fragmentation (by "fragmentation" the Council means that the focus is put on certain isolated parts of the whole issue at the cost of the whole picture).*

2.137 How does SKB makes the safety assessment comprehensible to laymen?

SKB knows from experience that it is difficult to make something as complicated as a safety assessment comprehensible to laymen. But we will translate it to Swedish. Furthermore, SKB will arrange information meeting and seminars about safety assessment for the purpose of describing the work done and results in a comprehensible fashion.

SR-Site's working language is English to facilitate international review. The English version of SR-Site will be submitted together with the applications. When the English version is finished, the work of translating it to Swedish will begin. Working with both versions simultaneously would entail a great deal of extra work and a risk of errors in writing and final editing.

The environmental court requites all submitted documents to be in English. SSM accepts receiving SR-Site in English first and the Swedish translation a little later. It is the Swedish version that serves as a basis for licensing and that SSM will circulate for consideration and comment. The municipality will of course get access to the English version of SR-Site at the same time as SSM, if they wish.

Canister: *According to Szakalos et al., corrosion of copper via hydrogen evolution can take place even in pure, deionized, oxygen-free water at 73 degrees C. The researchers believe that their new results show that the corrosion properties of the copper canisters are not good enough and that the KBS-3 concept should be partially re-evaluated.*

The Swedish National Council for Nuclear Waste believes that it is now important that the new issue of copper corrosion in oxygen-free water be thoroughly investigated.

2.138 How is SKB handling this question?

In the upcoming safety assessment (SR-Site), SKB will both discuss the influence of the proposed corrosion mechanism and make renewed calculations (based on data from the site investigations). In order to obtain additional data for the safety assessment, studies are now being conducted to see whether the hypothesis can be confirmed in other ways. SKB is carrying out experiments (electrochemical studies) and theoretical calculations as well as measurements of copper corrosion in a repository environment, for example in the Äspö HRL.

SKB has looked at what the consequences would be if copper should corrode in oxygen-free water. We can conclude that there is so much hydrogen in the groundwater that corrosion does not occur. SKB has now calculated what this corrosion reaction would mean for the repository's safety and arrived at the conclusion that it is of no importance. If corrosion should nonetheless occur, it would proceed so slowly and to such a limited extent that it would not affect the repository's long-term safety. The bentonite clay prevents the hydrogen gas formed in the reaction from being transported away, and the reaction stops.

If the bentonite buffer were to disappear, the copper canister would be affected. However, the corrosion process described by the researchers at KTH would not be the most serious threat in this case, but rather corrosion caused by sulphide reactions. SKB's conclusion is thus that corrosion of copper in oxygen-free water, if it can take place at all, would occur so slowly and to such a limited extent that it would not affect the repository's long-term safety.

Östhammar Municipality's statement of opinion concerning RD&D Programme 2007

The application for the final repository will be submitted in 2010. Then KBS-3V will be the main alternative, but SKB is also investigating the KBS-3H alternative. Since the background material for the comparison between the two versions is not expected to be ready before 2012–2013, a safety assessment cannot be submitted together with the application.

2.139 When will SKB describe how the question will be dealt with?

SKB has chosen KBS-3 as the method for disposal of spent nuclear fuel, with KBS-3V as the reference design. This means that the canisters will be placed vertically in individual deposition holes. As a part of the ongoing work of optimizing the design, SKB initiated studies in the early 1990s of a variant with horizontal deposition of the canisters. This design is called KBS-3H, where several canisters are placed in series in a deposition hole. The concepts for KBS-3V and -3H are similar to a great extent; they are variants of the same method. However, KBS-3H might be a better alternative, for example simpler in terms of emplacement of the buffer.

In about one year SKB will make a decision as to whether it is meaningful to go further with KBS-3H and start a full-scale test. If such a test has a positive outcome, we will have to perform a safety assessment for KBS-3H. This work will not affect the timetable for the applications.

SKB's proposal for handling a possible switch from vertical to horizontal deposition will be presented briefly in the application's top document, in the appendix about the activity and the general rules of consideration, in the EIS and in the technical description.

The application documents should have such breadth that it would be possible to switch to horizontal deposition (KBS-3H) after review by the Swedish Radiation Safety Authority, without a new licensing review by the Government. The reason for this handling of the question is that the technology for horizontal deposition is promising, but not yet available at the time of application. From now on the research on KBS-3H will be presented in the RD&D programmes.

National interests and other planned repositories

2.140 Comment: From a municipal viewpoint it is important that plans for the area be completed in good time. The area around Forsmark is an area of national interest for final disposal of spent nuclear fuel and nuclear waste. Prior to the decision to establish the area of national interest in Forsmark, the building committee in Östhammar Municipality stated its opinion that it is of importance that the national interest cease to apply when a decision on siting is made and that the scope of the area should otherwise only include the area that may be considered for licensing. The municipality would therefore like to note that if SKB plans to build a repository for long-lived low- and intermediate-level waste, SFL, in Forsmark, it is urgent that this be made clear early on so that the size of the area of national interest can be adjusted.

(SKB) It is not clear where SFL (the final repository long-lived waste) will be located, but a siting at Forsmark would be suitable. If we can show that the rock is good (which we already know in principle) and that long-term safety will be good, Forsmark should be the best place. Whether it will in that case be deeper down below SFR, at the Spent Fuel Repository or somewhere else cannot be said at this time. We assume that the repository will be at a depth of at least 300 metres, possibly deeper.

We must make sure that SFL and the Spent Fuel Repository do not affect each other. SFL will contain a great deal of concrete and may not be located where it can affect the Spent Fuel Repository. We are not setting aside any particular site for it right now. SFL will not be finished and put into operation before around 2050.

The decision on the boundaries of the area of national interest for final disposal of spent nuclear fuel and nuclear waste in Forsmark should be regarded in a somewhat longer time perspective. As long as SFR and the Spent Fuel Repository have not been fully built out and the plans for SFL do not require it, it is preferable that no change be made in the area of national interest.

Observations

SKB has carried out a large investigation programme in the site investigations and at the Äspö HRL. Some results from the investigations may be difficult to use in risk calculations, at the same time as it is important to include qualitative results in the assessment as well.

2.141 How is SKB handling qualitative data in the risk assessments?

(SKB) We are handling it in the background material for the safety assessments. (The reply cannot be elaborated on at our meeting.)

When models are made of the rock and its properties, the results of the modelling may sometimes conflict with actual observations.

2.142 How does SKB handle such conflicts?

(SKB) As far as conflicting facts are concerned, we work iteratively, and the contents of the site descriptive model have emerged from consensus. In cases where results point in the other direction, this is handled as an uncertainty.

The basic principle is that conservative (cautious) assessments are made in cases where there is a lack of knowledge or conflicting data. This ensures good margins. As knowledge and experience are accumulated, the assessments can be made less conservative.

Climate, biosphere, radionuclide transport

2.143 Comment: At the present time it is uncertain what the climate will be like in a 100,000 year perspective. Many factors influence what conditions will be like at a final repository. Climate models at the site investigation localities show possible evolutions of e.g. the biosphere under different climatic conditions and thereby provide a picture of how radionuclides can be transported to and through the biosphere. We believe it is important to include different local climate scenarios that cover variations in temperate climate conditions (e.g. dry or rainy) and link them to radionuclide transport through the biosphere.

(SKB) SKB has identified three climate domains of importance for the performance of the repository:

- Temperate domain
- Permafrost domain
- Glacial domain

We are therefore focusing our research efforts in the climate field on identifying and understanding conditions and processes within these climate domains. SKB's approach is to first construct a main scenario that shows how the different climate domains succeed each other during a glacial cycle, i.e. a period of about 100,000 years.

Based on the evolution in the main scenario and on our knowledge of the repository's performance and safety, a number of other scenarios are selected in a structured manner. The other scenarios cover all possible situations where climate-related processes affect the performance of the repository but are not covered in the main scenario. These scenarios contain alternative site-specific climate evolutions that may describe more extreme climates than in the main scenario.

Water flows in conjunction with ice sheets have been identified as an important field of research for repository safety. One question that has not been investigated is compression of the pores and fractures in the rock. An ice sheet will compress the pores and fractures in the rock. This could cause water in the rock to be pressed out towards the edge of the ice when the ice sheet advances. When the ice sheet retreats, water will be sucked into the formerly compressed rock, which can lead to increased water flows in the rock. As a consequence of the fact that oxygenated water enters the rock, there may be increased corrosion of the copper canisters.

2.144 Will SKB study compression of pores/fractures?

(SKB) No, since it doesn't affect the safety of the repository.

Buffer and backfill

The functions of the buffer and the backfill are very important for safety in a final repository. It may be difficult for SKB to study experimentally how bentonite reacts under long-lasting conditions in a new environment.

2.145 Has SKB planned field investigations of e.g. bentonite that has undergone glaciations?

(SKB) No, all bentonite is already old and has undergone glaciations.

SKB states in RD&D Programme 2007 (page 321 of the English version) that the backfill in itself is not a barrier, even though it is deemed important for preventing water transport in tunnels and ventilation holes. The tunnel from the ground surface to the repository, as well as the ventilation holes, could be a potential pathway for water transport to and from the repository.

2.146 Should the backfill be regarded as an individual barrier from a risk perspective?

(SKB) The backfill in the tunnels does not in itself constitute a barrier in the KBS-3 concept. It is, however, necessary in order for the buffer and the rock to have the desired function and is regarded from that aspect in the safety assessments.

The water flows in Forsmark are high in the upper layer of the rock. The depth with tight rock down to repository depth decreases with increasing depth of fractured rock.

2.147 Is the remaining depth with tight rock, between the fractured rock and the repository, sufficient as a safety margin against future water penetration?

(SKB) Yes, the depth of rock with low permeability above the repository is sufficient to ensure the long-term safety of the repository.

Groundwater flow

Knowledge of groundwater flows in the rock is one of the most important components in the safety assessment. Low water flows in the rock are linked to tight rock with few fractures. The smaller the groundwater flows, the less the risk that backfill and clay buffer will be damaged. Damaged clay buffer can in turn lead to corrosion of copper canisters. Measurements have been made of both groundwater flows and groundwater chemistry during the site investigation phase. From the water chemistry, estimates have been made of the water's age, which gives an indication of how fast the water moves in the rock. Old water indicates a low water flow rate, while young water indicates a higher water flow rate. The age of the water has not been used in water flow modelling in the SR-Can safety assessment.

2.148 Does SKB intend to use the age of the water in the modelling of water flows in the SR-Site safety assessment?

(SKB) Now, we don't intend to use the age of the water in the modelling of water flows. The water has moved in the rock over long periods of time. Since young and old water have been mixed, the age of the water doesn't say anything about how fast different substances can be transported with the flowing water.

Reactivation of old fractures

An important parameter in the safety assessment is the possible occurrence of earthquakes. Major earthquakes are easiest to observe in disturbances in soil layers and movements of rock fractures. SKB has conducted Quaternary geological studies in areas around Forsmark and Laxemar to determine whether earthquakes occurred during the last deglaciation. Further knowledge could improve the risk calculations compared with current analyses.

2.149 Does SKB intend to conduct further Quaternary geological investigations in a larger study area?

(SKB) Over a period of three years, SGU has conducted extensive Quaternary geological studies in Forsmark and Northern Uppland to trace possible disturbances in soil layers caused by large earthquakes. Their conclusion is that no major earthquakes (magnitude 7 or more) have occurred since the end of the last ice age. No further studies are planned by SKB. In the safety assessment it is nevertheless assumed that earthquakes may occur in the future. The repository is therefore being designed so that the risk that it will be damaged by an earthquake is very small.

The LILW programme and decommissioning

2.150 Comment: It is good that SKB has improved its reporting of the LILW programme since RD&D 2004. Kävlinge Municipality has expressed viewpoints concerning the fact that Barsebäck be dismantled earlier than planned in 2020. The Swedish Radiation Protection Authority has made the judgement that dismantling can be started earlier. An earlier start of dismantlement may mean that an SFL repository can be built earlier than SKB has planned. If there are valid arguments for siting the SFL repository in Östhammar Municipality, it is necessary that such plans be presented as soon as possible. It is important for the municipality to understand early the combined consequences of transport etc. if several facilities are sited in the Forsmark area.

(SKB) This sounds like a misunderstanding. "Immediate" dismantlement does not affect the timetable for SFL. The time for dismantlement of Barsebäck will not affect when SFL can be built or commissioned. What is referred to is probably the extension of SFR to be able to receive decommissioning waste. There the plans are fixed, and we expect to have the repository in regular operation by 2020. Even this is a rushed timetable that will not tolerate much delay in the application for the Spent Fuel Repository, or in the regulatory authority's handling of the application to extend SFR. When SFR is extended it will also be ensured that SFL waste can be interim-stored in SFR.

Transparency in the decision process

2.151 Comment: We believe that a Government decision must be founded on the attitude that long-term safety is the most important factor. SKB frequently says that safety may prove to be equally good at two sites and that other criteria will then influence the decision.

For the two site investigation municipalities in particular, it is a question of credibility that the criteria for site selection be explained openly and by no later than when SKB officially announces the site they intend to apply for. There may be no doubt that the safety of future generations should carry the greatest weight. After this, environmental and health aspects should also weigh heavily. Economic arguments can only be accepted in the very last instance.

(SKB) The site has been selected and is based on a document – "Final repository for spent nuclear fuel in Forsmark – basis of decision and reasons for site selection" (available on SKB's website) – that clearly shows that long-term safety has been the most important factor.

Best available technology

2.152 Comment: The municipality thinks that the Environmental Code's definition of best available technology should permeate the project and that it is important that a licensing decision be made in such a way that progress in the fields of technology and safety is put to use even after a licensing decision has been made.

(SKB) An important principle in the final repository project is the use of best available technology, or BAT. The Environmental Code's general rules of consideration in Chapter 2 require the use of BAT. We will explain how the requirements are met in the applications.

After the applications have been submitted, SKB will continue with its research and development work. The purpose is to make use of new technological developments. This is a guarantee that the latest knowledge at any given time will always be used. The research and development that is planned to be conducted up until 2020 is very ambitious. SKB does not believe the coming development work will lead to other methods and other materials, but that it will continue to refine the methods and materials that are intended to be used today.

In this context it can be noted that SKB is already conducting research pertaining to existing facilities that are in operation, for example measurements and calculations of the content of various radionuclides (the radionuclide inventory) in SFR, including the quantity of carbon-14. Carbon-14 is one of the nuclides that must be modelled in scenarios for future releases from SFR, since it gives a dominant dose contribution in a future probable scenario. In order to model future releases of carbon-14 from SFR, satisfactory data on the carbon-14 inventory are needed. The nuclide is difficult to measure in the operational waste, and the quantity (the inventory) has previously been calculated via correlation factors based on cobalt-60. The correlation factors are associated with large uncertainties. Being able to measure carbon-14 directly in the ion exchange resins is therefore of great importance for obtaining reliable data. A new method has been developed where both organic and inorganic carbon-14 can be measured in the ion exchange resins and in the process water systems.

2.153 What would happen if there were no barriers?

(SKB) At the consultation meeting with Östhammar Municipality on 30 September 2009, the municipality expressed a wish for a description of what would happen if there were no barriers in the final repository. What would the release curves look like then? The SR-Can safety assessment contains a number of analyses of cases where barriers are lost. These analyses, along with the main scenario in SR-Can, are presented below.

Overall requirements from the Swedish Radiation Safety Authority (SSM)

In its guidelines, SSM says that the time scale for a safety assessment for a final repository for spent nuclear fuel should cover a period of one million years after closure. The guidelines also state that the risk criterion is applicable up to about 100,000 years after closure.

The main scenario

Two risk contributions have been identified for the first glacial cycle, which is expected to last up until 120,000 years after closure: earthquakes and canister failure due to corrosion, if the buffer has been eroded by glacial meltwater. A few canisters are expected to be damaged due to corrosion during the first glacial cycle. The maximum value of the total calculated risk up to 100,000 years, i.e. the value at 100,000 years, lies close to the Authority's risk limit for Laxemar and about two orders of magnitude lower for Forsmark. The overall result from SR-Can is thus that the calculated risks for both Forsmark and Laxemar meet the Authority's requirement regarding the first glacial cycle after repository closure.

Loss of barriers

(Section 6.12 in R-07-24 /1/.)

This chapter is taken from the simplified Swedish summary of SR-Can /1/.

According to SKIFS 2002:1, the safety assessment should "include sequences of events and conditions that are selected and studied independently of probabilities in order to shed light on the importance of individual barriers and barrier functions".

Former SSI's guidelines state the following: "For repositories primarily based on containment of the spent nuclear fuel or nuclear waste, an analysis of a conceivable loss of one or more barrier functions of key importance for the repository's protective capability during the first thousand years after closure should be made separately and independently of the risk analysis. The purpose of such an analysis should be to clarify how the different barriers contribute to the protective capability of the final repository".

These requirements are a suitable point of departure for the formulation of cases to illustrate barrier functions. In general, no loss of key functions was expected to occur during the first thousand years in the reference evolution. These cases are thus purely illustrative with respect to the repository's safety. Since there is no special point in time during the first thousand years when it is more probable that a loss of function will occur, the cases are based on the assumption that the loss occurs initially, i.e. barrier defects that exist at the time of deposition.

The following cases of barrier defects have been analyzed:

- A big opening in the copper shell at closure of *the repository for all canisters*.
- An absence of buffer material, sufficient to render the buffer incapable of preventing groundwater flow through the deposition hole on closure of the repository and *for all deposition holes*.
- A combination of the above two cases, i.e. a large opening in all canisters and absence of buffer *in all deposition holes* at closure of the repository.

Each of the three cases is being studied with and without allowing for the bedrock's ability to retard radionuclides, resulting in a total of six release situations.

The most pessimistic of the three hydrogeological models for Forsmark has been used for these stylized calculations. This choice is adequate, since the results are used to set limits for the possible consequences of these posited failures.

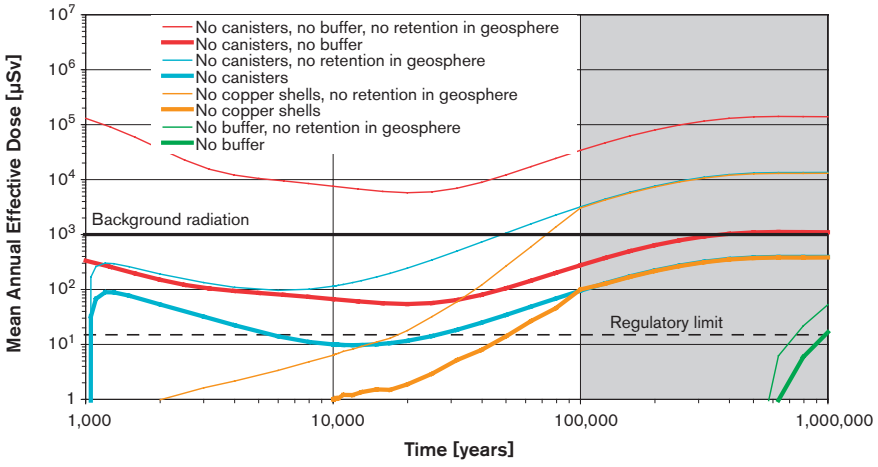
Results and discussion

The results of the defined cases are shown in the figure on this page. The thick red curve shows what happens if the fuel lies naked in the rock.

No copper shells

In this case, the primary safety function has been lost, which eventually has considerable consequences. The cast iron inserts are assumed to remain initially and retard the releases. The doses are dominated by radium-226, a naturally occurring radionuclide. However, it is worth noting that the calculated consequences for this stylized case are less than those caused by the background radiation. If the retarding capacity of the bedrock is also neglected, the consequences increase by roughly one order of magnitude.

Results of stylized cases to illustrate barrier functions. "No canisters" means that both the copper shell and the cast iron insert were defective from the start.



Results of stylised cases to illustrate barrier functions. "No canisters" mean that both the copper shell and the cast iron insert are initially defective.

No copper shells and no cast iron (no canisters)

This case resembles the above case, but with an earlier start of radionuclide releases. After 100,000 years the two cases are identical, since all inserts in the first case are then assumed to have penetrating breaches.

No buffer

In this case, canister failure only occurs in a few (ten) deposition holes, namely the ones where the groundwater flow transports such a large quantity of corrosive substances to the canister that corrosion causes breaches. The doses at the end of

the analysis period are around two orders of magnitude lower than the background radiation and increase by less than a factor of ten if the retarding capacity of the bedrock is neglected.

No canisters and no buffer

In this case, it is assumed that groundwater can flow unhindered through all deposition holes and that all canisters (both copper shell and cast iron insert) are defective. Consequently, two of the key barriers have been lost in all deposition holes. Only the slow dissolution of the fuel and the bedrock's retarding capacity are able to limit the consequences. The consequences in this case are comparable to those of background radiation. The results further show that the retarding capacity of the bedrock plays a more important role in this case. Neglecting the retarding capacity of the bedrock increases the doses by around two orders of magnitude.

This is a significant result. Despite the fact that all canisters and all buffer are assumed to be lost right from the start, the consequences are not worse than those caused by background radiation. Furthermore, the calculated doses increase only insignificantly after a million years, as long as the bedrock is stable and the biosphere resembles that during a period with temperate climate. This is because all canisters have already failed and the only factor leading to increased releases is continued fuel dissolution.

Conclusions

These analyses clearly demonstrate the multiple barrier function of the KBS-3 system. In the unrealistic case of total initial failure of canister and buffer, for example, Figure 2 clearly shows the importance of the bedrock. Similarly, if we unrealistically neglect the buffer but keep the canister and the bedrock, the buffer in particular has little effect, even though the buffer in itself is sufficient to keep the doses below those from the background radiation for nearly 100,000 years.

In summary, it has been shown that completely unrealistic illustrative hypotheses of early failure of all canisters and all buffer material lead to long-term consequences that are comparable to those of natural background radiation.

It should also be noted that the values used to convert releases to doses are designed to reflect the worst possible exposure situation during a period of temperate climate. For most of the analysis period of a million years, these dose conversion factors are expected to be lower.

Reference

1. Långsiktig säkerhet för slutförvar för använt kärnbränsle vid Forsmark och Laxemar – en första värdering. Förenklad svensk sammanfattning av säkerhetsanalysen SR-Can. R-07-24, Svensk Kärnbränslehantering AB, in Swedish only.

3 Common issues

No questions were posed that were common to the interim storage facility, the encapsulation plant and the final repository.

Meeting with County Administrative Board in Uppsala County

Date	27 January 2010
Time	09:00–12:00 hrs
Place	Assembly Hall, County Administrative Board in Uppsala County
Target group	County Administrative Board in Uppsala County
Invitation	The meeting was initiated by the County Administrative Board
Background material	Preliminary environmental impact statement (EIS), which deals with environmental aspects associated with construction, operation and decommissioning of the encapsulation plant and the final repository and transport to and from these facilities. The EIS contains descriptions of the impact, effects and consequences expected to occur. Measures planned to mitigate the consequences are also described. The material was prepared in the autumn of 2009 and reflects the state of knowledge at that time. The purpose of the preliminary EIS is to provide some idea of the aggregate environmental consequences and to allow viewpoints to be expressed on its disposition, scope, contents and conclusions. The material was posted on SKB's website on 21 December 2009.
Purpose	The County Administrative Board wanted to provide an opportunity for as many representatives as possible from the concerned functions to participate in the consultation on the preliminary EIS.
Present	County Administrative Board: *Göran Cederholm, Mona Åkerström, Sara Andersson, Lars Andersson, Mikaela Öster, Kalle Mälson, Åsa Eriksson, Lars Johnsson* and *Mats Lindman*. Östhammar Municipality (observers): *Peter Andersson, Marie Låås (Environment Office)* and *Jonas Christensen*. SKB: *Erik Setzman, Mikael Gontier, Bengt Leijon, Pia Ottosson, Kent Werner, Lars Birgersson* and *Sofie Tunbrant*.

1 Interim storage facility and encapsulation plant

No questions or viewpoints were expressed pertaining solely to the interim storage facility or the encapsulation plant for spent nuclear fuel.

2 Final repository

2.1 Is there room in Forsmark for large quantities of waste, in the event of an expansion of nuclear power? (Östhammar Municipality)

(SKB) SKB has investigated the area in question in Forsmark for the purpose of disposing of 12,000 tonnes of spent nuclear fuel, equivalent to 6,000 canisters. There may be room for additional waste, for example on a second level, but this possibility must be investigated.

2.2 Is it possible that a site for another final repository might be needed in the future? (Östhammar Municipality)

(SKB) Yes, it's possible. But if additional disposal space is needed, we will first explore the possibility of expanding the capacity of the final repository we plan to build now.

2.3 Will the final repository be built beneath the surface of both the ground and the sea? According to the maps included in the background material on water operations, most of the repository will be built beneath the ground surface, but a substantial portion will be located beneath the sea. Is this correct? (Östhammar Municipality)

(SKB) The repository layouts shown in the figures should not be interpreted too precisely. The exact layout will be determined as the detailed characterization furnishes information on what the rock looks like.

2.4 Doesn't locating parts of the final repository beneath the Baltic Sea violate the Baltic Sea Convention? (Östhammar Municipality)

(SKB) SKB will build a repository in the bedrock that may extend beneath the surface of the Baltic Sea. It will be accessed from land, which means it will comply with the Baltic Sea Convention. SKB will not dump any waste in the Baltic Sea, which would violate the convention.

2.5 It would be good to have a summary of the contents of the reference reports in the EIS and a more detailed account of SKB's strategies and choices. There is no argumentation regarding SKB's conclusions. (County Administrative Board)

(SKB) The EIS contains summaries of the contents of the reference reports, for example how method and site have been selected. But there is no argumentation. It can be found in other documents included in the applications. We have tried to limit the scope of the EIS, but we will take another look at this.

2.6 The EIS has a scope of about 350 pages, but deals with several different facilities and activities. This is not a lot of space for each activity. Which material is the subject of consultations? The EIS does not explain how SKB has arrived at its conclusion, but this is done in background reports. Are these the subject of consultations? Do not underestimate what information the readers want to find in the EIS. (Östhammar Municipality)

(SKB) SKB notes these viewpoints.

2.7 If an accident should occur in the rock cavern leading to a release of radioactivity, what will happen then? Will radioactivity be vented out? (Östhammar Municipality)

(SKB) SKB has not been able to identify any scenario – whether during normal operation, disturbances or mishaps – that could lead to a release of radioactivity from the final repository.

2.8 Blasting tunnels may require consultations, just as this is necessary in conjunction with mining. It is the County Administrative Board that convenes such consultations. (County Administrative Board)

(SKB) We have not come so far in our planning yet, but note the procedure.

2.9 How can SKB guarantee that the canister will not simply break apart at some time in the future? It is difficult to make categorical claims in view of the long time perspective, uncertainties etc. (Östhammar Municipality)

(SKB) The consequences of a canister breaking apart are not dealt with in the EIS, but they are in the safety assessment, SR-Site. Possible future geological scenarios are analyzed there, such as ice ages, earthquakes etc., and what effects they might have on the final repository.

2.10 If the assumed geological conditions should change in the future, is it possible to retrieve the canisters and move them?

(SKB) It is possible to retrieve canisters that have been deposited, but this will involve a great expenditure of resources. The principle is that the spent nuclear fuel will be disposed of in a safe manner that does not require monitoring or controls. Future generations should not be burdened with responsibility for the repository, but they must be able to retrieve the canisters if they wish to find a better solution.

2.11 Can it be said that the spent nuclear fuel will be placed in a final repository when it will in fact be retrievable?

(SKB) Yes, the spent nuclear fuel will be disposed of in such a way that monitoring or controls are not necessary.

2.12 How large is the impact area? 3–4 kilometres?

(SKB) It is estimated that the pressure in the bedrock 50 metres beneath the sea will be lowered in an area of about 25 square kilometres. The groundwater table will be lowered within an area of roughly one square kilometre.

2.13 Does any experience of groundwater lowering exist from mines? Have the calculations that have been done subsequently been verified? Has there been any follow-up of how well the models agree with reality?

(SKB) Unfortunately, as far as we know, no systematic comparisons have been made between calculations/predictions and actual outcomes.

2.14 Groundwater lowering has been calculated with various models. How well do the results of the different models agree?

(SKB) Groundwater lowering has been calculated with independent models. The results are similar. Groundwater lowering will be followed up in the monitoring programme.

2.15 In the calculations it has been assumed that the entire repository is open simultaneously. In reality only a part of the repository will be open at a time. How does this affect the calculations?

(SKB) Basing the calculations on the assumption that the whole repository is kept open is a conservative assumption that overestimates the lowering of the groundwater level. We have also carried out a number of calculation cases where only certain parts of the repository are open. These calculations show similar patterns regarding where the lowering of the groundwater level will occur, but different magnitudes of the drawdown.

2.16 Have you looked at a worst case scenario for groundwater lowering? How extensive can it be?

(SKB) We have in fact analyzed a kind of worst case, since we have assumed that the whole repository is open simultaneously and that the grout has relatively high permeability.

2.17 When the shaft passes heavily conductive fracture zones, they need to be sealed. How will this affect groundwater lowering?

(SKB) Since water-conducting zones will be sealed, groundwater lowering will be less, but the pattern will be the same.

2.18 Has the method for grouting been determined?

(SKB) The concept has been developed, but the exact method and grout have not been determined. A cementitious grout will probably be used, augmented with fine sealant if needed.

2.19 SKB plans to pass the heavily conductive zone where it is narrowest. Why go down there? Aren't flow and pressure greatest where the zone is narrowest?

(SKB) That's not necessarily true. Different parts of a fracture zone can have different transmissivity. Nor should it be viewed as a water-conducting fracture zone. Fractures with high transmissivity occur within a depth interval in the upper parts of the rock. Passing through where this depth interval is shortest means that the section that can cause problems is shortest.

2.20 When will SKB's forest management plan be ready?

(SKB) It will be ready in the spring.

2.21 In conjunction with the consultations held with the County Administrative Board regarding exemption from the Species Protection Ordinance, it is important to note that the County Administrative Board shares its knowledge and that it is SKB that comes up with suitable proposals for solutions to limit the impact.

SKB concurs entirely.

2.22 SKB intends to create new ponds for the pool frogs. Do these ponds have to function as intended before an exemption can be obtained from the Species Protection Ordinance?

SKB plans to submit an exemption application in the spring or summer of this year. At this time a timetable for the continued work will be discussed with the County Administrative Board. In general it can be said that the measures that will be adopted, e.g. creation of new ponds, must be in place and be shown to work before any impact occurs from the final repository.

2.23 Have you figured on the possibility that the exemption ruling may be appealed? How would that affect the timetable for creating the ponds?

(SKB) It is difficult to say how much an appeal would delay the timetable, but the application process for the final repository will take several years, so there is time for delays in creation of the ponds.

2.24 How long will it take before you know that the measures are working?

(SKB) It won't take very long, maybe 1–2 seasons.

2.25 Choice of site and method and matters of nuclear safety are crucial, but are not fully dealt with in the EIS. There may be criticism of this.

(SKB) The EIS presents the results of the site investigations in Forsmark and Laxemar fairly exhaustively, along with the reasons for the choice of Forsmark as the site of the final repository.

2.26 Besides these sites, another six sites have been investigated. How suitable are these sites with respect to long-term safety?

(SKB) Data on the bedrock are available from the study site investigations. No bedrock investigations were conducted within the framework of the feasibility studies.

2.27 SKB should draw conclusions from the data that are available. Why were Forsmark and Laxemar chosen for site investigations? This should be explained in the EIS.

(SKB) A summary of the siting work is provided in the EIS. A more detailed account will be given in another appendix to the applications. The EIS is not intended to be argumentative. SKB will consider expanding the description of the siting work and the site selection process in the EIS.

Discussion of account of site selection

The County Administrative Board pointed out that the EIS should include a description of how the best site and method were chosen. This can be done in an appendix, but should also be explained in brief terms in the EIS. SKB asked whether the ten-plus-page description of the siting and site selection process contained in the EIS is not sufficient. The County Administrative Board expressed a wish for a summary assessment in the EIS in addition to this description, preferably in the form of a table.

3 Common issues

3.1 Is the safety analysis report a part of the EIS?

(SKB) No, it is not a part of the EIS, but is included as an appendix to the applications under both the Environmental Code and the Nuclear Activities Act.

3.2 The preliminary EIS refers to reports that have not yet been published. When will these be available? It would be good if they could be made available as soon as possible, since they are important for being able to assess the contents of the EIS.

(SKB) All reports referred to in the EIS will be available when the applications are submitted. The reports will be posted on SKB's website as they are printed. However, we would like to emphasize that the consultation is about the EIS, not SKB's reports.

3.3 Where will safety issues be described?

(SKB) Long-term (post-closure) safety is described in the SR-Site safety assessment. Safety during operation (pre-closure safety) is described in preliminary safety analysis reports (PSARs) for the different facilities. These descriptions are included in the safety analysis report that is an appendix to the applications, under both the Environmental Code and the Nuclear Activities Act.

3.4 Perhaps the greatest detriment with the final repository for ordinary people is psychological detriment, i.e. fear. Fear is a disturbance in itself, which should be taken into account in accordance with the Environmental Code. A description of the disturbance caused by fear should therefore be added to the EIS.

SKB has done studies regarding psychosocial effects, which is described in the EIS. It is difficult to quantify the disturbance satisfactorily, since it has to do with personal perception. However, SKB will review the relevant section of the EIS to see whether it is possible to expand the description.

3.5 Despite the fact that it is difficult to quantify psychological detriment, it is important to express oneself clearly. Ordinary people are afraid of radiation. It is therefore better to

say too much about this in the EIS than too little, otherwise it might appear as if SKB is hiding something. For the same reason, SR-Site should be included in the EIS.

(SKB) That is a question of balance. We want to be more open about looking at aspects such as anxiety, fear etc., and this is a real issue. But it would be strange if too much were said in the EIS about something that does not pose a great risk, for example release of radioactivity from the final repository.

3.6 Maybe it would be good not to be so categorical in your formulations. Can you really claim that there are no radiological consequences whatsoever? It is important to find a good formulation, for example "radiological consequences of major importance".

(SKB) SKB has not found any scenario during the operating period where radioactivity could be released. A mishap could lead to radiation dose to personnel and is an occupational safety issue.

3.7 Are there any inventory lists in the EIS?

(SKB) No, but the EIS will contain references to reports with e.g. lists of natural values.

3.8 When will these appendices be available? At the time of the applications? Or earlier?

(SKB) They will be available by the time the applications are submitted. We will post them on SKB's website as soon as they are reviewed and printed.

3.9 Will the County Administrative Board need to decide whether to issue an exemption from the Species Protection Ordinance before these appendices are ready?

(SKB) The information needed to make a decision according to the Species Protection Ordinance will be available to the County Administrative Board when a decision is to be made.

3.10 Is the SFR included in the EIS?

(SKB) No, the EIS does not cover SFR. The planned extension of SFR is dealt with separately, via a separate application and EIS.

3.11 Discussion of account of radiation protection and safety matters

Östhammar Municipality said that radiation protection and safety issues are not adequately illuminated in the EIS. The licensing of Ringhals showed that these matters need to be described in detail in order to avoid a reprimand. The County Administrative Board is critical of the lack of a description in the EIS of how SKB arrived at the conclusion that radiation safety is not a problem.

SKB stated that radiation protection matters should be dealt with in the EIS, in accordance with the Environmental Code. However, the EIS will deal with significant impacts and consequences of the applied-for activity, and radiation will not give rise to any such impacts and consequences, which will be shown by the safety analysis report. Nevertheless, SKB will consider the wishes for an expanded description of radiation protection and safety matters in the EIS.

The County Administrative Board said that the EIS should not limit itself to saying that SKB "clears the bar", but also explain SKB's arguments for this.

3.12 The EIS should contain a description of what will happen if the final repository project is delayed. Could it be necessary to further expand Clab?

(SKB) If the project is delayed, it is possible to store additional spent nuclear fuel in Clab, for example by using compact storage canisters. Another possibility is that the fuel that does not fit in Clab could be interim-stored dry.

3.13 Discussion of best available technology and reprocessing

SKB said that the arguments showing that the best available technology (BAT) will be used will be given in an appendix to the applications, "Verksamheten och de allmänna hänsynsreglerna", ("The activity and the general rules of consideration"). As far as partitioning and transmutation is concerned, the technology is not available today. Another 50 years of research and development is estimated to be needed, and transmutation requires new nuclear power reactors. Even if the waste were transmuted, residues remain that must be disposed of. Thus, partitioning and transmutation does not solve the waste problem. Östhammar Municipality noted that reprocessing of spent nuclear fuel is being done in some other countries. SKB replied that Sweden has decided against reprocessing in favour of direct disposal of spent nuclear fuel. However, SKB is following the development of the reprocessing technology within the framework of its RD&D work.

The County Administrative Board said that in their decision on significant environmental impact in conjunction with the early consultation for the final repository they found that there was not sufficient reason to require a special account of "similar ways of achieving the same purpose", according to Chapter 6, Section 7, second paragraph of the Environmental Code, when alternative designs are presented in the environmental impact statement. The reason given by the County Administrative Board for this judgement is that the possibility of utilizing the spent nuclear fuel as a resource for the production of electric power is not realistic, given Swedish policy and legislation bearing on nuclear activities. Such use would require reprocessing and possibly also new nuclear installations.

Public meeting in Östhammar Municipality, theme water operations	
Date	6 February 2010
Time	11:00–12:00 hrs
Place	The Storbrunn cinema, Klockstapelsgatan 2, Östhammar.
Target group	Concerned parties.
Invitation	The meeting was advertised locally in Upsala Nya Tidning (9 and 30 January), Östhammars Nyheter (9 and 30 (January), Annonsbladet (13 January and 3 February) and Upplands Nyheter (15 January and 5 February). The advertisements also announced the consultation on the preliminary EIS. The meeting was also advertised (16 January) for national coverage in Dagens Nyheter, Svenska Dagbladet, Sydsvenska Dagbladet, Göteborgs-Posten, Västerbottens-Kuriren and Post- och Inrikes Tidningar (the Swedish Official Gazette). Written invitation to concerned parties.
Presentations	The meeting was preceded by presentations where Kent Werner presented the water operations that are planned in conjunction with construction and operation of the final repository for spent nuclear fuel in Forsmark.
Present	About 55 persons. Private citizens and concerned parties: Six persons. Representatives from: *Östhammars Municipality, MKG, Milkas, SERO, Åland's National Association for Nature and Environment (ÅNOM), the Baltic Sea Region Radioactivity Watch (BSRRW)* and *the European Committee on Radiation Risk (ECRR), Baltic Sea Regional Office.* SKB: *Erik Setzman, Kent Werner, Saida Laârouchi Engström, Mikael Gontier, Bengt Leijon, Olle Olsson, Magnus Westerlind* and others.
Moderator	*Ulf Henricsson.*
Minutes checker	*Marie Berggren.*

Questions and answers from the consultation meeting are given below. A compilation of written questions and viewpoints received within the framework of this meeting is presented separately: "Compilation of written questions and viewpoints and SKB's replies", page 161. The compilation includes the questions and viewpoints received in conjunction with consultations on the preliminary EIS and water operations in Östhammar Municipality (6 February) and Oskarshamn Municipality (9 February).

1 Interim storage facility and encapsulation plant

No questions or viewpoints were expressed pertaining solely to the interim storage facility or the encapsulation plant for spent nuclear fuel.

2 Final repository

2.1 Will radiation be measured in the water that flows into the underground facility and is subsequently pumped up?

(SKB) Samples will be taken of the water. (Clarification not given at the meeting: Samples will be taken of the water, but they do not include measurement of radioactivity.)

2.2 Rock spoil will be extracted from SFR in conjunction with the planned extension. Moreover, Vattenfall plans to build five wind turbines on the pier. Is movement of rock spoil included in SKB's planning?

(SKB) Yes, we are looking at the possibility of coordinating the rock handling. We don't know if it will work, but it is included in our planning. We are having discussions with Vattenfall concerning the planned wind farm.

2.3 If SKB moves rock spoil from the pier, could that affect the wind turbine project?

(SKB) We have no answers at this time, but we are aware of the question, which is included in our discussions with Vattenfall.

2.4 I have a drilled well and am interested in what I need to do so that we do not lose our water supply. If anything disrupts supply of water in the well, it could take a long time – several years – to restore it. Will the situation be monitored so that our water supply is always guaranteed? (Concerned party)

(SKB) We see no problems with the small number of wells that may be affected. We will naturally keep track of the situation in the wells by taking water samples and measuring groundwater levels. In the unlikely event the water in the wells should be affected, we will be prepared and measures will be taken relatively quickly. It will not have to take several years to restore the water supply in the wells.

2.5 SKB has said that 1–1.5 million tonnes of rock will be blasted out. This means that large quantities of explosive, about 13,000 tonnes according to my calculations, will be used, causing large quantities of nitrogen to be discharged. How much nitrogen will be discharged into the environment? Will it be processed in the sewage treatment plant?

(SKB) Both the EIS and the appendices report how much nitrogen waste is generated by the blasting work. Most will end up in the leachate from the rock heap. The leachate will be conducted to a broad irrigation area located within the rock heap area. The water will be recirculated several times before it is conducted to the fen area adjacent to Tjärnpussen for further nitrogen removal. From Tjärnpussen the water will be discharged to the cooling water channel.

(Clarification not given at the meeting: The water management system is described in brief terms in the appendices on water operations. There it is noted that the drainage water and leachate will contain nitrogen, although no quantities are given.)

FKA plans to build a new sewage treatment plant near Tjärnpussen. SKB intends to conduct its waste water (sanitary sewage) from toilets, showers etc. in the operations area for the final repository to FKA's new treatment plant. The waste water contains phosphorus, among other things.

2.6 Using a broad irrigation area can be difficult in the winter, since nitrogen breaks down slowly when it's cold.

(SKB) Leachate will mainly arise during rain and snow melting, periods when it is relatively warm. The quantity of leachate will be small during the coldest period.

2.7 The extent of the final repository towards the Forsmark NPP is shown in different illustrations. In some illustrations the final repository is depicted as lying beneath Forsmark 1. In other illustrations this is not the case. What is the true situation?

(SKB) The illustration that showed the greatest extent of the final repository, where part of the repository lies beneath the Forsmark NPP, illustrates the maximum extent of the repository when reserve areas have also been utilized. This is the extent on which the calculations of groundwater impact have been based, so as not to underestimate it.

2.8 SERO submitted a written petition entitled "SERO's view of water operations at Forsmark 6 Feb. 2010", and highlighted the following questions and viewpoints:

- **The site selected for the final repository is suitable in view of the fact that the area is already contaminated. Radioactivity in the area is extremely high, and using already contaminated areas for future repositories can be regarded as smart.**
- **The high radioactivity in the water offshore of Forsmark and the radioactivity in the land area around Forsmark will release radioactive substances in connection with dewatering of the land.**
- **Excavation and excavation spoil will, via water drainage and runoff, transport radioactive substances from the land to the offshore water area.**
- **Removal of shot rock from the pier will take place in an area that is contaminated with cesium-137, among other nuclides. The pier may therefore not be touched.**
- **Bridges and transport across the intake channel for cooling water are highly unsuitable, in view of the risk of accidents or sabotage.**

(SKB) SKB received the communication, see Appendix C. For SKB's reply and comments, see Appendix A. (The appendices are included in the minutes of the meeting.)

2.9 There are high natural values in the area where the final repository's surface part is planned to be located. Three ponds will be affected, among other things. Has SKB considered locating the surface part somewhere else to avoid impacting the ponds?

(SKB) Different locations of the operations area have been studied, but it is the properties of the rock that have dictated the location. Shafts and ramp should be built where it is easiest to pass through the bedrock, with a view to water-conducting areas. How the buildings will be located in relation to each other is determined by the activity to be pursued.

2.10 The final repository will be situated near the water and not particularly high above sea level. Will a future sea level rise affect the facility?

SKB has taken a future rise in the sea level into account in determining the location of the final repository. The facility will not be affected by a future sea level rise, which is predicted to be 1–1.5 metres. More about this can be found in the report Förväntade extremvattennivåer för havsytan vid Forsmark och Laxemar–Simpevarp fram till år 2100 ("Expected extreme sea levels at Forsmark and Laxemar–Simpevarp up to 2100", in Swedish only), SKB R-09-06.

2.11 How long will the final repository be kept drained?

(SKB) Drainage pumping will cease when the final repository has been backfilled with crushed rock and clay, which will take place after about 60–70 years of operation.

2.12 When the repository is closed it will be filled with water. Will fresh or salt water run into the repository at that time? Is there a risk for upconing of salt water?

(SKB) According to the modelling that has been done, there is no risk for upconing of salt water in conjunction with construction or operation or when the repository fills with water.

2.13 During the operation of the final repository, there will be spent nuclear fuel under ground while blasting is under way. Moreover, the nuclear power plant is located nearby. Has this been taken into consideration?

SKB has taken this into consideration. The safety distances will be sufficient. Handling of encapsulated nuclear fuel and blasting will not take place in the same area at the same time. The different areas in the final repository – the area with deposited nuclear fuel and the area where rock excavation work is under way – will be separated by partitions, which makes it possible to perform the different tasks at the same time.

2.14 I have observed that vibrations can be felt in buildings and land several kilometres from the tunnelling work currently being done in Stockholm. This will be noticeable in the final repository as well.

SKB has looked at this. The distance between areas where blasting is being done and areas where deposition is being done will be at least 80 metres.

We have experience from the extension of the interim storage facility Clab (stage 2). Blasting for the new pool was done there about 40 metres from the existing pool, where spent nuclear fuel is stored. Blasting for the extension of Clab was carried out with great caution, under controlled forms and was followed closely by SSM.

2.15 The drainage water will contain nitrogen, albeit small amounts, and be discharged into Söderviken. Why won't the drainage water be treated in the sewage treatment plant before it is discharged?

SKB has investigated this, but arrived at the conclusion that the amounts of nitrogen are too small and too diluted to warrant nitrogen removal. The water will, however, be treated to cleaned of particles and oil residues before it is discharged.

2.16 Why are air ventilation exhausts needed so far away from the centre of the facility?

(SKB) Most of the air is exhausted via centrally located shafts and ramp, but since the underground facility to be ventilated is so big there will be a need for ventilation shafts on the outskirts of the facility as well.

2.17 What land areas and properties has SKB purchased?

SKB has purchased the property Forsmark 3:32 (roughly 600 hectares) from Sveaskog. SKB is planning to purchase more properties.

2.18 SKB has said they will show great consideration for the forest in the 600 hectares previously owned by Sveaskog, particularly in view of the special values of the land from a nature conservation viewpoint. Now SKB has bought the forest. What plans does SKB have for the forest?

SKB is currently working on establishing guidelines for continued management of the forest area, and SKB's management will discuss forest management questions on 15 February. The natural values of the area will be in focus. Plans to preserve natural values and develop forest lands and wetlands are being drawn up in dialogue with the County Administrative Board and other stakeholders. SKB does not intend to cut down the forest.

(Clarification not given at the meeting: SKB's management will decide on a focus and strategy for management of SKB's land in Forsmark in the spring. Then a detailed body of material for management questions will be compiled.)

2.19 Fiskarfjärden is a valuable lake, with rich natural values. It gets its water from cold springs at the bottom of the lake. Could the lowering of the groundwater level result in the lake's being emptied of water?

(SKB) According to the calculations that have been done, the impact on Fiskarfjärden will be marginal. According to the previously shown figure, figure 16, the level of the lake will be lowered by no more than one centimetre.

2.20 Note that the conditions in Fiskarfjärden are unusual because water is forced in from below, from two different springs.

(SKB) We will look into the matter further.

2.21 I would like to return to the question of the unique natural values in the forest area purchased by SKB from Sveaskog. They must be preserved. What are SKB's intentions with the area? I am waiting to see some concrete plans, not just hear vague promises.

SKB will present detailed documentation during the spring/summer regarding the plans for the forest area.

3 Common issues

3.1 Is it true that the environmental court's decision is submitted directly to the Government and cannot be appealed? In other environmental matters it is possible to appeal the decision of the environmental court to the Superior Environmental Court. Won't that be possible in this matter? (SERO)

(SKB) No, it is not possible to appeal the Government's decision except in questions of formalities.

(Clarification of the review and decision process not given at the meeting: The environmental court submits an opinion to the Government. This opinion cannot be appealed. The Government decides whether the activity is permissible or not under the Environmental Code. It is possible to apply for judicial review of the Government's decision on formal grounds. If the Government decides that the activity is permissible, the environmental court issues a judgement with conditions, which can be appealed to the Superior Environmental Court. The judgement of the Superior Environmental Court can be appealed to the Supreme Court.)

3.2 I would like to clarify regarding SKB's assessment of who the concerned parties are for the water operations. The environmental court, not SKB, decides who the concerned parties are.

(SKB) That is correct, we present our assessment of who concerned parties are.

3.3 You say that subsidences of 0.7 millimetre are not a problem, but how large subsidences can the Forsmark NPP take?

(SKB) SKB has referred the subsidence study to FKA for consideration and is waiting for comments, including an answer to this question.

3.4 Östhammar Municipality has a working group that is going through the preliminary EIS and supporting documents on water operations. We find that there is a gap in the management of water between when the rock works start and when the sewage treatment plant is finished. Is this true?

There are a number of reports that you refer to in the EIS that have not been published yet. How can we have consultations on reports and references that have

not been published? How can be evaluate contents and conclusions in material that we have not seen? When will the reports be published?

(SKB) The sewage treatment plant is planned to be finished before the rock works begin.

The reports that have not yet been published will be published during the year, up until when the applications are submitted. At present the last reports are being finished and reviewed. You are all welcome to get in touch with Erik Setzman or someone else at SKB if you are interested in a given report. If it is available we will send it to you, otherwise we will put you on a list of recipients.

We would also like to point out that essential conclusions in the reports that have not been published have been incorporated in the EIS and the background material on water operations. The consultations are not intended to deal with the background reports, but with the EIS and the background material on water operations, which contain the important conclusions of these reports.

3.5 It is remarkable that we are having consultations about material that has not been published, which makes it more difficult to evaluate the material.

The results reported in the EIS come in many cases from underlying reports that have not been published. We must have access to these background reports in order to carry out a credible review.

(SKB) According to Chapter 6 of the Environmental Code, the consultations are concerned with the planned activity and provide an opportunity for private citizens and others to participate in the process, i.e. to follow the work with the EIS and to submit viewpoints during the course of the work. The background material for the EIS is compiled gradually. We are now in the final phase of the consultations and have chosen to consult about the preliminary EIS, which has been published, and on which we will like to hear viewpoints. We have also chosen to cite the references we intend to refer to in the final version of the EIS, even though all of them have not yet been published. We would also like to point out that it lies in the nature of the consultations that background material is compiled gradually and that all background material is therefore not available when consultations are held. All background reports will be available when the applications are submitted.

3.6 Many of the reports in the list of references have not yet been published. Is SKB obliged to specify what reports will be available even if they aren't available now? It's difficult to get an idea of what is available and what isn't.

(SKB) Within the framework of the site investigations we have published about 1,700 reports so far, and at present a hundred or so reports remain to be published. All background reports will be available when the applications are submitted.

3.7 Why doesn't the EIS say anything about the consultations?

(SKB) The consultations are still being held, which is why very little is said about them in the EIS. The chapter about the consultations will be much more detailed in the final version.

An account of the consultations that have been held, a consultation report, will be included in the applications, as an appendix to the EIS. SKB has also published annual summaries of the consultations that have been held.

(Östhammar Municipality) As far as I understand, it is unique for an applicant to produce a preliminary version of the EIS as a basis for consultations. This is positive, since it gives us an opportunity to familiarize ourselves with the environmental consequences of the project at an earlier stage than normal.

3.8 I have a question about the report on the consultations. A number of consultations have been held, and many questions have been asked. I wonder what questions have been asked and how the questions have been dealt with. This is not explained in the preliminary EIS. But I agree that it is positive that SKB has produced a preliminary EIS and that it is so detailed.
I would also like to agree with previous comments that it is difficult to find answers to all questions in the EIS when the reference literature is not available.

(SKB) To start with we want to point out that this part of the consultation is mainly supposed to be about water operations and that it is mainly questions concerning this aspect that are supposed to be addressed this morning. The entire afternoon is set aside for consultations on the preliminary EIS. I therefore suggest that we postpone questions about the EIS until this afternoon.

The questions and viewpoints that have been expressed in the consultations have been commented on by SKB. All questions received and SKB's replies can be found in the compilations of the consultations that have been published annually since 2002/2003. How SKB has dealt with questions and viewpoints received will be described in the consultation report appended to the applications.

Clarifications from SKB after the meeting: All questions and viewpoints received and SKB's replies and comments will be presented in references listed in the consultation report. The references can be ordered from SKB.

3.9 As far as I understand, all that is presented here are SKB's results and conclusions. How has the review process gone? Has the material undergone any scientific review by an independent outside party? Has there been any peer review? What kind of review process does SKB have for this and future work?

SKB has a process for reviewing reports. They are reviewed both internally within SKB and externally. Many of the results have also been published in scientific articles and have thereby undergone review in accordance with these journals' scientific quality and review processes. We are secure with our review process.

3.10 The EIS refers to unpublished reports by Hamrén et al. and by Allmér that deal with the impact the final repository will have on natural values in the Forsmark area.

(SKB) Those reports are among the references that have not yet been published. They are currently undergoing review.

3.11 I appreciate that you have produced a preliminary EIS and shared it with us, but wonder how we can go on from here and have viewpoints on the final EIS if the consultations are concluded now. There will be many questions concerning how you have arrived at the different conclusions. Is there any possibility of further consultations?

(SKB) How have we arrived at our conclusions? That is a good question, and it is our duty to answer it. We are always open to questions and viewpoints, and this will not stop just because the 5th of March is the last day to submit questions and viewpoints within the framework of the consultations. It will continue to be possible to talk to us even after the 5th of March.

3.12 How will SKB handle information/questions received after the 5th of March?

(SKB) Normally the consultations are concluded when the meeting ends, but throughout the consultations SKB has chosen to extend the period by keeping the meeting open for about two weeks to allow time for reflection and an opportunity to submit viewpoints and questions. Since this is the last meeting, we have chosen to keep it open for about one month after the concluding meeting in order to give everyone an opportunity to submit viewpoints.

Of course, SKB will listen to viewpoints and receive questions even after the 5th of March, just as we have always done. The difference is that viewpoints received by the 5th of March will be included in the minutes and the consultation report appended to the EIS and thereby also the applications. Questions received after the 5th of March will of course be treated seriously, but will not be included in the consultation report.

3.13 About your website, where it says that everything that comes in will be reported to the environmental court. It also says in the County Administrative Board's directives about the EIS that applicants shall report information to the environmental court in addition to what has been emerged in the consultations. Will this be done?

(SKB) The consultations are the formal part of the work referred to in Chapter 6 of the Environmental Code. In addition to the actual consultations, SKB meets around 12,000 persons each year in Oskarshamn and Östhammar via study visits, information meetings, nearby resident meetings, etc. We take note of questions expressed at these meetings, but it is not something we will report to the environmental court.

Public meeting in Östhammar Municipality, theme EIS

Date	6 February 2010
Time	15:00–17:30 hrs
Place	The Storbrunn cinema, Klockstapelsgatan 2, Östhammar.
Target group	Private citizens, organizations, government agencies.
Invitation	The meeting was advertised locally in Upsala Nya Tidning (9 and 30 January), Östhammars Nyheter (9 and 30 January), Annonsbladet (13 January and 3 February) and Upplands Nyheter (15 January and 5 February). The advertisements also announced the consultation meeting on water operations. The meeting was also advertised (16 January) for national coverage in Dagens Nyheter, Svenska Dagbladet, Sydsvenska Dagbladet, Göteborgs-Posten, Västerbottens-Kuriren and Post- och Inrikes Tidningar (the Swedish Official Gazette). A written invitation went to the organizations that receive funding from the Nuclear Waste Fund to follow the consultations, Östhammar Municipality, the County Administrative Board in Uppsala County and to all government agencies. This invitation also concerned the meeting in Forsmark and the equivalent meeting in Oskarshamn Municipality on 9 February.
Background material	Preliminary environmental impact statement (EIS), which deals with environmental aspects associated with construction, operation and decommissioning of the encapsulation plant and the final repository and transport to and from these facilities. The EIS contains descriptions of the impact, effects and consequences expected to occur. Measures planned to mitigate the consequences are also described. The material was prepared in the autumn of 2009 and reflects the state of knowledge at that time. The purpose of the preliminary EIS is to provide some idea of the aggregate environmental consequences and to allow viewpoints to be expressed on its arrangement, scope, contents and conclusions. The material was posted on SKB's website on 21 December 2009.
Presentations	The meeting was preceded by presentations where *Mikael Gontier* and *Pia Ottosson* presented the impact, effects and consequences of construction, operation and decommissioning of a final repository for spent nuclear fuel in Forsmark.
Present	Total about 80 persons. Private citizens/nearby residents: Two persons. Representatives from: *SSM, Östhammar Municipality, Oskarshamn Municipality, the Swedish National Council for Nuclear Waste, MKG, Milkas, the Swedish Renewable Energies Association (SERO), Åland's National Association for Nature and Environment (ÅNOM), the Baltic Sea Region Radioactivity Watch (BSRRW)* and *the European Committee on Radiation Risk (ECRR), Baltic Sea Regional Office.* SKB: *Saida Laârouchi Engström, Mikael Gontier, Bengt Leijon, Inger Nordholm, Olle Olsson, Pia Ottosson, Erik Setzman, Kent Werner* and *Magnus Westerlind.*
Moderator	*Ulf Henricsson.*
Minutes checker	*Hans Jivander.*

Questions and answers from the consultation meeting are given below. A compilation of written questions and viewpoints received within the framework of this meeting is presented separately: "Compilation of written questions and viewpoints and SKB's replies", page 161. The compilation includes the questions and viewpoints received in conjunction with consultations on the preliminary EIS and water operations in Östhammar Municipality (6 February) and Oskarshamn Municipality (9 February).

1 Interim storage facility and encapsulation plant

No questions or viewpoints were expressed pertaining solely to the interim storage facility or the encapsulation plant for spent nuclear fuel.

2 Final repository

2.1 Will you accept waste from other countries?

(Östhammar Municipality) No, we will not accept waste from other countries.

2.2

One of the municipal representatives has said definitely no to disposing of other countries' waste in the final repository in Östhammar. But this answer is given under current legislation. How can you be certain it isn't just a political assessment of today's situation? How can you be so certain that Forsmark will not become a disposal site for other countries' waste? Other political decisions may be made in the future entailing other obligations.

Since electricity produced in Swedish nuclear power plants is sold on the spot market, we are indirectly importers of nuclear waste. Are the municipality's inhabitants aware of this?

(Östhammar Municipality) We only know that today's situation makes it impossible to import foreign waste.

(SKB) The current wording of the law is very clear and SKB has only been contracted to dispose of the nuclear waste arising on Swedish soil, regardless of owner constellations and who is responsible for production of the nuclear waste. SKB is only responsible for waste produced in Sweden.

2.3

I think it is important not to forget essential aspects of this process. What you say today is that this is the last consultation about the EIS. That means that the long-term safety aspects will not be covered. Vital questions concerning recharge and discharge areas, copper corrosion and bentonite erosion are not included. I had expected that these issues would be dealt with in the EIS. It is remarkable that long-term safety is separated out of the EIS. Moreover, the consequences of speculative intrusion are not covered. The large amount of copper that will be present in the repository has the same signature as copper ore and could fool people in the future into believing it is an ore field.

There are many different future scenarios, and we would therefore like to have a consultation concerning the long-term safety aspects.

(SKB) Let us start by stating that we do not separate central issues out of the EIS. Long-term safety aspects are included in the environmental impact statement, although the actual safety analysis report is not.

The long-term safety assessment, SR-Site, is not completely finished, but will be submitted along with the applications. The previous long-term safety assessment, SR-Can, is still valid. The current assessment is that there will not be any great

differences in the results of SR-Site. However, certain premises have been supplemented with a view to the questions and viewpoints received in conjunction with the review of SR-Can.

We would also like to point out that we had consultations on the theme of "Safety and radiation protection" when SR-Can became available. (A table of completed consultations was shown, see Appendix F.) The theme and the background material for today's consultation is the preliminary EIS.

The work with the safety analysis report is governed by the regulatory requirements that are specified in regulations and guidelines. For example, SKB must examine the processes that can affect the final repository, such as copper corrosion and human intrusion.

2.4 **I have some viewpoints on the choice of site. The Environmental Code says that the best possible site should be selected for an activity. SKB has investigated several areas in Östhammar Municipality, for example Hargshamn. There is a larger fracture-free area there than in Forsmark. This would permit shipping of e.g. bentonite by sea via an existing port, eliminating less environmentally favourable overland shipments. There are also railway tracks for which improvements are already planned, plus good roads to Tierp. Hargshamn is closer to Stockholm and Uppsala, which should permit easier recruitment of personnel.**

SKB has selected a site that is very beautiful and has many valuable natural values. Hargshamn is already an industrial area today, where establishment of the final repository could be the seed of an industrial cluster.

Has SKB included aspects that will be relevant in conjunction with environmental and climate changes? It is currently estimated that the sea level will rise by about four metres due to global warming. What will then happen in Forsmark?

In contrast to Forsmark, Hargshamn is located far from any ore deposits, so there is no risk of intrusion either. In my opinion, Östhammar Municipality should also be interested in locating the final repository in such a good site as Hargshamn.

(SKB) These are very intelligent observations regarding Hargshamn. The site was evaluated in the feasibility study, when we concluded that conditions overall are better in Forsmark. The studies that have been done for site selection have been very thorough and the choice of site is well founded. We must also remember that the area around Forsmark has been designated as being of national interest for energy production, as well as for final disposal of nuclear waste. The final repository will be an addition to the existing cluster of nuclear activities in Forsmark.

As far as future sea level change is concerned, we have studied the consequences of a rise in the sea level. This is taken into account in the design work, where it has been decided to raise the ground level in the operations area.

2.5 **We are the final repository's nearest marine neighbour. Åland is only about 100 kilometres from here, which makes us an interested party here today. We have followed the process for a year and are disappointed that we haven't heard more about the safety aspects and the safety assessments. These are in our opinion the subjects of the greatest interest. Instead you repeat the same answers.**

I don't understand the point of being here today if we can't consult about the long-term safety assessment. You say you have had consultations about the final repository with affected parties (neighbouring countries) under the terms of the Espoo Convention, but we do not consider this to be complete since all reports and investigations are not available. What is the idea of having consultations with affected parties without discussing the issue of long-term safety?

(SKB) We have held the first part of the consultations under the Espoo Convention, with the countries around the Baltic Sea. The basis for the consultations was the table of contents of the EIS and the safety assessment SR-Can, which provides a preliminary assessment of the long-term safety of a final repository in Forsmark and Laxemar. We have received viewpoints from Finland and they did not include any viewpoints from Åland.

The second and concluding part of the Espoo consultations with the Baltic Sea countries will be carried out after the applications have been submitted. The basis for the consultations will be the part of the safety analysis report that deals with the long-term safety of the final repository, SR-Site, and excerpts from the EIS.

(Östhammar Municipality) Åland has been invited to participate in the municipality's reference group. There have been previous opportunities to participate, but then Åland turned them down. But we are happy to have you with us now.

(ÅNOM) We have unfortunately not participated previously. Now the political picture has changed and we would like to participate and have insight into the continued process. However, we would once again like to point out that it is unreasonable that the safety assessment will not be published until the end of the year. Why can't SKB wait another year with its applications so that we have time to consult about the safety assessment?

(SKB) We would once against like to point out that the main purpose of the consultations is to provide an opportunity to submit viewpoints and comments on the EIS during the ongoing work. The long-term safety assessment will be submitted with the applications and will be reviewed in the same process as the applications.

2.6 **I would like to point out that MKG will submit written viewpoints, comments and questions on the preliminary EIS. We also have some questions we would like to ask here.**

MKG submitted a consultation petition in May 2009 prior to selection of the final repository site. We also requested a consultation meeting at that time. SKB said no to a meeting and instead referred to an upcoming consultation meeting, this meeting. On review of the preliminary EIS, it can be concluded that none of the questions from our petition are dealt with in the EIS. We will follow this up in our next petition.

We also second the question about why we aren't consulting about the long-term safety assessment.

In 2006, when SR-Can was published, quite a few questions and comments were obtained from the regulatory review to which we would also like answers. They include questions about bentonite erosion and copper corrosion. It has been remarked by the regulatory authorities, then SKI and SSI, that SR-Can cannot show how these phenomena are dealt with.

Questions are also posed by the regulatory authorities occasioned by the fact that the rock in Forsmark is not dry, for example how the bentonite can swell, to which we have not received answers either. The question concerning copper corrosion in an oxygen-free environment also remains unanswered.

MKG therefore urges SKB to hold consultations on the long-term safety assessment. It isn't enough to see it first in the application; it is a typical consultation question. It is the most important question of all and must be taken seriously.

(SKB) We will answer previously submitted questions at the same time as we reply to the viewpoints received in connection with this consultation meeting.

As far as consultations are concerned, SKB believes that we have held the consultations that are needed and required to produce an EIS. We have had consultations on the siting work. Site selection is SKB's choice. This is SKB's task and no one else can decide which site we will apply for. When we have made this choice and presented all the facts that support our choice of site and method in the applications, we will await the decisions made by the regulatory authority and the Government.

SKB has had long-term safety as a theme on a previous consultation occasion and we take the matter quite seriously.

2.7 BSRRW and ECRR submitted a report to SKB: Preliminary Formal Response to the SKB Environmental Impact Statement of December 2009 relating to the proposed radioactive waste repository at Forsmark, Sweden by Chris Busby, ECRR – European Committee on Radiation Risk, Baltic Sea Regional Office, see Appendix G.

I would like to note that we issued a press release yesterday concerning the research that is being done. We do not consider it sufficient to only utilize SSM's and SKB's experts; independent experts must also be allowed to examine and review SKB's results. An alternative risk model for radioactivity and cancer cases must be used. The Swedish model is based on the ICRP model, which greatly underestimates the risks. Among other things, it shows that the fallout after the Chernobyl accident was not dangerous, which is of course quite wrong. There are also forms of cancer not included in the model. If SSM and SKB have the wrong radionuclide model, we are in trouble. I hope you can comment on which model is applicable.

The EIS compares the radiotoxicity of the fuel after 100,000 years to that of uranium ore. This comparison is wrong. Uranium from many different mines has been collected and concentrated in the final repository. The EIS says that cesium-137 remains after 100,000 years, but nothing about uranium-238 and plutonium-239. What remains of these isotopes and for how long? Uranium has a long half-life, which means that most of the uranium remains after 100,000 years.

(SKB) The risk model used by SKB is the one that is specified in SSM's regulations and that we must use. It is the International Commission on Radiological Protection's (ICRP) risk model, which is based on the relationship between radiation dose and cancer risk.

We have compared how toxic – radioactive – the spent nuclear fuel is after 100,000 years with the radioactivity of the quantity of uranium ore originally mined to produce it. However, the uranium is spread over a larger volume in the mine or deposit from which it was originally extracted. In other words, the comparison is relevant if one considers the total quantities.

2.8 We concur that the long-term safety assessment should be included in the background material for the consultations. Nor is there any account of radioactivity releases. A statement of probability cannot just be presented as a fact.

When I read the EIS I see no reference to the current debate about copper corrosion in an oxygen-free environment, for example as presented at the Swedish National Council for Nuclear Waste's seminar in November. You claim you haven't been able to repeat the experiments showing copper corrosion in an oxygen-free environment. Why doesn't SKB publish a report on these experiments and allow time for other researchers to review your findings? Even if you published your results now there isn't time for others to review them.

(SKB) If we were to allow time for researchers to do these experiments, this would assume that we agree with the results to which you refer. But we don't. We assert that the researchers at KTH do not have any proof for their theories, and their

results were also dismissed at the Swedish National Council for Nuclear Waste's seminar. They cannot prove the thermodynamics, nor have they done electrochemical analyses.

We take note of the studies and the research being conducted all over the world that may have a bearing on our work. We take criticism of our research seriously and continue to carry out calculations and analyses to verify our results. We believe that we have a safe method and that the copper canisters will not be affected in the long term.

2.9 BSRRW and ECRR say that there are many open questions and that more critical review is needed. Additional research is needed, which was also said at the Swedish National Council for Nuclear Waste's seminar, and this research should be conducted by independent researchers, for example the KTH researchers.

(SKB) We can only note that we at SKB are obliged to provide evidence for our claims. It is up to the reviewers of our applications to question our claims and come up with other evidence and claims. We are fully entitled to submit our applications and to have them reviewed, based on what we believe is the right method. We will continue to follow other research around us, including on the issue of copper corrosion in an oxygen-free environment, but our conclusion is that it does not affect long-term safety.

SSM will review our application under the Nuclear Activities Act and we will not submit an application we don't believe in and which we do not have actual research results and evidence for.

2.10 I have a question concerning the consequences of an accident at the nuclear power plant in Forsmark and what impact it would have on the final repository. How will you handle it? Will a risk analysis be done? Have you had discussions with the Forsmark NPP and the regulatory authority? The consequences would be even worse with the final repository in Forsmark.

(SKB) The question of the final repository and its location near the nuclear power plant in Forsmark has been discussed and studied. If there were a major release from the nuclear power plants, this could cause serious problems in the immediate environs, but it would not have any significant impact on the final repository. The activities in the final repository do not involve any fast processes or require any quick responses. It could stand idle and the area be closed off for several years without any consequences for safety in the final repository.

2.11 Has the siting of the final repository in Forsmark affected the nuclear power plant's safety assessment?

(SKB) The safety assessments are updated regularly, including the premises.

2.12 I have a question regarding copper corrosion in an oxygen-free environment (MKG will submit a petition to SKB). My impression of the Swedish National Council for Nuclear Waste's seminar is not that the KTH researchers' results were dismissed, but that SKB did not want to discuss the matter any further. SKB's paid researchers were not interested, but fully support SKB's research. Other researchers were more open to the results. Why hasn't SKB shown that the KTH researchers are wrong? SKB is conducting experiments on copper corrosion in the Äspö hard rock laboratory.

My next question concerns intrusion. I can see that you have taken up the aspect

in the EIS as far as inadvertent human intrusion is concerned. But you haven't included intentional human intrusion.

We live in an age with a constant risk of nuclear weapons proliferation, and wherever there is plutonium there is a risk that someone will try to take it. Plutonium does not deteriorate with time. This issue is not addressed at all in the EIS.

The question is even more relevant here since a premise for the KBS-3 method is that the repository does not need to be monitored. This has not been dealt with in the EIS. How will it be handled if monitoring is necessary?

(SKB) As far as copper corrosion is concerned, the KTH researchers have not drawn any conclusions regarding long-term safety. SKB has no comments at this time regarding human intrusion, but asks to be allowed to get back on this matter.

2.13 The final repository will be built in stages. When the first 100 canisters have been deposited, further build-out will commence. This means that the deposited canisters will be subjected to disturbances, since the blasting will cause powerful shock waves. Have you studied the effects of blasting on the tightness of the seal and the contents of the canisters? What will be the effects of these countless shock waves?

(SKB) The matter has been analyzed and there are limits to the size of the shock waves that will be tolerated.

2.14 Goal descriptions in the project, at least initially, are contained in a number of documents and legislation. It surprises me that in several sections in the EIS it seems as if the goal of the reports and analyses has been to develop the KBS-3 method, not to find the best method. No alternatives are presented. What methods have been available but been dismissed? When was disposal in deep boreholes dismissed?

(SKB) You are asking for analyses of alternative methods in the EIS. We have studied alternative ways to dispose of the spent nuclear fuel and arrived at the conclusion that there is no other available method that meets the stipulated requirements.

2.15 We assert that there is indeed another method that serves the purpose and would like to see analyses of it and accounts of when it was dismissed and for what reasons.

(SKB) I assume you're referring to Deep Boreholes, and SKB can only note that disposal in deep boreholes does not fulfil the purpose when it comes to providing safe, verifiable deposition and being able to repair any defects that occur.

2.16 Repairability is not a requirement in the legislation. What do you mean by verifiable? The repository will not be monitored.

(SKB) Verification can take the form of visual inspection at the time of deposition for KBS-3, which is not possible for Deep Boreholes.

2.17 Will verifications of the method take place for several years?

(SKB) It is not a question of following up for 100,000 years. The initial state will be verified by inspection at the time of deposition.

2.18 In reference to the discussion concerning Deep Boreholes, I have posed a question to one of our most renowned glass artists, Bertil Vallien, regarding the possibility of encasing the fuel pellets in glass beads. According to him it would be quite possible, after which the beads can just be dumped in the rock. They will be able to resist the pressure and environment there.

(SKB) I don't intend to make any more comments about Deep Boreholes, but I do strongly object to the notion of "just dumping in the rock". SKB doesn't dump

anything anywhere; I don't consider that choice of words to be satisfactory. What we do, and have been doing for many years, is serious research where we take our mission of finding a solution for final disposal of spent nuclear fuel very seriously. We conduct very serious research, and the scientists who are working on this deserve a better judgement and vocabulary than this.

2.19 The municipality has previously asked a number of questions which SKB has answered, but we are not satisfied with any of the answers. We are talking about the replies to questions 79, 81 and 82:

79) "How credible are the models used for the rock, and what degree of uncertainty exists in the models?"

81) "How credible are the models for how the groundwater flows in the rock, and how uncertain are the results?"

82) "How credible are the models for transport of radionuclides through the rock and how uncertain are the results?"

We don't expect any answers today, but we would like the clarifications that are made to be comprehensible to ordinary people. Laymen must also be able to understand what is meant.

(SKB) SKB will return to these questions later with clearer explanations.

2.20 As regards the safety analysis report, you make frequent references to SR-Can. SSI and SKI have expressed quite a few critical viewpoints on SR-Can (2007). Have you commented on these viewpoints in any document so that the process can easily be followed?

(SKB) We have regular discussions with the regulatory authority about the comments and questions that arise in conjunction with the review of SR-Can. These meetings and consultations are documented in notes. Prior to the applications, SKB will explain how we have dealt with all questions and viewpoints so that traceability and links will be readily accessible.

2.21 I wonder about the formulation "There is no risk for releases of radioactivity during the operating period" in the EIS. Does this apply only during the operating period or even after the repository has been closed? How can you know how much the canisters can take? Could you describe a situation where canisters break apart? What are the criteria for defining a possible event where a hole could occur in the canister? How does dispersion take place in the rock and the groundwater?

(SKB) We have examined numerous possible scenarios where a canister could be damaged. An example during the operating phase is that the canister is dropped from a great height. That risk is eliminated by never handling the canisters at great heights. Do not confuse operational (pre-closure) safety with long-term post-closure) safety.

As far as radionuclide releases in a long-term perspective are concerned, a number of scenarios are described in SR-Can. For example, an earthquake could cause displacement of the rock at a fracture zone, damaging a canister. This risk is avoided by not depositing canisters in or near fracture zones.

Another scenario is that fresh meltwater seeps down into the repository and erodes away the bentonite around the canister. This could in turn lead to canister corrosion. The first ice age is projected to occur in about 30,000–40,000–50,000 years. The long-term safety assessment shows what it would entail in the form of radionuclide releases, and the EIS is supposed to describe the effects and consequences of this.

(Östhammar Municipality) This was an excellent reply, but it is unfortunately not in the EIS. Why isn't this described in the EIS? It should be included in the report.

(SKB) Perhaps it should be included in the EIS, but at the same time the EIS is supposed to describe significant environmental consequences, which this is not assessed to be. However, this account will be included in the safety assessment.

(Östhammar Municipality) This is a pedagogical problem. The difficulty is seeing what isn't there. The document should be easy to ready by many people and must therefore be extra pedagogical.

2.22 Events that can give rise to consequences (environmental impact) are supposed to be described in the EIS.

Radionuclide releases have consequences! We have a responsibility to do the right thing now.

(SKB) The safety assessment will show that the events that can occur will not give rise to consequences.

(ÅNOM) SKB must also describe the consequences in 30,000–40,000 years.

2.23 Will consequences for animals and nature be described in SR-Site?

(SKB) The safety assessment will primarily be about man, but also the biosphere in a broad sense.

2.24 If a canister breach occurs, it will have consequences for man and the environment. This must be described in the EIS. Not doing so is a quality defect and a threat in the application procedure. We would like to see a consultation meeting on long-term safety.

(SKB) The safety analysis report includes aspects affecting man. (Clarification not given at the meeting: Calculations of doses to biota are also included in the safety analysis report.)

2.25 In the first place I would like to concur with Milkas's request to be allowed to participate as an observer when SSM and SKB consult. We have been trying to get invited since 2005, but SKB has always said no. Just like the municipality, we want to participate as observers.

We would also like to state the following: In the RD&D process, the Government has said that they would like to see better background material on Deep Boreholes.

How is this expressed in the application?

No action alternative – we expect a little more than just saying that everything remains in Clab. There must be something else SKB can tell us.

Long-term safety – risks and environment, SKB has to sketch the scenario where a canister corrodes in 1,000 years. What will then happen to man and the environment?

If the bentonite clay disappears after 10,000 years, what will happen then?

(SKB) The answers will be given in SR-Site. (Later on during the meeting, SKB stated that scenarios where some or all barriers had been removed were included in SR-Can.)

3 Common issues

3.1 Is a tape recording being made of the meeting? Otherwise it may be difficult to check the minutes.

SKB is not making a tape recording. We don't consider it necessary, since there have not been any problems for the minutes checkers at previous consultations.

3.2 Has anything new occurred since the 21st of December, when the preliminary EIS was presented? If so, is it possible to start with a presentation of this, in other words to reverse the agenda?

(SKB) On 21 December 2009, SKB had a meeting with the municipality in Östhammar. Then we reported what is included in the preliminary EIS, how it is structured and what types of information are included, in other words a kind of reading instruction. The purpose of today's meeting is to present the contents and the results of the EIS, i.e. the impact and environmental consequences of the planned activity. Another purpose is to give everyone an opportunity to ask questions, offer viewpoints and discuss. The target groups for the meeting of 21 December and the public meetings, today in Östhammar and on 9 February in Oskarshamn, are different. The target group in December was the municipality as a reviewing body, while the public meetings are open to everyone.

Nothing new has happened since 21 December, but since the meetings have different contents and out of respect for the preparatory work done by my colleagues, we see no reason to change the agenda.

3.3 Is it a part of SSM's work to judge when SKB can conclude the consultation process?

SSM is guided by what the law says. SSM will make that judgement when we review the EIS and the account of the consultation process. Only then can be make an assessment. The law says that consultations should continue until the application and the EIS are submitted, but it is also reasonable to allow the applicant reasonable time to compile the material to be submitted.

3.4 The question of whether Sweden will accept waste from other countries is owned by the legislators, which gives rise to great uncertainty. No one knows what will happen in the future.

We in the municipality's EIA Group have been working intensively since the week before Christmas to familiarize ourselves with the huge body of material contained in the EIS and will submit our viewpoints in writing. However, we have some viewpoints we would like to express today.

We note that writing an EIS is not an easy task and have viewpoints on how it is structured and the compilations. We urge SKB to consider whether the material should be divided into a separate EIS for each activity – Clab, Clink and the final repository – plus a joint compilation. We therefore propose a breakdown of the EIS, since these are not easy matters to understand.

We also note that it is relatively easy to read the material, since the information is readily comprehensible, but that one can always wonder what is not included and bring out matters that are not described. This is an issue we all have to contend with.

It is regrettable that the safety analysis report is not included, but it will be included in the applications. We would, however, like to point out that the safety analysis report and the long-term safety assessment are such crucial parts of the material that they should have been included in the EIS so that viewpoints could be expressed during the consultation, since it has consequences for both man and the environment – now and in the future.

We also regret the lack of an account in the EIS of the uncertainties in the method, for example with regard to corrosion of the canister, but assume that the discussion of copper corrosion will be fully examined in the coming application.

The purpose of the applied-for activity should be clarified. Is the purpose to build a final repository, or is the purpose to build a final repository according to the KBS-3 method? If it is to build a KBS-3 repository, the alternatives are not of

sufficient interest. But if it is to build a final repository, the alternatives have broader significance in our opinion. They are not included in the EIS. We believe that the choice of method should be explained more clearly.

We have seen in the list of references for the EIS that a number of reports are not available yet, for example 3-8, which is remarkable. We have therefore not been able to judge, comment on or evaluate the claims that are made.

Another thing is cumulative effects, a concept that can be viewed in different ways. For example, noise and transport. In the EIS and the applications, we would like SKB to show alternative modes of transport to Forsmark, for example of bentonite.

We wonder about shipments by barge between Hargshamn and Forsmark and think that the possibilities should be explored. Truck transport will increase by about 40 percent, with considerable consequences for affected persons. SKB has described the consequences of this at Norrskedika, but there will also be considerable consequences at Harg.

Other aspects of cumulative effects together with the final repository in Forsmark are consequences of the extension of SFR and, further ahead in time, where SFL (the final repository for long-lived waste) will be sited.

How is the activity in the final repository affected by the ongoing activity at the nuclear power plant? If anything happens at the nuclear power plant, for example a release of radioactivity leading to closure, how will this affect the final repository?

A description of the no action alternative should be included in the EIS, i.e. what are the consequences if the applied-for activity is not realized? The no action alternative is continued storage in Clab, which can have different consequences depending on why the applications do not go through. We believe that the consequences of different reasons why the activity is not implemented should be reported in the no action alternative.

(SKB) Those were many questions and viewpoints that we will try to answer. First I would like to comment on the structure of the EIS. As you can appreciate, it has not been simple to compile all the research, reports, investigations and analyses that have been produced during the course of the process. A lot of time has been devoted to producing a clear EIS, at the same time as we have done our best not to overlook essential aspects. We receive tips and viewpoints on how the account can be designed.

The environmental impact statement and the safety analysis report are two supporting documents, and they will be submitted as we have now presented them, each in their own appendix. But we will think about what clarifications we can make in the EIS as far as the work with the safety assessment and its results are concerned.

As far as other comments and viewpoints are concerned, we look forward to your written petition, which we will reply to and append to the minutes. See Appendix A in the minutes of the meeting.

3.5 I would like to get back to my remark from this morning and clarify what I said about the high cesium concentration in the Baltic Sea. First I would like to remind you of the fact that SERO submitted written viewpoints and questions this morning, which will be appended to the minutes. See minutes about water operations in Forsmark of 6 February 2010, Appendix C.

(Clarification: A consultation meeting was held that morning about water operations planned in conjunction with the construction and operation of the final repository for spent nuclear fuel in Forsmark. The meeting is documented in separate minutes.)

About water operations in conjunction with Forsmark

(A graph of measured radioactivity in the Baltic Sea was shown, see Appendix E in the minutes of the meeting.) The concentrations of radioactivity in the Baltic Sea are the highest in the world. They are much higher than measured values around Chernobyl, which is quite remarkable. We wonder SFR is leaking, in which case there must also be high concentrations on land. According to data from the Helsinki Commission (HELCOM), a concentration of 150,000 becquerels per square metre has been measured in the area where the final repository is planned to be built. Why aren't further studies being done concerning e.g. concentrations of cesium-137, strontium and plutonium in the area? What is said on page 37 of the EIS about uranium and alpha radiation is not enough.

In my opinion, the no action alternative, i.e. business as usual, is not acceptable. We have a ticking bomb in Clab. According to a new report, nuclear fuel should not be kept under water for longer than five years, since zirconium can then begin to react, forming hydrogen. I therefore urge you: Close Clab immediately! There is a risk it will start to burn.

(SKB) Let us start by observing that we have long experience of operating Clab, about 25 years. Clab and its operation are supervised by SSM, which has no objections. We can also assure you that SFR does not leak. SFR also stands under SSM's supervision. We would also like to clarify that, as far as the consequences of establishing a final repository are concerned – the subject of today's consultation – there are clear guidelines and requirements that we must fulfil to get a licence to establish the final repository. The EIS stipulates guideline values and limit values that must be met.

We will comment on viewpoints submitted in writing in an appendix to the minutes. See Appendix A.

(SERO) I would like to point out that it is very remarkable that you intend to build a final repository at a distance of less than 30 kilometres from a nuclear power plant. If an accident occurs at the power plant, the final repository will not be accessible.

3.6 SKB says that the prerequisites for not releasing any radioactivity are:

- **The canister fulfils the acceptance criteria at fabrication.**
- **All types of disturbances and mishaps have been identified.**
- **All disturbances and mishaps are discovered.**
- **If any disturbances or mishaps occur, action must be taken.**
- **All disturbances and mishaps must be handled correctly.**

It remains to be shown that the canister fulfils the acceptance criteria. These criteria have not yet been presented, so it is obviously not known whether the canister meets them or not. The safety assessment, which describes disturbances and mishaps, is not yet available, so it is not possible to assess matters with a bearing on disturbances and mishaps.

It is remarkable that neither matters pertaining to acceptance of the canister nor matters pertaining to disturbances and mishaps have been acceptably accounted for. A supplement to the EIS is needed.

(SKB) Development and testing of the copper canisters have been conducted in the Canister Laboratory for some time in order to optimize design. There are criteria for the weld that joins the lid to the canister. The canister deposited in the final repository must be leaktight. The welding method that will be used is called friction stir welding and entails "stirring" together the copper in the lid and the canister. Our experience from the Canister Laboratory shows that this method is reliable. It should also be remembered that the wall of the copper canister is five centimetres thick.

As far as possible disturbances and mishaps are concerned, we go through all events that could conceivably occur and adapt the design of the facilities and the activities to avoid dangerous mishaps. For example, the canister can withstand being dropped from a given height. The facility is therefore designed so that the canister never has to be lifted above that height. Going through various scenarios of possible disturbances and mishaps in handling is one of the key activities in designing a facility.

We can conclude that a lot of work has already been done, but research and development will continue. This is a prerequisite for ensuring that we use the best available technology and knowledge.

3.7 **Regarding the no action alternative – we heard earlier here today sensible comments on how the no action alternative should be presented, and I concur with these. There is a lack of documentation, research and alternatives to the no action alternative. According to what SKB said earlier here today, you are doing nothing, but continue to store fuel in Clab, and this is not acceptable. Of all the methods available today, there must be some other alternative you could research further. It is better to do the right thing in 30 years than the wrong thing today.**

BSRRW and ECRR will also submit viewpoints and questions in writing.

(SKB) The purpose of the no action alternative is to describe what will happen if the project – final disposal according to the applied-for method – does not come about, i.e. what do we do with the spent fuel then? Developing alternative methods for the no action alternative is not compatible with the definition of the no action alternative and does not lie within the framework of our mission.

3.8 **The work of the Safety Group includes reviewing the EIS, and we will submit our viewpoints and comments in writing. We would, however, like to highlight some questions here today.**

We believe that the EIS is too sketchy and we question its scope with regard to radiological releases. We regret the absence of the long-term safety assessment, which we consider to be an essential part of the account. A general description of radionuclides should also be included in the EIS. The calculation models contain a number of uncertainty factors that are based on assumptions. More models should be used.

More information on the consequences of the high rock stresses is needed.

How has SKB imagined we should get to see and have an opportunity to review and comment on the safety assessment? No opportunity is given to consult on this matter. Is this compatible with the requirements in the Environmental Code?

If you get down into the rock and discover quite different conditions than those you expected, disturbances, water flows and other problems. How will SKB handle this?

We emphasize that the municipality has the same questions as the Safety Group, and we will submit our viewpoints in writing.

(SKB) The question of how the review of the safety assessment will take place has already been answered a number of times today. There will be ample opportunity for review of the safety assessment and all other documents included in the applications, within the framework of the licensing procedure. We will naturally answer your written questions and append them and SKB's replies to today's minutes.

3.9 **After the accident in Chernobyl, it became clear that there must be a distance of at least 30 kilometres from a reactor in operation to the site of a repository for spent nuclear fuel. We are currently increasing the power capacity of our nuclear power plants by 40 percent, and no one knows how the reactors will react. What we do know is that we cannot**

increase the pressure or the temperature, but that the power increase must be effected by increasing the steam flow, which is disastrous. We know today that there are problems with the steam separators. The zirconium tubes could burst and the steam vibrate so that the fuel assemblies are shaken apart. We have unsolved problems with control rods that break. There is a German patent that solves the problem with gap gases.

In the final repository we have the problem of corrosion of the copper canister in an oxygen-free environment. The pressure in the canister is very high; what do we know about the effects of internal radiation on the canister? There may be six decilitres of water in the top of the canister water. Hydrogen and carbon dioxide probably react with copper and iron. What will happen in the canister?

This is not discussed in the EIS.

President Obama has halted all work with siting of a final repository.

Why? A new canister has been developed in the USA that is sprayed with ceramics.

There are approximately 710 metres between reactor unit 1 and Clab in Oskarshamn.

Venting of the reactors' filters takes place at the ground surface.

I once again question the proximity of the final repository to the reactors in Forsmark.

How will we get to the repository if an accident occurs?

The statement was left without comment.

3.10 I am coming in at a late stage and would therefore like to know how SKB has arrived at what questions/themes should be covered by the consultations. How are you planning to consult on long-term safety? If people want to continue to talk about long-term safety, you will have to clarify your thinking.

SKB's consultations under Chapter 6 of the Environmental Code began in 2002–2003. At the beginning there was a long dialogue between affected parties about what the EIS should contain. Scoping reports were produced together with the concerned county administrative boards and municipalities. These discussions are reflected in the contents of the preliminary EIS and the themes of the consultations. But the contents have been developed, areas have been dismissed or added in response to results and viewpoints obtained during the course of the journey.

As has been said previously during this meeting, we are open for questions and viewpoints up until the 5th of March 2010. Then we have to close the consultation so that we can finish the consultation report, which is an appendix to the EIS, which will be submitted with the applications. It is worth repeating that the dialogue does not end on 5 March. Only the formal part ends then. The dialogue will continue for some time; the licensing process will probably take several years. The authorities will review and question our results, as they should do, to make sure we perform our task properly.

3.11 It would be valuable if SKB would post all questions received on their website so that they are all accessible.

(SKB) Illustrations shown at today's meeting will be posted on SKB's website at the beginning of next week. All questions posed will be noted in the minutes, which will be available on the website. Written questions and viewpoints will be posted in their entirety.

3.12 The EIS does not report any radioactive releases from the final repository. Does that mean that there will not be any releases at all? Is there any link in the chain where there is a risk of release?

(SKB) The EIS reports that there will be some releases of radionuclides from Clab and Clink, but not from the final repository. This applies to releases during opera-

tion. Possible radionuclide releases from the final repository after closure will be described in the assessment of long-term safety.

3.13 Is there a risk of releases in conjunction with transport?

(SKB) No. (Clarification not given at the meeting: There are no identified disturbances or mishaps that give rise to radioactive releases. Hypothetical accidents can give rise to releases. See the preliminary EIS, page 201.)

3.14 What happens now with the consultations? I am trying to understand that the consultations under the Environmental Code are at an end, but would like to get clarification regarding the regulatory consultations and the dialogue with Östhammar Municipality. What does this mean for the consultations about the RD&D reports?

(SKB) On 5 March we are closing for questions and viewpoints within the framework of the consultations under the Environmental Code, since we need time to consider the viewpoints we have received and conclude the consultation report.

But it will still be possible to pose questions and express viewpoints, and information meetings will be held as needed. We assume that we will have to defend our applications and count on a continued dialogue. We will answer all questions put to us, and we may need to supplement the applications.

Everyone who has been involved up to now – municipalities, private citizens, etc. – have made a great contribution to the process. We have listened and heeded your viewpoints, both inside and outside of the formal framework. And we will continue to do so; the conversations with affected parties will continue. There are great opportunities to exert influence.

As far as the review of the RD&D reports is concerned, it is expected to follow the same procedure as before. SSM will circulate them widely for consideration and collect viewpoints and comments in the same way as before. At present, however, the legislation is being revised and the results may affect the RD&D process.

3.15 The environmental movement is excluded from the regulatory consultations, but the municipality is allowed to sit in as an observer. We have previously said we want to be invited, but SKB has said no. We would once again like to ask to be invited to the regulatory consultations.

No one commented.

3.16 I would like to concur with what has been said earlier today. I have not received replies to our questions regarding the EIS, since no experts are here. Only managers are here today. No results have been reported on the long-term aspects. I find it irresponsible to claim that there will be no problems. Does SKB really want to make an irresponsible report? We would like to submit a responsible report about models and would be glad to cooperate with models for the assessments.

(SKB) That isn't true; we have experts here today, and they are the ones who have presented the results in the EIS. For example, Mikael Gontier has a doctorate in the subject, so he really is an expert.

3.17 Should I interpret this as meaning that the EIS is about what can happen on the ground surface, while the other part, what happens in the rock, is described in the safety analysis report? Won't the municipality's questions be answered as EIS questions?

(SKB) The EIS describes effects and consequences for man and the environment. The long-term safety assessment describes what happens if the barriers don't perform as intended.

The KBS-3 method is based on the barriers' isolating the canister from contact with the groundwater. If this isolation is breached, the barriers will retard the transport of radionuclides. According to SSM's regulation for the final repository, the risk of damage must be less than one in a million. The long-term safety assessment must show credibly that this is possible with the KBS-3 method. The assessment, SR-Site, is not finished, but we will answer as best we can questions about how the assessment is being done and what calculations are being done. However, the basis can be found in the previous safety assessment, SR-Can. The safety assessment is about making it credible.

3.18 Many of us here believe that the consultations cannot be concluded until the safety assessment is finished. When the assessment is finished we have to have another consultation meeting!

No comment was made.

3.19 I realize there isn't time for more questions, and besides the dynamic in the room has disappeared, but I would nevertheless like to ask a few questions.

The description of transport in the EIS is not satisfactory. You say there won't be any radioactive releases from the shipments from Clink to the final repository. How do you arrive at that? Have you performed a drop test or modelled such a test?

(SKB) As far as transport is concerned, this is something we already have a great deal of experience with. Our ship m/s Sigyn is already carrying the spent nuclear fuel from the nuclear power plants to Clab. For this we use transport casks fabricated in accordance with international requirements, which for example means that they have to pass a drop test and withstand fire for a certain time. The transport casks for canisters of encapsulated nuclear fuel will be fabricated to equally stringent standards at least. But encapsulated fuel will not be transported in transport casks until around 2023.

3.20 So you haven't performed any tests? Are they just theories? I would like references to reports about this.

(SKB) We use similar types of transport casks today, which are licensed.

3.21 How do you plan to solve the ventilation problems associated with the transport casks? I assume you have to keep the ventilation going.

(SKB) No ventilation is needed for the casks used for transport of spent nuclear fuel to Clab today. When the time comes to transport the spent nuclear fuel, it will have been stored in Clab for 30–40 years and will have cooled. A canister will emit a maximum of 1,700 W, which is equivalent to a good space heater. Since no ventilation is needed in the transport casks today, it won't be needed then.

3.22 At what stage will the public get access to all background material about transport?

(SKB) A report that was published a few years ago will be updated for the application. Two alternative designs of transport cask will be described.

3.23 What speed limit applies for the guarded canister shipments?

(SKB) I don't have the exact figure, but it's somewhere around ten kilometres an hour. The shipments will be under guard with a view to possible terrorist acts, for example.

3.24 Will you develop any special terrorist protection?

(SKB) We have no plans to do so at present. (Clarification not given at the meeting: Shipments of radioactive waste are girded by protective measures, both physical and administrative. The answer implied that no additional terrorist protection is planned.)

(Milkas) I believe a great deal remains to be answered with regard to the environmental impact statement and the long-term aspects. We must get access to the background material so that we can draw our own conclusions.

(SKB) An account of this will be given in the applications. As far as the shipments are concerned, they will comply with the Transport Act and the IMDG Code.

Public meeting in Oskarshamn Municipality

Date	9 February 2010
Time	19:00–21:00 hrs
Place	Figeholms Fritid och Konferens (Figeholm Leisure and Conference), Hägnad, Figeholm.
Target group	Concerned parties and owners of nearby properties (water operations) as well as private citizens, organizations, government agencies.
Invitation	A written invitation went to concerned parties (OKG) and owners of nearby properties. The meeting was advertised in Oskarshamns-Tidningen and Nyheterna (16 January and 6 February). The meeting was also advertised (16 January) for national coverage in Dagens Nyheter, Svenska Dagbladet, Sydsvenska Dagbladet, Göteborgs-Posten, Västerbottens-Kuriren and Post- och Inrikes Tidningar (the Swedish Official Gazette). A written invitation went to the organizations that receive funding from the Nuclear Waste Fund to follow the consultations, Oskarshamn Municipality, the County Administrative Board in Kalmar County and to all government agencies. This invitation also concerned the meeting in Figeholm and the equivalent meeting in Oskarshamn Municipality on 6 February.
Background material	Preliminary environmental impact statement (EIS), which deals with environmental aspects associated with construction, operation and decommissioning of the encapsulation plant and the final repository and transport to and from these facilities. The EIS contains descriptions of the impact, effects and consequences expected to occur. Measures planned to mitigate the consequences are also described. The material was prepared in the autumn of 2009 and reflects the state of knowledge at that time. The purpose of the preliminary EIS is to provide some idea of the aggregate environmental consequences and to allow viewpoints to be expressed on its disposition, scope, contents and conclusions. The written invitation included a brief account of the consequences of planned water operations in Laxemar-Simpevarp. A more detailed technical account was available via SKB's website in the form of a preliminary report: Water operations in Laxemar-Simpevarp Clab/ Encapsulation plant – Diversion of groundwater, withdrawal of cooling water from the sea and construction of a stormwater pond. Water operations were described in detail in the preliminary EIS. All material was posted on SKB's website on 21 December 2009.
Presentations	The meeting was preceded by presentations where *Mikael Gontier* and *Pia Ottosson* presented the impact, effects and consequences of construction, operation and decommissioning of a final repository for spent nuclear fuel in Forsmark and an encapsulation plant next to the existing interim storage facility, Clab, on the Simpevarp Peninsula.
Present	Total about 70 persons. Representatives from: *SSM, Oskarshamn Municipality, Östhammar Municipality, the Regional Council in Kalmar County, the Swedish National Council for Nuclear Waste, MKG, Milkas and the Döderhult Nature Conservation Society. SKB: Saida Laârouchi Engström, Mikael Gontier, Anders Nyström, Katarina Odehn, Olle Olsson, Pia Ottosson, Jenny Rees, Tomas Rosengren, Erik Setzman, Magnus Westerlind, Olle Zellman* och *Håkan Andreasson* (part of meeting).
Moderator	*Ulf Färnhök.*
Minutes checkers	*Roland Davidsson* and *Elisabeth Englund.*

Questions and answers from the consultation meeting are given below. A compilation of written questions and viewpoints received within the framework of this meeting is presented separately: "Compilation of written questions and viewpoints and SKB's replies", page 161.

The compilation includes the questions and viewpoints received in conjunction with consultations on the preliminary EIS and water operations in Östhammar Municipality (6 February) and Oskarshamn Municipality (9 February).

1 Interim storage facility and encapsulation plant

1.1 Figure 27 shows that heavy metals will be accumulated in the stormwater pond. Where do these heavy metals come from?

(SKB) The heavy metals come from transport emissions and are washed to the stormwater pond with the stormwater.

1.2 It is clear from Figure 30, which shows discharges to water from Clab, that cesium-137 is discharged. Where does cesium-137 come from?

(SKB) Cesium-137 comes from damaged fuel that is received in Clab.

1.3 Why is cesium-137 discharged?

(SKB) It is associated with the handling of the fuel in Clab. The water is treated via ion exchange resins and filters, but all radioactivity cannot be captured, so small quantities of radioactive material are discharged.

1.4 Where in the body is cesium-137 stored?

No reply was given.

1.5 Is it common for damaged fuel to be received in Clab?

(SKB) It happens that damaged fuel is received in Clab, but not often.

1.6 According to Figure 30, cobalt-60 has been discharged, especially prior to 1999. Why is that?

(SKB) Certain material in some components, for example pumps, at the nuclear power plants began to be replaced in the late 1990s. As a result, the quantity of cobalt-60 that accompanies the spent nuclear fuel to Clab has diminished. Furthermore, water treatment in Clab has been progressively optimized.

1.7 Is Clab located beneath the surface of the Baltic Sea?

(SKB) Yes, the storage section is located about 25 metres beneath the surface of the Baltic Sea.

1.8 Is it fresh or salt water that runs into Clab?

(SKB) It is fresh water. Samples are taken of the drainage water.

1.9 I have seen myself that water runs into Clab, corroding the rebar. Are samples taken of that?

(SKB) I am no expert on Clab, but I know there is groundwater in the drainage pumped from the rock gap. Is that the water you are referring to? Samples are taken according to the requirements made by the regulatory authority.

1.10 I have also seen rust running through the fractures into Clab. What is done about this?

(SKB) I find it difficult to believe this could be true. Since we don't have anyone here with specific knowledge of Clab, we will have to get back to you.

1.11 Seepage of water into Clab

(SKB) A question was asked earlier about seepage of water into Clab. We now have with us the plant manager of Clab, Håkan Andreasson, to provide some clarification.

It is groundwater that seeps into Clab, not sea water. Groundwater discharged from Clab is checked with respect to radioactivity.

(Clarification not given at the meeting: Hydrochemical data show elevated chloride concentrations in the seeping groundwater.)

1.12 Seepage of water into Clab was discussed earlier, but no good answers were given. Does SSM know about this?

(SKB) The seepage consists of groundwater, which is kept outside of the controlled area and is pumped out under controlled forms.

(Clarification not given at the meeting: Hydrochemical data show elevated chloride concentrations in the seeping groundwater.)

(SSM) Compliance with SSM's regulations, rules and requirements is checked via the monitoring programme for Clab. We are now aware of any seepage of water into Clab that poses a risk to the facility.

1.13 You say that you only approve storage of nuclear fuel that has been produced in the country, but there is nuclear fuel in Clab that is not included in that category. What do you do with it?

(Oskarshamn Municipality) Perhaps I was a little unclear here. What we accept is spent nuclear fuel according to SKB's communication dated 17 March 2006.

1.14 There are great uncertainties associated with the no action alternative, both in terms of the quantity of spent nuclear fuel and the time perspective. It says on page 298 of the EIS that "With reasonable maintenance, Clab can be operated safely for 100–200 years…". The municipality does not consider this to be an alternative. We consider it very important that continued interim storage in Clab not become a long-term alternative.

(SKB) There is a requirement in the legislation that a no action alternative must be included in the EIS. We are supposed to describe the options for and consequences of continued interim storage in Clab, but we don't consider it to be a viable option.

1.15 The remaining capacity in Clab is about 3,000 tonnes and the annual increment of fuel is about 218 tonnes. This means that Clab will be full in around 2023. What does this mean if the project is delayed? Furthermore, implemented and planned power increases at the nuclear power plants will give rise to a large quantity of spent nuclear fuel. How are these problems being dealt with?

(SKB) We have just put a new rock cavern into operation, Clab 2, which has the capacity to store about 5,000 tonnes of spent nuclear fuel. By switching to compact storage canisters it is possible to pack the fuel more densely, which would enable the capacity in Clab to be increased to about 10,000 tonnes. However, increasing the capacity in Clab requires a licence. There is spare capacity in the event of a delay.

1.16 If a licence is required to expand the capacity in Clab, shouldn't this be included in the application that is about to be submitted?

(SKB) In order to store 10,000 tonnes of spent nuclear fuel in Clab, we must first make certain modifications. If this is decided, we will submit a separate application. SKB has decided to postpone the matter.

With an annual fuel increment of about 200 tonnes we will just be able to manage with the existing licences. If we have to apply for additional licences, SKB foresees no problems with this.

1.17 We do not see where there would be capacity to store the canisters and the fuel if the process is delayed. The options mentioned seem to be more compact storage in Clab and storing the fuel at the nuclear power plants? We would like to see a coherent description of the storage options. How much capacity is there? Does this lead to any environmental impact as far as radioactivity is concerned?

(SKB) We will bring this question with us and try to put together an account that clarifies it.

1.18 A report produced by a consultant for SKB shows that it would be possible to reduce emissions from the future Clink facility by 95–99 percent. This sounds fantastic. If it is technically feasible and doesn't jeopardize safety, will SKB explore this option?

(SKB) The study that was done has to do with use of the best available technology (BAT) in Clab. Before measures are adopted, however, they must be further studied and safety-evaluated.

1.19 Stormwater management from Clink is an environmentally hazardous activity and the water has to undergo treatment before it is discharged. We want it to be a condition that no water is discharged before it has been treated to remove particles.

(SKB) We will bring this question with us and deal with it if needed.

1.20 It's about drying of fuel in Clink. As we understand, this is a new step in the process that will be introduced and that is not used in Clab today. Are there references to the drying method? Is the method used anywhere else in the world? Is the method the best available technology, BAT?

(SKB) We have experience of drying the fuel from the nuclear power plants. Drying is done by vacuum, but we have also looked at an alternative that entails drying by hot air. An additional method is currently being investigated. The drying method is a technical matter that will be accounted for in the technical description, but not in the EIS.

1.21 You say on page 197 of the EIS that traffic noise on highway 743 is increasing and that another 40 persons or so will be exposed to noise in excess of 55 dBA. In the summary, page 307, it says that there will be no increase in the number of residents exposed to noise in excess of 55 dBA. Which is true?

(SKB) We have noted the comments and will have a look at the formulations in the EIS.

1.22 Is that why you don't report the consequences of the noise increase? Which criteria do you use?

(SKB) We use the Swedish EPA's guideline values.

1.23 If the guideline value is exceeded, steps must be taken to avoid exceeding 30 dBA outdoors. Have you checked this?

(SKB) What has been done is calculations for the noise level indoors. We have not performed any measurements outdoors. The value of 55 dBA is already exceeded today outdoors. (Comment from audience member) Just because the value is exceeded today doesn't mean that SKB shouldn't continue work on the matter and produce an impact statement.

1.24 The EIS talks about noise from highway 743, but nothing about traffic safety and accidents. Do you intend to make an analysis of this?

(SKB) We have looked at traffic safety and the risk of accidents in the environmental risk analysis. There we arrived at the conclusion that the additional traffic generated by Clink has no impact on traffic safety risks. However, if the final repository had been sited at Laxemar, it could have affected the traffic safety risk. The environmental risk analysis report is in preparation.

1.25 Radiological operations will be conducted in the Clink facility, which will be partially above ground. Have you looked at the safeguards issues? How robust is Clink's physical protection against terrorist attacks, for example?

(SKB) The facility's physical protection will comply with the regulatory requirements. Clink will be subject to the same requirements on physical protection as Clab. Safeguards have no direct connection with the environmental impact statement, but will be treated in the safety analysis report, which will be appended to the applications.

1.26 I hereby submit a petition to the secretariat containing viewpoints and comments from SERO. (The petition is included in Appendix E). I would also like to bring up some of the questions for discussion.

Clab should be closed immediately, since the facility can be compared to a ticking bomb. Against the background of the studies done after the terrorist attack on 11 September in the USA, the U.S. Nuclear Regulatory Commission concludes that the storage of nuclear fuel in cooled pools that takes place at nearly every nuclear power plant does not provide a sufficient safety margin in the event of an accident or a terrorist attack that causes the water to drop below the tops of the fuel assemblies. In such a case there is a risk that the most recently stored fuel from a reactor will get hot enough to ignite the zirconium cladding, which could lead to the release of large quantities of radioactivity. A conclusion is thus that nuclear fuel should not be stored under water for longer than five years. If someone disables Clab's cooling system, we will only have a week to restore it. The no action alternative in the EIS is therefore not an alternative. Close Clab as soon as possible.

Many countries have opted for dry interim storage in dry casks, an option that should be adopted by Sweden as soon as possible, see appended document by Professor Frank von Hippel. These casks can withstand interim storage for up to 100 years.

The short distance between Clab and the nuclear power plant is unacceptable. Clab should not be located closer to a nuclear reactor than 30 kilometres. The distance between Clab and reactor O1 is approximately 700 metres.

(SKB) We have read the statement submitted by SERO on Saturday in Östhammar, which is mainly supported by two documents. We can observe that the document NUREG 1738 no longer exists. It existed in draft form in 2001, but has now been taken away since it was considered to be a poor study that was never approved by the NRC (Nuclear Regulatory Commission).

The document from Alvarez is based on reports produced by the NRC. When the NRC reviewed Alvarez's work, they concluded that the NRC's data had been overinterpreted and that the conclusions in this document are therefore not correct.

You also claim that the NRC has said that spent nuclear fuel should not be stored in water for more than five years. That is not correct, there is no such requirement.

1.27 I protest against the logic where storage in pools in Clab is compared with storage at the nuclear power plants. Where in the world is spent fuel stored in the same way as in Clab? If it's so good why isn't it done everywhere?

Here you are planning to place the encapsulation plant next to a reactor. Where in the world is this kind of thing done?

(SKB) When we site nuclear facilities we don't look at what other countries, with other conditions, have done. The basic principle is that the siting should be safe. There are rules and ordinances that govern siting.

1.28 According to Professor Frank von Hippel, Clab can be compared with a ticking bomb, and now you are planning to store more fuel in Clab.

When you raise the burnup of the fuel the decay heat increases, which means that the distance between the fuel assemblies in the interim storage facility must be increased. Now the power level in our nuclear power plants is being increased. It is not possible to increase the temperature or the pressure, which means that the steam flow must increase. This may lead to powerful vibrations in the fuel assemblies, which entails a risk of cracking of the fuel assemblies. This must be taken into account when increasing the quantity of waste in Clab is suggested.

(SKB) We have switched from standard storage canisters to compact storage canisters in Clab 1, so we have experience of this. As far as power increases at the nuclear power plants are concerned, which do indeed lead to increased burnup, we will evaluate what this means for the design of the storage canisters, choice of material, etc.

1.29 Why doesn't SKB switch to dry interim storage now? The technology is available. I don't want Clab to continue to be operated in its present condition in view of the problems that could occur if, for example, someone should place an explosive device in the cooling water channel.

(SKB) It's true that the technology for dry interim storage exists. At the same time, we mustn't forget that Clab has functioned well for a long time, since 1985. Both SSM and the municipality are satisfied with Clab. Monitoring of Clab takes place in accordance with SSM's requirements. In other words, we have a safe facility.

1.30 Water is leaking in, causing the concrete to decompose and the rebar to rust. I have seen myself how rusty water runs out of the fractures.

(SKB) Where have you seen that? I don't know of any place where sea water seeps in. Groundwater seeps in, which is why we have a roof over the pools. As far as rust is concerned, we use stainless steel for interim storage.

(Clarification not given at the meeting: Hydrochemical data show elevated chloride concentrations in the seeping groundwater.)

1.31 You were forced to build a roof over the pools because too much water was leaking in.

(SKB) I have been working in Clab since 1985 (when it was put into operation), and we have had a roof over the pools the whole time, as long as there has been fuel in Clab.

1.32 The question of a roof over the pools was discussed when the facility was licensed.
(SKB) I wasn't around then, so I can't comment on this.

1.33 Two of us here today are members of an inventors' association. I have developed an alternative system for disposal of spent nuclear fuel that doesn't require an encapsulation plant. I can't afford to take out a patent, but am willing to sell the solution to SKB for SEK 100 million.
SKB notes the offer and recommends that the solution be sold on the global market.

1.34 I would like to get back to the question of the distance between Clab and the existing reactors. If we were to have an accident in the nuclear power plant, the area where Clab is located would be contaminated. How would we then take care of the facility? We can only leave Clab's cooling system without maintenance for about a week.
(SKB) The safety analysis report for Clab on which the existing licence is premised says that it would take 6–8 weeks before the fuel would be exposed if there were a loss of cooling. In other words, there would be plenty of time to top up with water or take other action.

1.35 The no action alternative is not a no action alternative. Continued interim storage in Clab is not safe. Dry interim storage in dry casks that last at least 100 years is used in the USA. We should adopt that system.
(SKB) An interim storage facility requires service and maintenance. This applies to a dry interim storage facility as well. Clab is a good and well-run interim storage facility where we have long experience of how to handle the fuel, maintain the facility, etc.

(Comment from audience member) That isn't true. The Swiss have a dry interim storage facility in large rock vaults. The facility runs itself and is cooled by natural ventilation. SKB only propagates for their own poor method.

1.36 How is the pool bottom in Clab cleaned?
(SKB) With a kind of vacuum cleaner, like in a swimming pool. The water is run through a filter.

2 Final repository

2.1 The final repository will be operated until about 2070, after which it will be decommissioned. How will you document it and inform future generations, for at least the next 10,000 years, of the existence of the repository and what it contains?
(SKB) Many countries are examining this question. Sweden is taking part in the planning of a new OECD-NEA project in which France and Belgium, among other countries, are also interested in taking part. In this project, the countries will jointly study how we could cross-reference, what strategies we can choose for information preservation, etc. The work is still in its infancy and will begin with feasibility studies.

2.2 Preservation of information is certainly an issue that should be addressed in the EIS.
(SKB) I don't see how this can be construed as an environmental impact issue. We are required to build a final repository that does not require institutional controls. However, information preservation is an important issue that will be dealt with internationally. It is also an important issue for repositories for other types of hazardous waste, for example mercury and other heavy metals.

It is important to find good solutions for information preservation internationally.

2.3 Do you have proof today that the KBS-3 method is a satisfactory functioning method with respect to long-term safety?

(SKB) We believe that we have a functioning method that has been developed over a long time, and on which we have also consulted over a long time. Now we look forward to having the method undergo licensing review.

2.4 Since the account of long-term safety, SR-Site, is not finished, the consultation period should be extended. It says in the EIS that the account of long-term safety will be updated for the final EIS. I don't think it's right to hold the last consultation meeting when there are questions that still need to be studied and discussions in progress.

(SKB) Over the years, consultations have been held on different themes. In May–June 2007 the theme was "Safety and radiation protection", with SR-Can as background material for the consultations. (As SKB gave this reply, figure 39 in Appendix B in the minutes from the meeting was shown.)

2.5 You mention that you have had consultations on SR-Can and show a figure that says you had consultations on safety and radiation protection in 2007. This is no proof that enough consultations have been held. Long-term safety is the most important environmental aspect in the entire process, and the report on long-term safety, SR-Site, is not available to consult about.

(SKB) Consultations should deal with work in progress and not final products, since the latter will be submitted for review. Now we are offering an opportunity for everyone to express viewpoints and comments on the preliminary EIS. The final EIS will be submitted with the applications for review.

In connection with the review of SR-Can, SKI and SSI submitted around 340 viewpoints, which we will act on in the work with SR-Site. The basic assessment in SR-Can and the assessments made prior to site selection remain valid.

We will take with us the viewpoints from MKG and Milkas concerning the inadequate scope of consultations on long-term safety. We will consider whether it is possible to expand the description of long-term safety in the EIS.

2.6 As we noted in Östhammar, we (MKG) will submit a detailed petition, so what we are saying now is only a fraction of what we will cover in the petition.

As far as the question of siting is concerned, MKG submitted a petition to SKB in May 2009 where we expressed a wish for a special consultation meeting on site selection.

The upcoming assessment of long-term safety will deal with Forsmark. However, it would be valuable to also include Laxemar in the assessment so that the sites can be compared. It would be good if other sites were included in the assessment as well.

(SKB) We are submitting applications for Forsmark and we will carry out an assessment of long-term safety for a siting in Forsmark. In the siting appendix we will present the safety assessment calculations done for Laxemar. Regarding other sites that have been investigated through the years, we do not have enough data to carry out safety assessment calculations, but we will present relevant data in the siting appendix.

2.7 My question concerns long-term environmental safety. I wonder what issues are making it so difficult to finish SR-Site. Why isn't SR-Site finished? What are the issues?

(SKB) SR-Site is at a critical stage prior to the applications, but no particular difficulties remain. However, SSM's regulations and guidelines stipulate extensive requirements on the safety analysis report. Many analyses have to be made, which takes time. Quality assurance also takes a lot of time.

2.8 Have any new questions come up?

(SKB) No new questions have come up. The questions are the same as in SR-Can, but have now been analyzed in greater depth. The most important questions are mentioned in the preliminary EIS. Events that can lead to canister damage are earthquakes and erosion of bentonite.

2.9 So SR-Site will not contain much that is new?

(SKB) No, much of the work is concerned with dealing with the 340 questions that emerged from SKI's and SSI's review of SR-Can.

2.10 Is it possible to see the list of questions from SKI's and SSI's reviews?

(SKB) The questions posed by SKI and SSI are in their review reports.

3 Common issues

3.1 Will a tape recording be made of the consultation meeting?

(SKB) No.

MKG stated that they do not want to verify the minutes if the meeting is not taped.

3.2 It was mentioned earlier that no disturbances or mishaps lead to doses above the acceptance criteria. Are these the acceptance criteria for internal or external radiation?

(SKB) Both and internal and external radiation are referred to.

3.3 Who establishes the limits for the acceptance criteria? Can they be changed as easily as the becquerel limits were changed in conjunction with the accident in Chernobyl?

(SKB) The criteria in this case are dose limits, and they are established by SSM. The EU directive also regulates the limits. This means that there is an inherent inertia that makes it impossible to change the limits quickly.

3.4 So it isn't possible to change the acceptance criteria as easily as it was before to change the becquerel limits?

(SKB) We can't answer how the becquerel limits were changed before. It isn't our area of competence.

3.5 SKB says that this is the last consultation meeting. How can the consultations be concluded when the most important question, long-term safety, is hardly mentioned in the EIS? Moreover, what is said about long-term safety in the EIS is italicized text that will be modified later. How can such an unfinished process be concluded?

(SKB) The consultations have been conducted since 2002–2003, with different themes on different occasions. Safety and radiation protection were the theme of the consultations in 2007. The background material at that time included the SR-Can safety assessment.

We would once again like to clarify that these consultations are not supposed to be about reviewing the documents that will be submitted with the applications. These documents will be made available at the time of the licence applications.

Prior to this consultation meeting we presented a preliminary EIS to provide an opportunity to express viewpoints, questions and comments on material that is as close to being finished as possible.

3.6 Why not have another consultation meeting, this time based on the final version of the EIS?

(SKB) The idea of consultations is to present and discuss material that is not yet in finished form and can therefore be influenced. It is not meaningful to consult about a finished report. The finished material will be reviewed in the licensing process.

3.7 As far as ionizing radiation is concerned, you say that there won't be any, but if there is, what will the range of dispersion be?

(SKB) This is really not a question for the EIS, but is dealt with in the PSAR (preliminary safety analysis report, including long-term safety) for the final repository and Clink. There is already a safety analysis report for Clab today where the consequences of possible mishaps are dealt with.

The facilities are adapted to the activity that will be conducted so that not even the worst-case scenario gives rise to releases that exceed the legal limit. An example is "dropped canister". If a canister is dropped from a great height during handling, the canister could be damaged. High lifts of canisters are therefore avoided wherever possible.

3.8 The question of radioactivity in the Baltic Sea was raised at the consultation meeting in Östhammar last Saturday. Radioactivity of up to 150,000 becquerels per square metre has been measured in the bottom sediments offshore of Forsmark, according to the Helsinki Commission. How much radioactivity is there in the sea there?

(SKB) The radioactivity that is present in the Baltic Sea mainly stems from the accident in Chernobyl. SSM has information on the radioactivity in the sea.

3.9 Cesium-137, cobalt-60, uranium and plutonium have been measured in the Baltic Sea. What do they come from? Are the nuclear power plants leaking? Or perhaps SFR?

(SKB) There is a monitoring programme for sampling of radionuclides around the nuclear power plants, and the results are reported to SSM.

3.10 Is tritium measured in the wells in the areas? Tritium is a kind of hydrogen with a long half-life. Since the tritium molecule is small, tritium is highly mobile. It has been measured in the ground around nuclear power plants, although not in Sweden.

(SSM) There are national measurement programmes, and it is the department of environmental monitoring at SSM that has information about this.

(SKB) Table 8-4 on page 162 in the EIS shows that measurements of tritium are performed in the water discharged from Clab.

3.11 Is a working KBS-3 method a prerequisite for SKB to submit the applications?

(SKB) Yes, a prerequisite for our submitting the applications is that we can argue that the KBS-3 method works and meets the regulatory requirements. We must show that we will comply with the safety requirements during operation and after closure. If we cannot demonstrate this to the environmental court, SSM and the Government, we won't get a licence. We believe that the KBS-3 method is safe.

3.12 Do you have proof that encapsulation and final disposal will really work as intended? You have to be able to demonstrate it in reality and not just in words.

(SKB) We contend that we can demonstrate it and therefore want to submit the applications and have the method undergo licensing review.

3.13 It says in the EIS that the low-level waste is taken to the near-surface repository MLA in Simpevarp, where OKG is the activity operator, and the intermediate-level waste to SFR in Forsmark, where SKB is the activity operator. The waste consists among other things of filters from Clink. There are two strategies for managing filters. One strategy is frequent replacement of filters, whereby the filters can be regarded as low-level waste and be placed in MLA; the other is to replace the filters less frequently and regard them as intermediate-level waste for deposition in SFR.

- **Does the licence for MLA contain such limit values that long-lived nuclides are limited in the near-surface repository? Is there a prescribed limit on the quantity of such nuclides?**
- **Is the near-surface repository subject to the Landfill Ordinance? SFR and MLA are not included in SKB's applications. The municipality questions whether MLA is a suitable repository for low-level waste from Clink and would rather see that such waste from the final repository system is deposited in SFR.**

(SKB) SSM's criteria govern where the waste may be disposed of. All waste from nuclear facilities must have a type description in which all constituent radionuclides and their properties are described. I can't answer as to whether MLA falls under the Landfill Ordinance.

(SSM) We just want to confirm what SKB has said. There is a system that describes what may be disposed of in different types of repositories or landfills and how the waste is to be managed. There are rules and regulations that govern this from a nuclear perspective. I cannot answer specific questions about MLA.

3.14 It says on page 326 in the preliminary EIS that a reconciliation with environmental objectives will be presented in a separate appendix. What environmental objectives are referred to here, and what environmental objectives are being reconciled with?

(SKB) Reconciliation will be done with national and regional environmental objectives. The local environmental objectives are being updated, so reconciliation cannot be done with them.

(Oskarshamn Municipality) The municipality has proposed that SKB should reconcile with the regional environmental objectives, not the local ones.

(Regional Council in Kalmar County) The Regional Council in Kalmar County has established the goal "Fossil-fuel-free 2030 – no net emissions of fossil carbon dioxide from Kalmar County".

(SKB) We will take the question with us.

3.15 Many alternatives should be looked at in the EIS. One alternative is to convert Clab to a dry storage facility. If you look at different siting options, a co-siting of interim storage, encapsulation and final disposal in the interior of the country could be a good alternative. Neither we in Milkas, nor as previously stated SERO, consider Clab to be a no action alternative.

(SKB) Clab is an existing facility that works well. SKB and the regulatory authority agree on this, so there is no reason to move interim storage and change a method that has been worked satisfactorily since 1985. It is always possible to switch to dry storage, but we are satisfied with the system we have and see no reason to make any changes.

3.16 In the EIS, the description of the no action alternative is limited to what happens if nothing is done. It is quite possible to be more imaginative in the EIS and look at other no action alternatives. Things can happen in the world. Before what happened on 9/11 with airplanes flying into the skyscrapers, we didn't think anything like that could happen.

One alternative is to look at what would happen if a KBS-3 repository is not built. Different future energy alternatives can also be discussed. It is also possible to discuss in the EIS what would happen if SKB doesn't get a licence.

(SKB) I would like to point out that Oskarshamn Municipality does not view Clab as a final solution. The municipality has said yes to interim storage of spent nuclear fuel in Clab, but the ultimate aim must be final disposal of the spent fuel.

We now have a method that we consider to be ready for licensing. The no action alternative entails that the fuel will be interim-stored in Clab. There is no place for speculation about various scenarios in the licence applications or the EIS.

Through the years we have received guidance from society, for example in the form of Government decisions regarding SKB's RD&D programme. The Government has previously said that we can regard the KBS-3 method as a planning premise for our continued work. In other words, society has followed our efforts. We expect the environmental court, the regulatory authorities and the Government to critically review our applications and offer questions and viewpoints. We assume that the applications will have to be supplemented, but we don't think any government wishes to protract the question of disposal of the spent nuclear fuel unnecessarily.

3.17 I would like to get back to Clink and the copper canister. On 16 November, the Swedish National Council for Nuclear Waste held a seminar on corrosion of copper in an oxygen-free environment. If you look at patent databases, there are about 500 patents that deal with canisters, including ones made of ceramic materials. Has SKB been asleep and failed to take notice of these studies? The canister SKB plans to use is made of copper and iron. In view of the fact that some water, about 600 millilitres, will remain after the fuel has been dried, the pressure inside the canister may amount to 700 bar.

(SKB) Lots of things can be patented, the only requirement is that it should be a new concept. You don't have to show that the object of the patent works, so there is every reason to be sceptical to patents.

We have looked at different canister alternatives. With regard to ceramic materials, brittle fracture has not been ruled out. We have chosen a copper canister and believe we have a carefully considered and thoroughly engineered canister design.

We have conducted thorough studies of what pressure can arise in the canister. It is true that corrosion is possible, but we keep this under control by limiting the quantity of water that can enter the canister. So we have the problem of corrosion well in hand. In conjunction with radioactive decay, helium will be formed in the canister. The pressure caused by the helium will gradually increase, but it will take a very long time before the pressures are high, on the order of one or more millions of years.

3.18 SKB clearly has the world's best canister! I think it's strange that the world's nuclear power countries aren't beating down your door to buy it. Milkas asks that alternatives to the canister be presented. There are many better alternatives, for example a cubical canister.

(SKB) Most countries are working with geological disposal, where the disposal method and the canister to be used are adapted to the environment in question. Several countries are working along the same lines as the KBS-3 method. In one of the appendices to the applications, the Method Appendix, we will explain why we have chosen the canister we have chosen and what alternatives we rejected and why.

3.19 The scope of the EIS chosen by SKB is far too narrow. Everything except the nuclear power plants should be included in the EIS. This means that the EIS should also include SFR, LILW (disposal of long-lived waste, for example from the decommissioning of the nuclear power plants) and the near-surface repositories.

(SKB) The future applications concern interim storage, encapsulation and final disposal of spent nuclear fuel. The scope that has been chosen is entirely in accordance with EIS practice.

3.20 We would have liked to see you discuss various alternatives regarding the no action alternative. You say that the final repository must be safe, but what if it isn't? Isn't that the reason for a no action alternative? In the description of the no action alternative on page 325 in the EIS it says "Clab can, with reasonable maintenance, be safely operated for 100–200 years, and the fuel withstands long-term storage well". Where does this come from? How has the evolution of society been taken into account? If what might happen actually happens, the only alternative is to build the final repository. The no action alternative needs to be developed. More no action alternatives should be described.

(SKB) Where do our claims in the EIS come from? That is a legitimate question. We do not make unrealistically optimistic calculations in the safety assessment, but include pessimistic scenarios. The law requires final disposal of the spent nuclear fuel. We have to look at what could happen. Clab is not a long-term solution, since it requires monitoring and maintenance. The fact that the no action alternative may appear dystopic (pessimistic) must not entail that a poor final disposal solution is being chosen.

3.21 What is the point of the consultations? Simply put: so that you as the applicant end up with a good application, and so that the environmental court and the regulatory authority end up with as good background material as possible. It is therefore important to develop the no action alternative. There are other no action alternatives than the one presented by SKB, but perhaps SKB doesn't want to present other, better no action alternatives. Unlike SKB, there are others who see problems if the KBS-3 method is implemented.

SKB understands the argument and the viewpoint.

3.22 In my opinion the limitation in time must be defined precisely, since OKG's owners are planning and designing new nuclear power plants. In the academic world as well, more people are embarking on educations in nuclear power engineering.

(SKB) We are applying for a licence for the current Swedish nuclear power programme. If there is a change, it will have to be dealt with in a new application.

We consider it positive that there is interest in nuclear power. There is a great need for nuclear power engineers in view of the fact that many baby boomers will soon retire.

3.23 The application should include other ways to solve the problem.

(SKB) The no action alternative should describe what will happen if the applied-for activity is not implemented. Our neighbour, Finland, has decided that the no action alternative is not a viable option.

Summary of written questions and viewpoints and SKB's replies from the public consultation meeting in Östhammar Municipality on 6 February and Oskarshamn Municipality on 9 February 2010

Written invitations to participate at the consultation meeting and/or to submit written viewpoints were sent to the following organizations (which receive funding from the Nuclear Waste Fund to follow the consultations), government agencies and concerned municipalities. The table also shows who replied.

Together with the invitation, a preliminary version of the environmental impact statement (EIS) was sent, which deals with environmental aspects associated with construction, operation and decommissioning of the encapsulation plant and the final repository and with transport to and from these facilities. The EIS contains descriptions of the impact, effects and consequences expected to occur. Measures planned to mitigate the consequences are also described. The material was prepared in the autumn of 2009 and reflects the state of knowledge at that time. The purpose of the preliminary EIS is to provide some idea of the aggregate environmental consequences and to allow viewpoints to be expressed on its disposition, scope, contents and conclusions. The material was posted on SKB's website on 21 December 2009.

Swedish Work Environment Authority	No reply
National Board of Housing, Building and Planning	Abstains
Swedish Energy Agency	Abstains
National Board of Fisheries	Viewpoints expressed
National Institute of Public Health	Abstains
Swedish Fortifications Agency	No reply
Swedish Armed Forces	No objections
Swedish Board of Agriculture	No viewpoints
Legal, Financial and Administrative Services Agency	No reply
Swedish Chemicals Agency	No reply
Swedish Coast Guard	Viewpoints expressed
Swedish Civil Contingencies Agency	Abstains
Swedish National Council for Nuclear Waste	Viewpoints expressed
Swedish Environmental Protection Agency	No reply
Regional Council in Uppsala County	No reply
Regional Council in Kalmar County	Viewpoints expressed
National Heritage Board	No objections
National Police Board	No objections
Geological Survey of Sweden (SGU)	No objections
Swedish Maritime Administration	No reply
National Board of Forestry	No reply
National Board of Health and Welfare	No reply
Swedish Radiation Safety Authority	Viewpoints expressed
Swedish National Grid	No reply
Swedish Agency for Growth Policy Analysis	No reply
Swedish Agency for Economic and Regional Growth	No viewpoints
Vattenfall Vindkraft	No reply
Östhammar Municipality – municipal executive board	Viewpoints expressed
Östhammar Municipality – Environment and Public Health Committee	Viewpoints expressed
County Administrative Board in Uppsala County	Viewpoints expressed

Oskarshamn Municipality	Viewpoints expressed
County Administrative Board in Kalmar County	Viewpoints expressed
Swedish NGO Office for Nuclear Waste Review (MKG)	Viewpoints expressed
Swedish Environmental Movement's Nuclear Waste Secretariat (Milkas)	Viewpoints expressed
Swedish Renewable Energies Association (SERO)	Viewpoints expressed
Döderhult Nature Conservation Society	Viewpoints expressed
Energy for Östhammar	No reply
Elvisjö 3:3	No reply
Forsmark 3:13	No reply
Forsmark 3:30	No reply
Forsmark 3:32 (SKB)	No reply
Forsmark 3:33	No reply
Forsmark 3:34	No reply
Forsmark 3:38	No reply
Forsmark 3:51 (Uppland Foundation)	Viewpoints expressed
Forsmark 6:5 (FKA)	No reply
Forsmark 6:8 (SKB)	No reply
Forsmark 6:17	No reply
Forsmark 6:18 (Vattenfall)	Viewpoints expressed
Berkinge 9:1	No reply
Swedish Road Administration	No objections
Simpevarp 1:8 (OKG)	No reply
Simpevarp 1:9 (SKB)	No reply

In addition, replies were received from Oss (Opinion Group for Safe Final Disposal in Östhammar) and the Waste Network, the Swedish Society for Nature Conservation in Uppsala County, Åland's Provincial Government, Eckerö Municipality – Åland, Åland's National Association for Nature and Environment and the Action Group for a Nuclear-Free Åland (ÅNOM), the European Committee on Radiation Risk (ECRR) – Baltic Sea Regional Office, EK Miljökonsult AB, Janeric Thelin, Leif Wahlberg.

SKB's general replies

Many of the questions and viewpoints that have been received from various bodies raised questions of a similar nature. General comments are offered in reply to these questions and viewpoints under the following headings:

A – Conclusion of the consultations.
B – The role of the safety assessment in the EIS.
C – The no action alternative – scope and main features.
D – Consequences of interruption in the work.
E – The final repository's location in an area with high natural values.
F – Site selection and choice of method.
G – Description of cumulative effects in the EIS.
H – SKB's proposal for conditions.

A – Conclusion of the consultations

Consultations according to Chapter 6 of the Environmental Code began in both Oskarshamn and Östhammar in 2002 with early consultations for a final repository on each site. The consultations were concluded in May 2010 to allow time to process the viewpoints that had been received and compile the consultation report for the applications.

Consultations of sufficient scope

Regarding the scope and content of the consultations, SKB's view is that we have held the consultations that are needed and required to produce an adequate EIS.

Viewpoints have been expressed that the consultation process should continue until it is possible to gain an idea of the project's environmental consequences and post-closure safety. SKB's view is that the material that has been compiled for the consultations and presented at the consultations plus material available for example on SKB's website is quite sufficient for this. It is also SKB's view that consultations of sufficient scope have been held.

Consultations – review

SKB believes that it is important to distinguish between consultations according to the Environmental Code and the review that is part of the licensing process. The consultations shall, according to the Environmental Code (Chap. 6, Sec. 4), be concerned with the siting, scope, design and environmental impact of the activity and the content and design of the environmental impact statement.

The idea of consultations is to present and discuss material that is not yet in finished form and can therefore be influenced. SKB has presented a preliminary EIS, consulted about it and incorporated the comments and viewpoints that we have received in the final version and submitted it with the applications. The same applies for the assessment of post-closure safety. We have presented a preliminary version, SR-Can, which served as a basis for consultations, incorporated the viewpoints we have received the final version and submitted it with the applications.

Both the EIS and the assessment of post-closure safety (SR-Site) are central documents in the applications under both the Environmental Code and the Nuclear Activities Act. Both applications will be circulated for consideration by the environmental court and SSM, providing ample opportunity for review and comments on content, calculations and conclusions in the documents.

B – The role of the safety assessment in the EIS

Post-closure safety

Viewpoints have been expressed that the question of the final repository's post-closure safety has not been sufficiently dealt with in the consultations.

Throughout the consultation process, SKB has made it clear that even if a given consultation meeting focuses on a given theme, it has always been possible to pose any question dealing with interim storage, encapsulation and final disposal of spent nuclear fuel, including questions about post-closure safety.

Furthermore, some consultation meetings have focused on post-closure safety. During 2007, consultations were held on the theme "Safety and radiation protection". The background material provided a general description of SKB's work with safety and radiation protection. An appendix contained a summary of the SR-Can safety assessment (Can stands for canister).

During and following the consultation meetings in February 2010, several actors expressed the wish that a closer look be taken at this question in the consultations. For this reason, SKB arranged a concluding consultation meeting in Östhammar on 3 May 2010 on the theme "The role of the safety assessment in the EIS". An account was given at the meeting of SKB's work with safety assessments along with a status report on the ongoing work with the assessment of post-closure safety, SR-Site.

Assessment of post-closure safety

The safety assessment, SR-Site, is comprehensive and is presented in separate documentation included in the applications under both the Environmental Code and the Nuclear Activities Act.

SR-Site is supposed to show that the selected site and method, in combination with the design of the repository itself, are sufficiently good and fulfil the regulatory authority's safety criterion. The regulatory authorities (former SKI and SSI) have said that the sites where SKB has conducted site investigations must be compared with respect to post-closure safety and that a complete safety assessment for the selected site is sufficient. The safety assessment calculations done for Laxemar are reported in the documentation included in the application under the Nuclear Activities Act.

Post-closure safety in the EIS

SR-Site shows that the activity in the final repository for spent nuclear fuel does not have any significant radiological impact on human health and the environment. This comprises a point of departure for the environmental impact statement and a prerequisite for obtaining a licence for the activity. Since the final repository does not give rise to any significant radiological environmental impact, the EIS only contains a summary of conclusions and important results from SR-Site.

Continued work

Both applications will be circulated for consideration by the environmental court and SSM, which means there will still be ample opportunity for review and comments on the content, calculations and conclusions in the assessment of post-closure safety.

C – The no action alternative – scope and main features

The requirement in the Environmental Code that a no action alternative shall be included in the EIS means that the EIS must contain a description of what will happen if the applied-for activity is not implemented. In this case, what will happen is continued storage of the spent nuclear fuel in Clab.

SKB has described the feasibility and consequences of continued interim storage in Clab. Wishes have been expressed that SKB should broaden the description of the no action alternative, for example by presenting other methods for continued interim storage and describing different possible societal evolutions. These types of presentations and accounts go beyond the requirement on description of a no action alternative in the Environmental Code and do not lie within the purview of SKB's work.

Furthermore, a part of SKB's mission is to dispose of the spent nuclear fuel so that human health and the environment are protected in the short and long term. Society's requirements on how disposal should take place are embodied in laws, regulations and international agreements. The Nuclear Activities Act says that the holder of a licence for nuclear activities is responsible for "...ensuring the safe management and final disposal of nuclear waste arising in the activities...". Sweden is a party to the 1997 Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. SKB has interpreted its obligation under this convention to entail that the waste problem shall in all essential respects be solved by the generations who have benefited from the nuclear power. In other words, to "wait and see" is not an acceptable option.

In this context it can also be mentioned that Oskarshamn Municipality has said that they do not view Clab as a final solution. The municipality has said yes to interim storage of spent nuclear fuel in Clab, but the ultimate aim must be that the spent fuel is placed in a final repository.

D – Consequences of interruption in the work

There are no steps in the process in the encapsulation plant that require rapid action. If the encapsulation process has to be interrupted for some time there are no environmental consequences. Only a few canisters are handled at the same time, and they are handled by remote control in radiation-shielded areas.

Nor does the process in the final repository involve any steps that require quick responses. It could stand idle and the area be closed off for several years without any consequences for safety in the final repository. One canister of encapsulated fuel at a time is fetched in a transport cask from the terminal building on the ground surface and taken down the ramp. In the transloading hall, the canister is transferred to the deposition machine and carried to the deposition hole. Both the transport cask and the deposition machine are radiation-shielded and can be left with a canister inside.

If there is a loss of cooling in the storage pools in Clab, the water will be heated up. The time it would take to heat the water to boiling and vaporize it is highly dependent on the fuel's decay heat. If the facility is abandoned at the point when the fuel reaches its peak decay heat, it takes roughly a week before the water starts to boil. Then it takes another ten to twelve weeks before the pools have boiled dry. In other words, there would be plenty of time to top up with water or take other action. The subject is dealt with in detail in the report "Förlängd lagring i Clab" ("Extended storage in Clab", in Swedish only), SKB R-06-62.

E – The final repository's location in an area with high natural values

There are high natural values in and near the area in Forsmark that may be affected by the establishment of a final repository for spent nuclear fuel. It has been suggested that the site selected by SKB for the final repository is unsuitable in view of this and that the natural values have not been given enough attention in the consultations.

SKB has been clear throughout the consultation process about the fact that there are great natural values in the Forsmark area. This type of question was raised already in the preliminary version of the EIS, which was the subject of the consultations, and impact, effects and consequences for natural values were described.

Detailed assessments of the natural values that risk being affected by groundwater lowering are presented in the two appendices on water operations: "Vattenverksamhet i Forsmark. Bortledande av grundvatten från slutförvarsanläggningen för använt kärnbränsle". ("Water operations in Forsmark I. Diversion of groundwater from the final repository for spent nuclear fuel", in Swedish only), SKB R-10-14, and "Vattenverksamhet i Forsmark II. Slutförvarsanläggningen för använt kärnbränsle – vattenverksamheter ovan mark". ("Water operations in Forsmark II. The final repository for spent nuclear fuel – Water operations on the surface", in Swedish only), SKB R-10-15. Preliminary versions of these two appendices comprised background material for the consultation on water operations.

SKB will take steps to limit the magnitude of the groundwater impact (sealing of the rock) and to mitigate the consequences of groundwater lowering (preparedness for infiltration in sensitive wetlands). Furthermore, we will draw up a management plan to promote the area's natural values on our land in Forsmark. Aside from the cultivated forested areas, it is our ambition that the management of the area should be aimed at preserving and promoting the area's natural values.

Considering the planned measures and given that the management of the area will be adapted to the local natural values, there are good prospects that the area's biological status will not be adversely affected in a large perspective. Furthermore, the area has been designated by the Swedish Nuclear Power Inspectorate (SKI) as being of national interest for final disposal of spent nuclear fuel.

F – Site selection and choice of method

Site selection

A suitable site has been selected

SKB has selected Forsmark as the site for the final repository for spent nuclear fuel. The site selection is the end result of an extensive siting process that began in the early 1990s. The strategy and plan for the work was in turn based on experience from investigations and development work over a period of more than ten years prior to then. In other words, the selection of a site for the final repository is well-founded.

Sites were chosen for site investigations on the basis of an extensive body of material that included general siting studies, feasibility studies etc. The choice was based on a number of factors, foremost among them being the potential suitability of the site with respect to post-closure safety, i.e. the properties of the bedrock. The properties of the bedrock were also the most important aspect in the choice between Laxemar and Forsmark.

The selected site, Forsmark, is very suitable to host a final repository for spent nuclear fuel according to the KBS-3 method. The area around Forsmark has been designated as being of national interest for energy production, as well as for final disposal of nuclear waste. The final repository will be an addition to the existing cluster of nuclear activities in Forsmark.

SKB is submitting applications under the Nuclear Activities Act and the Environmental Code for a licence to build the final repository in Forsmark. The basis for the applications is an assessment of post-closure safety for a siting in Forsmark. The safety assessment calculations done for Laxemar are reported in the documentation included in the application under the Nuclear Activities Act.

It is SKB's choice

As the applicant it is SKB's responsibility to identify a site for the facility in the applications for a final repository for spent nuclear fuel. SKB argues that the site is good enough both in the applications themselves and in an appendix to the applications. The Swedish Radiation Safety Authority, the environmental court and the Government will decide whether the choice is sufficiently well-founded.

The scope of the description in the EIS

The EIS describes the site selection work in general terms with arguments as to why SKB rejected sites. The area in Forsmark is described in detail and compared with the site in Laxemar.

A more detailed account of the site selection process is provided in a special appendix to the applications (SKB R-10-42), which describes the siting work and the selection of a site for the final repository. Furthermore, SKB's supporting material and reasons for the decisions that have been made during the course of the work, and for the site selection decision, are also described.

Choice of method

Development of the KBS-3 method

SKB has developed the KBS-3 method over a long period of time. An account of the development of the method has been submitted to the Government every three years in the RD&D programmes. Over the years, the direction of SKB's work has received the approval of both the Government and the regulatory authorities.

Studies of other methods

SKB has studied and followed other methods than the KBS-3 method for a long time. This work has also been described in the RD&D programmes. On several occasions, SKB has also compared other methods with the KBS-3 method. These comparisons have not shown that any of the other methods are more suitable than the KBS-3 method. On the contrary, none of the other methods satisfy the purpose of the final disposal of the spent nuclear fuel.

Scope of description in the EIS

The EIS describes environmental consequences caused by the applied-for activity, i.e. the use of the KBS-3 method. The EIS contains an overview of other methods for disposal of the spent nuclear fuel, as well as SKB's view of these methods. However, SKB sees no reason to describe the environmental impact of methods that do not fulfil the purpose of the final repository or are not available.

SKB's choice of method is presented in a special appendix to the applications entitled "Utvärdering av strategier och system för att ta hand om använt kärnbränsle" ("Evaluation of strategies for disposal of spent nuclear fuel", in Swedish only), SKB R-10-25. The report describes the grounds for SKB's choice of the KBS-3 method and the reasons why other methods have been dismissed. Forsmark has been chosen as the site for the final repository based on the KBS-3 method.

G – Description of cumulative effects in the EIS

By "cumulative effects" is meant how an activity or a measure, in combination with other activities in the area, impacts the environment in an area. The EIS deals with cumulative effects of other existing or planned activities in both the Laxemar and Forsmark areas. In the Laxemar area, the Oskarshamn Nuclear Power Plant and the planned holiday resort in Figeholm have been taken into consideration. In the Forsmark area, the Forsmark Nuclear Power Plant, the final repository for short-lived radioactive waste (SFR), a planned wind farm and the high voltage direct current (HVDC) cable between Sweden and Finland (the Fenno-Skan cable) have been taken into consideration.

Viewpoints have been expressed that SKB should also consider the cumulative effects that can arise due to the final repository for spent nuclear fuel that Finland plans to build near Olkiluoto. SKB does not intend to do this. Firstly, it can be observed that a prerequisite for licensing of the final repositories that are planned in Sweden and Finland is that the countries' regulatory requirements are met. Secondly, it can be noted that the question of environmental impact caused by activities in other countries is dealt with under other rules. SKB, via the Swedish EPA, is conducting consultations under the Espoo Convention with the countries around the Baltic Sea. These consultations focus on transboundary environmental impact. Similarly, Finland is conducting consultations with the countries around the Baltic Sea, including Sweden, on the possible transboundary environmental impact caused by their planned final repository.

The EIS deals with transboundary environmental impact caused by the activity for which SKB is applying for a licence. It is concluded that the only possible transboundary environmental impact would be if radionuclides were dispersed from Clab, the encapsulation plant or the final repository or in connection with transport of the encapsulated nuclear fuel. How much radioactivity could be released from different types of mishaps during the operating time of the facility is described in the various safety analysis reports that have been produced for the different facilities and for the transportation system. Analyses show that the doses to which an individual could be exposed are far below the relevant limit values.

SSM has a regulation with a risk criterion that SKB must show that the final repository will satisfy in the long term. The risk criterion applies to a representative individual in the group exposed to the greatest risk. Individuals living at greater distances from the final repository, for example in nearby countries, will be exposed to even lower risk.

H – SKB's proposal for conditions

In the case of environmentally hazardous activities, the conditions for the licence are determined based on the principle that the environmental impact with respect to human health and the environment should be acceptable.

SKB proposes in its application under the Environmental Code which conditions should apply to noise outdoors next to residences for activities at the encapsulation plant and the final repository during the construction phase and the operating phase and to handling of chemical products and hazardous waste. Otherwise, SKB proposes in its application under the Environmental Code that the activities – including measures to reduce water and air pollution, waste and other disturbances to the surrounding environment – should be conducted in essential agreement with what SKB has stated or undertaken in the objective.

1 Interim storage facility and encapsulation plant

1.1 The activity in Oskarshamn includes construction of a new small rock pit. The water from this rock pit will be treated by sedimentation and oil separation. There will be no nitrogen removal, since SKB does not expect the quantities to be great. However, the National Board of Fisheries would like to know the actual quantities. (National Board of Fisheries)

(SKB) Detailed estimates of nitrogen quantities in the drainage water generated in conjunction with the construction of the encapsulation plant can be found in the report SKB P-09-06, "Dagvattenhantering för Clab och inkapslingsanläggning för använt kärnbränsle", ("Stormwater management for Clab and the encapsulation plant for spent nuclear fuel", in Swedish only). After having passed treatment installations for sedimentation and oil separation, the drainage water will be conducted to the storm-water system for Clab. SKB intends to improve Clab's existing system for stormwater management by establishing a stormwater pond at Herrgloet. The stormwater pond will remove some of the nitrogen (roughly 30%) from the drainage water it receives.

1.2 The Regional Council would like SKB to report on the possibility of making use of all waste heat from Clink and the environmental consequences of this. (Regional Council in Kalmar County)

SKB will use the best available technology for optimizing energy efficiency, for example heat is planned to be extracted from the cooling water to heat the encapsulation plant.

1.3 The three consultants' viewpoints on the municipality's question no. 107, concerning what requirements are made on defects in the form of slag inclusions and methods for quality assurance of the copper canisters, including using the recently discovered technique of generating sound waves in the terahertz range... (Östhammar Municipality, municipal executive board)

(SKB) The requirements on permissible defects are divided into requirements on the copper shell and on the inserts.

The copper shell is made of a very pure material based on electrolytic copper, where we have not managed to detect any defects whatsoever in the parent metal. We have, however, shown that forging of the copper lids can give rise to cold shut. What has then gone wrong in the process has been investigated. We have methods to detect the occurrence of such defects (ultrasonic and inductive testing) that we use regularly for inspection of test-fabricated lids. We normally get small root defects of a few millimetres in the seal welds. We can minimize these defects by means of recently developed adaptive control of the welding process. We can detect these defects as well by means of subsequent inspection.

The purpose of acceptance requirements for defects in the copper shell is to ensure an intact corrosion barrier. We have not yet set the final requirements on permissible defects in the copper shell.

As far as the cast insert is concerned, we can tolerate defects such as slags and porosities. The exact size of the tolerated defects depends on where they are located in the insert. The tolerance is calculated based on nuclear standards.

As far as testing methods are concerned, we are working with ultrasonic testing with frequencies of several megahertz (MHz) using phased array technology. Higher-frequency sound waves are quickly attenuated due to the material structure, in which case we do not get an image of the interior of the canister. This applies to both the copper shell and the insert. Gigahertz (GHz) waves are used for acoustic microscopy, i.e. for studies of small test objects such as integrated circuits. Terahertz (THz) waves are not usually used for ultrasonic testing, but as a form of radar (electromagnetic waves).

1.4 Pages 187–189: ***In view of the nearness to Clab, blasting will be carried out with great caution; //page break// for example, smaller and denser charges than normal will be used.***

It appears as if a sentence has been lost in the page break. (Östhammar Municipality – municipal executive board)

(SKB) This has been put right in the final version of the EIS.

1.5 Page 162: ***Table 8-4. Annual radioactive discharges from Clab to water recipient. Mean values of measured discharges during the period 1997–2006.***

What do these levels mean? (Östhammar Municipality – municipal executive board)

(SKB) The table shows mean values over a 14-year period for the radioactivity that leaves the facility via effluent and contaminates the surrounding environment, in other words the actual discharges from Clab during operation that contaminate the sea (Hamnefjärden).

1.6 Page 162: ***When more damaged fuel is stored in Clab, discharges of Cs-137, which comprise a significant fraction of the radioactive discharges to water, will increase.***

How much could these discharges increase? (Östhammar Municipality – municipal executive board)

(SKB) The Cs-137 concentration in the water in the storage pools will increase with the quantity of damaged fuel that comes to Clab, but damaged fuel is not often received. Before the water is discharged to the receiving water (the Baltic Sea), it is

purified by filtration and ion exchange, so the discharged quantities are small. The established limit values for effluent will not be exceeded. See also reply to question 1.9.

1.7 **Page 163:** ***If all measures can be adopted without impairing safety in the plant, the discharges could be reduced by 95–99%. This would mean that current discharges could be significantly reduced, despite an increasing load.***

If it is possible to reduce the discharges by 95–99%, why hasn't SKB done this? (Östhammar Municipality – municipal executive board)

(SKB) Additional study and practical tests are required to determine whether the measures can be implemented in a manner that does not adversely affect nuclear safety, radiation protection and waste management at the plant.

1.8 **Page 167:** ***Figure 8-17. Dose to critical group from annual discharges to water from Clab during the period 1998–2007.***

The bar showing release and dose for 2001 shows that the releases were much higher this year. Why were the releases much higher in 2001? (Östhammar Municipality – municipal executive board)

(SKB) The relatively high value for 2001 is due to the fact that a major atmospheric release occurred caused by a dust puff during the cleaning work.

1.9 **It emerged at the consultation meeting in Oskarshamn on 9 February 2010 that the radioactivity leaking from Clab is due to the fact that fuel rods can be damaged in the reactors. When the fuel comes to Clab, this leads to some escape of radioactivity. Does it still happen that fuel rods are damaged when they arrive at Clab? Will power increases in reactors lead to more fuel being damaged? (Östhammar Municipality – municipal executive board)**

(SKB) It happens that damaged fuel is received in Clab, but not often. There is nothing to indicate that the power increase will lead to an increase in the incidence of fuel damage, which means releases of Cs-137 will not increase. Even now fuel damage is rare, and constant efforts are made to further reduce its occurrence. See also reply to question 1.6.

1.10 **Page 20, first paragraph:** ***In areas where airborne radioactivity is expected, the ventilation system is equipped with filters.***

What happens with these filter later? Where are these filters stored prior to final disposal? (Östhammar Municipality – municipal executive board)

(SKB) Spent filters are sealed in containers and immobilized in cement moulds if necessary. These moulds are then transported to SFR for final disposal.

1.11 **Inspection of canister: Will SKB work with self-inspection or will there be some independent inspection organization? If you have self-inspection, how will SKB quality-assure the self-inspection? (Östhammar Municipality – municipal executive board)**

SKB's activity is subject to the Swedish Radiation Safety Authority's regulations. This means that the self-inspection which SKB has developed in its quality manual will be supplemented by primary and independent safety review, independent inspection by a third-party body with accreditation in the area and qualification of certain systems and processes.

1.12 **Page 173:** ***The encapsulation plant is designed for a production capacity of 200 filled canisters per year, i.e. around one canister per work day /9-1/. The planned production rate is an average of about 150 canisters per year.***

Is a production rate of a canister a day a stressful pace? It isn't a good idea to set up time requirements. Enough time should be allowed for each canister to encapsulate the fuel in a safe manner. Safety must always come first. (Östhammar Municipality – municipal executive board)

SKB agrees that safety must always come first. A production rate of one canister per day is not a stressful pace.

1.13 Page 177: ***The fuel is then taken up out of the pool and put into a handling cell to dry and be placed in a copper canister.***

How is the fuel dried? Is it possible to get the fuel completely dry? If any water is left can it affect the canister's barrier function? (Östhammar Municipality – municipal executive board)

(SKB) Drying is done by vacuum, but we have also looked at an alternative that entails drying by hot air. The drying method is described in the technical description – SKB R-10-01, "Teknisk beskrivning – mellanlagring, inkapsling och slutförvaring av använt kärnbränsle", ("Technical description, interim storage, encapsulation and final disposal of spent nuclear fuel, in Swedish only") – not in the EIS. After drying a small amount of water remains, about 600 millilitres per canister. The remaining water will not affect the canister's barrier function.

1.14 Page 201: ***Mishaps that are analyzed in the preliminary safety analysis report are, for example, major fire, prolonged loss of cooling, major leakage from pools, various handling mishaps (e.g. dropped transfer canister or fuel assembly), earthquake and other external impact.***

What is a transfer canister? (Östhammar Municipality – municipal executive board)

(SKB) In the handling pool in the encapsulation plant, the fuel assemblies are moved from the storage canister to a transfer canister, which is intended for internal handling. This is done for several reasons, for example that the storage canisters contain more assemblies than can fit in a canister, while the transfer canister has the same number of positions as the canister.

1.15 Clab – Water management

Viewpoints on water management mainly concern stormwater management, which besides Clab also involves the encapsulation plant. R-09-XX, reference /8-1/, has been used as background material.

First the municipality notes that stormwater is defined as wastewater in the Environmental Code (Chap. 9, Sec. 2, point 3). This means that stormwater discharge is an environmentally hazardous activity and that plants for stormwater should be designed in accordance with the principle of best available technology.

SKB's ambition to improve the current stormwater system is laudable. However, a clearer functional description of this process is needed. This is because stormwater is often a significant source of pollution. The pollutants are mostly bound to particles, which makes treatment relatively simple, e.g. that the water first passes through an embankment of fine-grained sand on the downstream side of a pond before being discharged into a watercourse.

If extinguishing water can be diverted to the stormwater system following a fire, particle separation is particularly important. If the extinguishing water may also contain radioactive particles, particle separation is even more important. The EIS does not contain any description of what extinguishing water after a fire might look like and where it might end up. The municipality would therefore like a description of the content of the extinguishing water and how it is treated in the event of a fire in Clink.

In order for particle removal to work, there must not be any uncontrolled overflow of

the water in the event of high flows, which is ensured by flow equalization via e.g. a pond, which has also been proposed in the EIS. The pond, with an area of 400 sq.m according to the EIS, would however appear to be small considering the figures on stormwater volume provided in the EIS.

The municipality would like SKB to stipulate in the EIS:

- **that stormwater shall be treated to remove particles before being discharged into Herrgloet,**
- **that the requisite equalization capacity shall be provided so that overflow of stormwater cannot occur.**

The purpose of the above precautions is to remove all particles from the water prior to discharge and to equalize any variations in hydraulic load. The municipality would like the application to contain a condition to this effect. (Oskarshamn Municipality)

(SKB) The report that describes stormwater management for Clab and Clink has been published, SKB P-09-06, "Dagvattenhantering för Clab och inkapslingsanläggning för använt kärnbränsle", ("Stormwater management for Clab and the encapsulation plant for spent nuclear fuel", in Swedish only).

Stormwater: wastewater or not

According to the municipality, stormwater should be defined as wastewater under the Environmental Code. This is correct, but does not apply to stormwater from one or two properties. In SKB's case, the stormwater that is diverted to the planned pond comes from only a part of a single property. The stormwater is not connected to any existing system and does not include stormwater from any other property than SKB's own property. SKB's interpretation is therefore that the stormwater cannot be defined as wastewater in the sense of the Environmental Code. However, the general rules of consideration are applicable, including the precautionary principle, since stormwater management is a part of the activity. SKB has therefore come up with a new proposal for management of stormwater at Clab in conjunction with construction and operation of Clink.

Capacity of stormwater pond and risk of overflow

The surface area of the stormwater pond (400 m^2) is equal to nearly three percent of the paved area from which water is collected (14,000 m^2). Three percent of the paved area is in the upper end of the range that is normal for a stormwater pond. SKB judges that the capacity of the planned pond for flow equalization and particle removal is sufficient.

The existing piping system has sufficient capacity for at least a 10-year rain event, and probably also a 20-year rain event. From a stormwater treatment viewpoint, it can be an advantage that the stormwater bypasses the stormwater pond during extreme flows in order to prevent flushing effects. This can be achieved by giving the new pipe to the pond a limited diameter and conducting other water via an existing pipe to Herrgloet. The discharges from such occasional, very rare rain events will comprise a negligible fraction of the total pollution load.

SKB observes that there is nothing in the content of the stormwater to warrant special measures to prevent stormwater overflow at all costs. Furthermore, oversizing the pond increases the risk that it will dry out and thereby not fulfil its function completely.

Fire and extinguishing water

All waste water that arises in the plant is conducted via the floor drainage system to the Oskarshamn Nuclear Power Plant's sewage treatment plant. This includes extinguishing water. In the sewage treatment plant, the radioactivity is removed from the water before it is discharged into Hamnefjärden via the cooling water stream.

No radioactively contaminated water will be conducted to the rainwater drainage system. Only extinguishing water used on the outside of the buildings will be drained via surrounding grass and asphalt surfaces to the rainwater drainage system, which connects to the stormwater pond. The solution proposed by SKB for management of stormwater from Clab has ample capacity to prevent untreated extinguishing water from reaching the receiving water.

SKB asserts that the measures being adopted to manage the stormwater formed on the property are reasonable and well in line with the intentions of the Environmental Code.

1.16 Clab – Releases of radionuclides

Proposed measures to reduce releases and discharges of radionuclides are given on page 162.

The section begins by observing that discharges will increase. If no measures are adopted, two of the three factors mentioned could increase the discharges to 1,000 MBq per year.

The description of possible measures to maintain or reduce the discharges is unclear. SKB refers, in reference /8-10/, to a study where a number of measures have been proposed, but SKB says that it is uncertain whether the measures are technically feasible. If measures are proposed, shouldn't that normally mean that the measures are feasible? Does SKB mean that the measures have not been evaluated with respect to the safety aspects, and if so what is critical for feasibility? The municipality is anxious that the discharges not increase and would like to see a commitment in the final EIS regarding the measures SKB intends to adopt to maintain or reduce the discharges.

Dose to critical group from releases from Clab is shown on page 167 in Figure 8-17. What is the reason for the sudden spike in the releases in 2001?

Figure 8-19 on page 168 shows a time series of dose to critical group from nuclear facilities in Oskarshamn. Why doesn't the graph cover the last few years (the time series covers the period 1970–2004)? The same question also applies to Figures 8–17 and 8–18, where the statistics cover the period 1998–2007. In both cases measurements are continuous, so data should also be available from the immediately preceding years.

The municipality would like to know the following:

- **reason for spike in dose to critical group in 2001 (Figure 8-17),**
- **update of Figures 8-17, 8-18 and 8-19,**
- **what SKB means by "technically feasible". Feasible in what sense?,**
- **what SKB means by "jeopardize safety". What is the source of risk? The process?, External threats?**
- **what measures SKB intends to adopt to maintain or reduce the releases and discharges. (Oskarshamn Municipality)**

(SKB) The relatively high value for 2001 (Figure 8-17) is due to the fact that a major atmospheric release occurred caused by a dust puff during the cleaning work. Figures 8-17 and 8-18 have been updated with more recent statistics.

The study referred to by SKB resulted in a number of proposals for measures such as use of more efficient treatment technology. However, practical tests are required to determine whether they are feasible. Further study is also required to determine whether the measures can be implemented in a manner that does not adversely affect safety, radiation protection and waste management at the facility. If all measures can be adopted, the discharges could theoretically be reduced by 95–99 percent.

1.17 Clink – Drying of fuel

Drying of fuel is a new process in the final repository system. The drying process gives rise to releases of radionuclides that will be captured by filters or collected when the system is decontaminated.

The municipality would like to know the following:

- **the drying method that is planned to be used,**
- **whether the results of drying (e.g. water ratio/water content) are critical with respect to unwanted reactions in the canister or other releases and whether criteria have been established for approved/rejected drying results,**
- **whether the proposed drying method is used elsewhere and, if so, what the experiences are of this method and its emissions,**
- **whether the chosen method is best available technology. (Oskarshamn Municipality)**

(SKB) Drying of the fuel is done by vacuum, but we have also looked at an alternative that entails drying by hot air. After drying a small amount of water remains, about 600 millilitres per canister. The remaining water will not affect the canister's barrier function.

The method for vacuum drying described in the application is used both nationally and internationally in conjunction with fuel shipments. The drying systems are equipped with HEPA filters that capture the radioactive particles dislodged from the fuel during the drying process.

While designing the encapsulation plant we also evaluated drying with hot air. Right now we are evaluating a third method, where nitrogen gas is used to drive the water out of the fuel. It is very possible that this will be the method ultimately chosen for drying of the fuel. This is a part of our ongoing efforts to find the best available technology.

1.18 Clink – Waste management

Waste management is described on page 192. The low-level waste is taken to MLA, the near-surface repository for low-level waste in Simpevarp, where OKG is the activity operator, and the intermediate-level waste is taken to SFR in Forsmark, where SKB is the activity operator.

The waste consists among other things of filters from Clink. There are two strategies for managing filters (page 192). One strategy is frequent replacement of filters, whereby the filters can be regarded as low-level waste and be placed in MLA; the other is to replace the filters less frequently and regard them as intermediate-level waste for deposition in SFR.

With regard to MLA, the municipality would like the following information:

- **whether the licence for MLA contains such limit values that long-lived nuclides are limited in the repository and whether a quantity limit is stipulated for such nuclides,**
- **whether the repository is subject to the Landfill Ordinance (2001:512),**
- **in the event the repository does not fall under the Landfall Ordinance, whether MLA is comparable in design, operation and closure to landfills that fall under the Landfill Ordinance.**

SFR and MLA are not covered by SKB's application. The municipality questions whether MLA is a suitable repository for low-level waste from Clink and would

rather see that such waste from the final repository system is deposited in SFR. The municipality would like the application to contain a condition to this effect. (Oskarshamn Municipality)

(SKB) The original licences for MLA 1 and MLA 2 do not contain any limit values for long-lived nuclides, but are limited by requirements regarding a maximum radioactivity content in the whole repository.

In 2010, OKG received new updated radiation protection conditions for the whole of MLA from SSM. They include nuclide-specific limit values (including for long-lived nuclides) stipulating how much radioactivity may be present in MLA when radiation monitoring ceases in 2075. Based on what is already present in MLA, OKG has therefore calculated what can be deposited in future campaigns without exceeding the nuclide-specific limits for 2075.

The Landfill Ordinance (SFS 2001:512) does not formally apply to nuclear waste repositories. However, SSM makes the judgement in the new radiation protection conditions that the Ordinance is a reasonable point of departure for the requirements that should be made on siting, design and operation. SSM's new radiation protection conditions for MLA therefore contain many new requirements on OKG that can be directly linked to the Landfill Ordinance.

1.19 Clink – Noise

The consequence for increased noise due to transport activities has not been analyzed in the EIS. Noise from highway 743 is one of the biggest disturbances from the activity, which is also pointed out in SKB's own reports. SKB should hold a discussion and declare what they assess the consequence to be of the noise from highway 743. Does the increase warrant protective measures of a technical and/or administrative nature or compensatory measures of some kind?

Beyond what has been said above, the measurement unit for noise in the form of daily equivalent sound level is questioned, as is the numerical value for acceptable noise, in this case a guideline value based on a 24-hour value (daily equivalent).

The equivalent level measured over 24 hours on a road that is sparsely trafficked during certain parts of the day "permits" a high sound level during other parts of the day. The daily equivalent sound level can be suitable as a measurement unit on roads where the traffic is evenly distributed during the day. Highway 743 is not such a road. The guideline value for highway 743 should be based on the disturbance the noise can cause at a particular place and at different times of the day, for example daytime 07–18 hrs, evening 18–22 hrs, and nighttime 22–07 hrs, as well as Sundays and holidays. These "site-specific" guideline values should also be supplemented by maximum values for the noisiest vehicles.

In summary, the municipality is of the opinion that the road noise should be reported, commented on and assessed in the EIS based on the following principles: what SKB considers to be the criterion for acceptable noise level on highway 743 and how this should be measured the activity exacerbates a disturbance that already today exceeds the guideline values that SKB cites and presumably contends should apply. SKB should then show that the existing noise and the additional noise from the activity at Clink do not give rise to detriment or damage in the sense of the Environmental Code. (Oskarshamn Municipality)

In its studies, SKB uses the criteria that are standard in the sector. When it comes to noise, these criteria come from the Swedish EPA's general recommendations and the Swedish Transport Administration's work with noise. According to the noise study commissioned by SKB, slightly more residents will be exposed to noise levels above the guideline values, but no health consequences are expected.

1.20 Clink – Traffic accident risk and insecurity for road users and residents.

SKB's report R-05-48 regarding highway 743 states that the existing road section in its current condition entails:

- **an elevated accident risk,**
- **an elevated consequence risk in the event of an accident,**
- **insecurity for road users and residents,**
- **minimal space for pedestrians and cyclists,**
- **limited visibility at certain exit points,**
- **barrier effects (difficult for residents to cross the road),**
- **conflicts between vehicles travelling at different speeds.**

The municipality points out that the current status of highway 743 does not allow an increase in traffic without protective measures and/or precautions being taken. In view of the above, the municipality would like to know SKB's position regarding:

- **the consequences of the increased traffic resulting from the activity at Clink,**
- **if and how protective measures and/or precautions will be issued and what they will be. (Oskarshamn Municipality)**

(SKB) The consequences of the traffic generated by the activity at Clink are reported in the EIS. SKB's future activity will result in increased traffic on highway 743. SKB will, however, plan the transport activities to limit the traffic increase and the traffic accident risks, for example by reducing the number of empty hauls. Possible protective measures are the responsibility of the Swedish Transport Administration.

1.21 No action alternative

For Oskarshamn Municipality, the no action alternative entails great uncertainty regarding the quantity of spent nuclear fuel that will be stored in Clab, as well as the time horizon for interim storage. It can be noted that power increases have been implemented in the nuclear power plants during Clab's operating time, leading to an increase in quantities of spent fuel received. In the event new reactors are built in the future, they will probably have a higher power capacity, further increasing the quantities of spent fuel coming to Clab.

SKB has analyzed different scenarios and concludes (page 298) that *"Prolonged interim storage in Clab does not entail any serious risks for the environment, provided today's high quality of operation and maintenance can be maintained. Clab can, with reasonable maintenance, be safely operated for 100–200 years, and the fuel withstands long-term storage well. If Clab should be abandoned in the future, this could have serious consequences".*

The municipality concludes, on the basis of SKB's analysis, that safety-related considerations are not critical if the no action alternative is opted for, at least not in a 100-year perspective. The municipality does not consider it likely that societal functions would break down so completely that Clab would be abandoned within 100 years. However, the municipality is anxious that Clab should not become a long-term repository. (Oskarshamn Municipality)

SKB is also anxious that Clab should not become a long-term repository. See also SKB's general reply C ("The no action alternative – scope and main features").

1.22 Safety issues

A large part of the encapsulation plant will be located above ground level. The municipality would like information on:

- **what sources of risk have determined the design of the physical protection (are e.g. acts of terror, sabotage, natural disasters and plane crashes included?),**
- **the physical protection for Clab during the construction period for Clink. (Oskarshamn Municipality)**

(SKB) The plant's physical protection must meet the requirements in the Nuclear Activities Act and SSM's requirements in regulations 2008:1 and SSMFS 2008:12.

In SSMFS 2008:1, Chapter 1, Section 2, physical protection is defined as: "Technical, administrative and organizational measures for the purpose of protecting a facility against unauthorized intrusion, sabotage or other such impact which can result in a nuclear accident and for the purpose of preventing illicit trafficking with nuclear material or nuclear waste". Another purpose of the physical protection is to protect SKB's employees, contractors and visitors as well as physical assets from damage. Clink will be subject to the same requirements on physical protection as Clab.

The plan for physical protection is, for security reasons, confidential and is only disclosed to SSM.

SKB is currently overhauling the plan for physical protection during the construction period. This work will probably result in our commencing the construction of the encapsulation plant by enlarging the area for physical protection so that the encapsulation plant is built within this area. This will minimize the impact on the physical protection for Clab during the construction period.

1.23 No action alternative

The proposed no action alternative is continued storage of the spent nuclear fuel in Clab. In the reference scenario with 50–60 years of operation of the nuclear power reactors, it will be necessary to increase Clab's storage capacity by one block (Clab 3). The EIS does not contain a detailed description of how long the current storage capacity will suffice and when the third block will have to be ready for operation. Regarding the no action alternative, the possibility should also be considered that extended storage may be necessary if the licensing and/or the construction of the final repository system takes a much longer time than expected (point 5.4, page 79). Different scenarios that influence when the storage capacity of Clab must be increased should be included in the EIS. It should also be clarified that the no action alternative is not a real no action alternative, since it requires that additional measures be adopted and has a clear and limited duration in relation to the need of long storage time if the final repository is not realized. (County Administrative Board in Kalmar County)

(SKB) The description of the no action alternative and Clab's storage capacity has been developed on the basis of submitted viewpoints. See also SKB's general reply C ("The no action alternative – scope and main features"). See also reply to question 3.49, page 250.

1.24 Licensing

As a main alternative, SKB intends to apply for a licence to build the encapsulation plant adjacent to Clab on the Simpevarp Peninsula. The new, integrated plant is called Clink. The existing licence for Clab must therefore be replaced, and SKB intends to apply for a licence for the whole new facility. The County Administrative Board is of the opinion that the EIS, as well as the licence application, should include the entire Clink facility, including a build-out of Clab stage 3, for the reasons given under the heading "No action alternative". (County Administrative Board in Kalmar County)

(SKB) The present licence applications do not include an extension of Clab with a third rock cavern with storage pools, since an extension will only be necessary in the event of a very large delay of the Nuclear Fuel Programme. See also reply to question 3.49, page 250.

1.25 Risk and safety issues

Section 11.1.2.2 "Risks of unplanned abandonment", page 298, describes a worst-case scenario with dryout in Clab when the fuel reaches its peak decay heat in the year 2042. A dose calculation shows that a person within a distance of 1 km could receive a dose equivalent to about 400 millisieverts per year, which is far above the established dose limit for the public of 1 millisievert per year. It would be valuable from a preparedness viewpoint to also see a calculation showing at what distance from Clab this dose is not exceeded. The worst-case scenario should be described more fully. (County Administrative Board in Kalmar County)

(SKB) A more complete description is provided in the report "Förlängd lagring i Clab", SKB R-06-62 ("Extended storage in Clab", in Swedish only). There it is shown that the calculated dose decreases with the distance from the source (Clab) and if abandonment occurs later in time.

1.26 Sea level rise

Under the heading 11.2.1 Simpevarp, page 299, predictions of higher sea levels due to global warming up to 2100 are described. In the most extreme case, the maximum sea level may rise by 341 cm. No impact assessment is made here of what could happen in the facility at these sea levels.

If it is without any importance for construction/operation at Clink, this should be clearly noted. (County Administrative Board in Kalmar County)

(SKB) The change in sea level has been allowed for by raising of the ground level within the operations area. In the "worst-case scenario" of the sea level rise during the operating period of Clink, only the intake building for cooling water will be affected and will be under water.

1.27 The report describes the following three water operations:

- **Extraction of cooling water from the sea.**
- **Diversion of groundwater.**
- **Construction of stormwater pond.**

According to the current ruling, permits have been issued for extraction of cooling water and diversion of groundwater. The County Administrative Board thereby has no objections to this. The quantity of groundwater that is diverted is expected to increase somewhat. Based on what is described in the report, the County Administrative Board deems that this will not damage any natural environments. However, it is important that water pumped away during the construction phase undergo treatment as described in the report before reaching the receiving body of water.

The County Administrative Board has no objections to construction of a stormwater pond on the site in question. (County Administrative Board in Kalmar County)

SKB notes the County Administrative Board's viewpoints.

1.28 In its consultation response to SOU 2009:88 regarding liability for damages, SERO has demanded that Clab be closed as quickly as possible (Appendix SERO's consultation response). This demand is made against the background of the studies done after the attack of 11 September in the USA where the US Nuclear Regulatory Commission finds that storage of spent nuclear fuel in cooled pools at nearly every nuclear power plant does not provide a sufficient safety margin in the event of a pool failure (Clab – explosive charge in cooling water intake) that causes loss of water in the event of an accident or attack with the result that the water falls below the tops of the fuel assemblies. In such a case there is a risk that the most recently stored fuel from a reactor will get hot enough to ignite the zirconium cladding, which could lead to the release of large quantities of radioactivity (Alvarez et al., 2003a).

The Nuclear Regulatory Commission's own analyses have indicated that such a fire in zirconium cladding with release of radioactivity is possible (e.g. USNRC, 2001 a).

- ***Undesirable* events.**
- ***Probability* that the scenario will occur.**
- ***Consequences* if the scenario should occur.**

The scenario described in the EIS's no action alternative is virtually identical to the scenario described in the NRC study. Planning to build an encapsulation plant adjacent to Clab in such a situation would appear unwise.

The frightening thing about the no action alternative is that it describes the current situation. SKB says that they have dual pumping systems and daily inspection. The Clab facility can be compared to a ticking bomb. Few if any countries in the world besides Sweden have chosen active cooling for interim storage of spent nuclear fuel.

A facility that will be used for up to 50 years after the last reactor has possibly been shut down should not be located closer to a nuclear reactor than 30 km. The distance between Clab and O1 can be estimated at about 700 metres. This is a completely unacceptable distance in this context.

An interim storage facility must be capable of withstanding

- **A collapse of society.**
- **Loss of cooling for a long time.**
- **Loss of power supply for a long time.**
- **Terrorist attacks without great damage to society as a result.**
- **A radioactive area that is highly contaminated for a long time.**

The interim storage facility that has been chosen by most countries with dry casks or castor cylinders should be adopted as soon as possible by Sweden (see appendix by Professor Frank von Hippel – compilation of "Spent Fuel"). The cylinders should be spread over a large geographic area in Sweden.

The encapsulation plant should be located at Forsmark to minimize transport.

In the no action alternative in the preliminary Environmental Impact Statement, there is a description of a scenario with abandonment of Clab without any description of what happens when the water level has fallen below the fuel assemblies, which is described in (Appendix – "Spent Fuel Pool Storage").

The no action alternative described in the preliminary EIS is not an acceptable no action alternative! (SERO)

(SKB) It can initially be noted that the no action alternative entails that final disposal is not realized, which entails continued storage in Clab of the spent nuclear fuel. See also SKB's general reply C ("The no action alternative – scope and main features").

The question is based among other things on a document from Alvarez, which is in turn based on reports produced by the NRC. When the NRC reviewed Alvarez's work, they concluded that the NRC's data had been overinterpreted and that the conclusions in the document are therefore not correct.

We have long experience of operating Clab, about 25 years. Clab as a facility and its operation are supervised by SSM. If there is a loss of cooling in the storage pools in Clab, the water in the pools will be heated up. The time it would take to heat the water to boiling and vaporize it is highly dependent on the fuel's decay heat. If the facility were abandoned at the point when the fuel reaches its peak decay heat, it would take on the order of a week before the water starts to boil. Then it would take another ten to twelve weeks before the pools have boiled dry. In other words, there would be plenty of time to top up with water or take other action. The subject is dealt with in detail in the report "Förlängd lagring i Clab" ("Extended storage in Clab", in Swedish only), SKB R-06-62. The report also deals with what

happens when the water level has fallen below the fuel assemblies. See also SKB's general reply D ("Consequences of interruption in the work").

Simpevarp and Forsmark are compared in the EIS with regard to siting of the encapsulation plant. In general it can be observed that no significant consequences or differences in terms of risks have been identified, so the two sites are judged to be equivalent from an environmental and health viewpoint. The advantage of a siting at Clab is that the personnel's experience of fuel handling can be taken advantage of at the same time as SKB can utilize the existing systems and plant parts in Clab for the encapsulation plant as well.

1.29 Power increase at existing reactors increases accident risk

Review of distance to reactors for Clab and planned final repository in Forsmark in relation to the so-called Chernobyl distance where the recommendation is not to locate future activities closer to a operating reactor than 30 km.

A power increase of 40% in existing reactors can increase the accident risk by a factor of three.

The power increase can probably not be accomplished by an increase of temperature and pressure in the reactor vessel but by an increase in the flow of steam, in other words the quantity of steam will probably be increased by increasing its velocity without increasing its pressure and temperature. This could lead to critical steam velocities approaching the speed of sound, causing "steam explosions" or powerful pressure pulses accompanied by vibrations in fuel and control rods, at the same time as the critical temperature where water can be kept in the liquid phase is about 374 degrees and the pressure is 220 bar. When water is converted to steam the reactor loses the water's damping action in the nuclear process. The difference between the operating temperature of 283 degrees and the supercritical temperature of 374 degrees is only 91 degrees. (SERO)

(SKB) If there is a loss of cooling in the storage pools in Clab, the water will be heated up. However, we are not talking about any rapid processes in Clab; there is plenty of time to add water or adopt other measures. See also SKB's general reply D ("Consequences of interruption in the work").

A prerequisite for SSM to grant licences for power increases is that they can be implemented safely in the nuclear power plants. What is of interest to SKB is how the power increases will affect the properties of the spent nuclear fuel. There will be no change in the current set of requirements for handling spent nuclear fuel.

1.30 No action alternative acc. to EIS identical to current situation: This alternative is not a no action alternative, since Clab cannot be abandoned without devastating consequences. (SERO)

(SKB) The no action alternative entails that final disposal is not realized, which entails continued storage in Clab of the spent nuclear fuel. See also SKB's general reply C ("The no action alternative – scope and main features").

If there is a loss of cooling in the storage pools in Clab, the water will be heated up. However, we are not talking about any rapid processes in Clab; there is plenty of time to add water or adopt other measures. See also SKB's general reply D ("Consequences of interruption in the work").

1.31 Use of compact storage canisters in Clab raises new questions. [Note: In the petition for SERO there is an argument leading to the conclusion that the distance between the fuel assemblies in Clab must be increased rather than decreased.] **(SERO)**

SKB has switched from standard storage canisters to compact storage canisters in Clab 1, so we have experience of this. As far as power increases at the nuclear power plants are concerned, which do indeed lead to increased burnup, we will evaluate what this means for the design of the storage canisters, choice of material, etc.

1.32 The interim storage facility at Clab should switch as soon as possible to dry casks according to the German or American model. (SERO)

SKB notes the viewpoint, but is of the opinion that Clab is well suited for interim storage of spent nuclear fuel.

1.33 Copper canister – no description of internal environment – there are no canister comparisons with e.g. plasma-sprayed boron ceramic coating, US Patent WO 2007/117279 A2. (SERO)

(SKB) The copper canister is dealt with thoroughly in the assessment of post-closure safety, SR-Site, with background reports.

1.34 Stormwater

We find no description of how the stormwater will be treated to remove radioactivity e.g. following fire in the plant (extinguishing water). (Döderhult Nature Conservation Society)

(SKB) There is a description of stormwater treatment in the EIS. A more detailed description is provided in the report "Dagvattenhantering för Clab och inkapslingsanläggning för använt kärnbränsle", ("Stormwater management for Clab and the encapsulation plant for spent nuclear fuel", in Swedish only), SKB P-09-06.

All waste water that arises in the Clink plant is conducted via the floor drainage system to the Oskarshamn Nuclear Power Plant's sewage treatment plant. This also includes extinguishing water from fire extinguishing in the buildings. In the sewage treatment plant, the radioactivity is removed from the water before it is discharged into Hamnefjärden via the cooling water stream.

Any extinguishing water used on the outside of the buildings will be drained via surrounding grass and asphalt surfaces to the rainwater drainage system. The eastern part of this drainage system connects to the stormwater pond. The solution proposed by SKB for management of stormwater from Clab has ample capacity to prevent untreated extinguishing water from reaching the receiving water.

1.35 Cooling water intake and discharge

We find no descriptions of the impact of the cooling water intake and the cooling water on local fish stocks and other marine life. (Döderhult Nature Conservation Society)

(SKB) Information on the impact of the cooling water intake and cooling water discharge is provided in concise form in the EIS and in greater detail in the appendix to the EIS entitled "Vattenverksamhet i Laxemar– Simpevarp. Clab/inkapslingsanläggningen (Clink) – Bortledande av grundvatten, uttag av kylvatten från havet samt anläggande av dagvattendamm", ("Water operations Laxemar–Simpevarp. Clab/encapsulation plant (Clink) – Diversion of groundwater, withdrawal of cooling water from the sea and construction of stormwater pond", in Swedish only), SKB R-10-20.

1.36 Radioactive releases

It is evident from the EIS that the quantity of released radioactivity will increase. What will the consequences be if SKB doesn't manage to reduce these releases?

In their safety assessment for the encapsulation plant, SKB has done certain calculations of the possible environmental impact of disturbances and mishaps in Clink. They have calculated that radioactivity may be dispersed up to 10 km, but say that the quantity of radioactivity will not exceed the acceptance criterion. Since we are talking about the dispersal of radionuclides, we would like to see a description of the impact on biological life.

What support does SKB have for its opinion that serious events such as terrorist attacks on the plant will not occur? Clink will be located at a shallower depth than the fuel pools and will thereby be more vulnerable to attack. (Döderhult Nature Conservation Society)

(SKB) The requested assessment of the impact on biological life has now been carried out, see the report "Radiologisk påverkan på växter och djur från Clink under drift", (Radiological impact of operation of Clink on plants and animals", in Swedish only), SKB R-10-53. The results of the study show that radioactive releases from Clink during normal operation are not expected to give rise to any consequences for the animals and plants in the area. The study is summarised in the final version of the EIS.

The facility's physical protection will comply with the SSM's regulations. Clink will be subject to the same requirements on physical protection as Clab. Physical protection is not covered in the environmental impact statement, but is treated in the safety analysis report (SR-Drift) that is appended to the applications.

1.37 Possible Clab 3

Simple calculations show that the fuel pools in Clab 1 and 2 may fill up around the same time SKB expects trial operation of Clink and the final repository to start. If the start of the facilities is postponed, it may be necessary to build another storage pool for spent nuclear fuel. We think that an extension of Clab and its environmental consequences, as well as the safety consequences for Clink if Clab is extended, should be included in the application and the EIS. (Döderhult Nature Conservation Society)

(SKB) SKB's assessment is that another extension of Clab will not be necessary. If additional space for interim storage of spent nuclear fuel is needed, there are other options, such as switching to compact storage canisters in both pools, leaving the fuel longer at the nuclear power plants, dry interim storage of the fuel, or a combination of these and other alternatives. See also reply to question 3.49, page 250.

1.38 Sea level rise

SKB has drawn a map showing how sea level rise could affect the encapsulation plant. The chosen figure, 341 cm, is the result of a purely theoretical calculation. In view of the great uncertainties that exist when it comes to future climate change and associated sea level rises, even higher sea level rises should be studied to see what effects/consequences they have, along with an assumption that they can occur earlier than 2100, i.e. during operation and before the pools have been emptied and Clink has been dismantled. (Döderhult Nature Conservation Society)

(SKB) SKB has studied the consequences of a future rise in the sea level. It is a worst-case scenario of a rise in the sea level during the operating period of about 340 centimetres. Only the intake building for cooling water to Clink will be affected and stand under water in this case. Even if this should occur before 2100, only the intake building for cooling water to Clink will stand under water.

1.39 Proximity to another nuclear activity

What risks are involved in locating an encapsulation plant directly adjacent to a nuclear power plant? We find no environmental impact statement for a situation where, in the event of a serious nuclear power accident, it is not possible to reach Clink due to the fact that the area is severely contaminated. (Döderhult Nature Conservation Society)

(SKB) The processes that occur in the encapsulation plant and the final repository are not rapid ones. If the encapsulation process has to be interrupted for some time there are no environmental consequences. See also SKB's general reply D ("Consequences of interruption in the work").

1.40 Alternative methods

It says on page 13 that continued storage is possible in Clab or with one of the methods for monitored storage used internationally. What other methods are used internationally? (EK Miljökonsult AB)

(SKB) Monitored storage can be divided into wet storage and dry storage. In wet storage, radiation shielding and cooling are provided by water. In dry storage, the storage container or space provides radiation shielding and cooling. Everyday operation is simpler in dry storage than in wet storage, but monitoring is needed in both cases. Monitored storage cannot be said to be a method for final disposal of spent nuclear fuel.

Wet storage requires systems for heat exchange, purification and water supply. Continuous operation and maintenance of the plant are required to guarantee safety. The Swedish interim storage facility Clab is an example of monitored wet storage.

Monitored dry storage can be done in two different ways:

- The spent fuel is placed in specially designed containers of metal or concrete which are stored outdoors or in special storage buildings. The containers constitute radiation shields and prevent the dispersal of radioactive substances. Certain types of storage containers are also approved for transport of spent nuclear fuel.
- The spent fuel is placed in thin-walled gastight metal containers that are stored in special concrete structures. The container prevents the dispersal of radionuclides. Radiation shielding and protection against mechanical damage is provided by the surrounding concrete structure and the building.

There are facilities for dry storage in Canada, Germany and the USA.

1.41 What is done to prevent dryout in the event of unplanned abandonment? What is done to prevent radionuclides from being released into the surrounding air in the event of unplanned abandonment? (EK Miljökonsult AB)

(SKB) Nothing specific is being done today to prevent or mitigate the consequences of unplanned abandonment of Clab. The consequences are largely dependent on when this occurs. The later the milder the consequences, since the fuel's radioactivity and decay heat diminish over time. The consequences are also dependent on whether the facility has to be abandoned immediately or there is some advance warning. If there is advance warning, certain consequence-mitigating measures can be adopted, for example shuffling of the fuel to even out the decay heat, opening of doors between the pools and filling of the entire underground part with water. See also SKB's general reply D ("Consequences of interruption in the work").

2 Final repository

2.1 The Swedish Society for Nature Conservation and MKG believe it is important that the viewpoints offered by them in the consultations can be discussed with the activity operator, Svensk Kärnbränslehantering AB, SKB. The organizations therefore request a special consultation meeting on site selection with SKB. (MKG)

(SKB) As the applicant it is SKB's responsibility to identify a site for the facility in the applications for a final repository for spent nuclear fuel. SKB argues that the site is good enough both in the applications themselves and in an appendix to the applications. See also SKB's general reply F ("Site selection and choice of method").

2.2 To sum up, the Swedish Society for Nature Conservation and MKG want to offer viewpoints regarding site selection in the consultations:

1. Site selection must be based on the choice of method, and this has not been decided yet. SKB should examine alternative methods thoroughly and with an open mind and put off selecting a site until the method question is solved.

2. It is important that the activity operator, Svensk Kärnbränslehantering AB (SKB), not rush site selection. Great uncertainties exist today as to whether the artificial barriers of copper and clay, which are the cornerstone of the method chosen by SKB, will provide adequate environmental safety. Furthermore, the two candidate sites differ greatly, both geologically and hydrologically. The differences affect the function of the artificial barriers. Selecting a site before this site-specific impact on the barriers has been clarified is not a reasonable course of action for a responsible activity operator.

3. Even if the activity operator's, SKB's, current choice of method, the KBS method, turns out to be the method that is ultimately chosen for final disposal of spent nuclear fuel, there are in all probability better sites for the repository than the two investigated sites in Oskarshamn and Östhammar.

4. The site selection process has not been focused on long-term environmental safety, which has led to the choice of two poorly suited sites in the immediate vicinity of two nuclear power plants by the activity operator, SKB, for site investigations.

In summary, the activity operator's, SKB's, site selection process cannot be considered to be guided by either the needs of the method in terms of geological and hydrological environment or environmental considerations. The site selection process can therefore not be considered to satisfy the requirements of either the Environmental Code or the Nuclear Activities Act. (MKG)

1. SKB has developed the KBS-3 method over a long period of time. An account of the development of the method has been given every three years in the statutory RD&D programmes. The direction of SKB's work has received the approval of both the Government and the regulatory authorities. Site selection for the applications for the Spent Fuel Repository was done based on KBS-3. SKB has studied and followed other methods than the KBS-3 method for a long time. This work has also been described in the RD&D programmes. On several occasions, we have also compared other methods with the KBS-3 method. These comparisons have not shown that any of the other methods are more suitable than the KBS-3 method.

2. Final site selection in May 2009 was not rushed, but was based on extensive investigations and evaluations. There are questions related to the canister and the buffer that remain to be answered. But the nature of these questions is not such that they affect site selection.

3. The choice of sites for site investigations was made on the basis of an extensive body of material that includes general siting studies, feasibility studies etc. The site that was finally selected, Forsmark, is highly suitable for hosting a final repository for spent nuclear fuel according to the KBS-3 method.

4. The choice of sites for site investigations was based on a number of factors, foremost among them being the potential suitability of the site with respect to post-closure safety, i.e. the properties of the bedrock. The properties of the bedrock were the most important factor in the choice between Oskarshamn and Forsmark as well.

See also SKB's general reply F ("Site selection and choice of method").

2.3 The National Board of Housing, Building and Planning thinks it is good that an integrated environmental impact statement is produced for the whole nuclear waste chain. The preliminary environmental impact statement deals with different methods for disposing of nuclear waste. It is important that SKB explains in detail why they chose the selected method. It is also good to clarify how SKB arrived at the conclusion that Forsmark is the most suitable site for the final repository. (National Board of Housing, Building and Planning)

SKB concurs with the Board's assessment. Besides in the EIS, there are detailed descriptions of the choice of method and site in other appendices to the applications. See also SKB's general reply F ("Site selection and choice of method").

2.4 To enable the National Board of Fisheries to make an assessment of how general fishing interests may be affected by the activity, the EIS should include a description of the aquatic environment in the area in question. This should describe current environmental status and include an account of what fish species occur and any commercial and recreational fishing in the area. The preliminary EIS describes this to some extent. It is also desirable that any fish in Tjärnpussen and the cooling water channel be described. Similarly, any recreational fishing should be described. In general, the EIS should give an account of how the fish stocks and their habitats will be affected by the various measures planned to be included in the activity. (National Board of Fisheries)

(SKB) Fish inventories in the area's major lakes were carried out in conjunction with the site investigations (SKB P-04-06, "Sampling of freshwater fish. Forsmark site investigation") and were supplemented in 2008 by fish inventories in minor lakes in the vicinity of the planned facility. Recreational fishing occurs in the area, but is judged to be of limited scope (in part due to poor accessibility). At the same time, fish stocks and the availability of fish spawning grounds are not expected to be adversely affected by the activity. Impact on aquatic environments and fish is described particularly in appendices to the EIS ("Vattenverksamhet i Forsmark I. Bortledande av grundvatten från slutförvarsanläggningen för använt kärnbränsle". ("Water operations in Forsmark I. Diversion of groundwater from the final repository for spent nuclear fuel", in Swedish only), SKB R-10-14, and "Vattenverksamhet i Forsmark II. Slutförvarsanläggningen för använt kärnbränsle – vattenverksamheter ovan mark". ("Water operations in Forsmark II. The final repository for spent nuclear fuel – Water operations on the surface", in Swedish only), SKB R-10-15.

Tjärnpussen is a very small lake (5,000 m^2) that lacks fish according to the results of inventories carried out in 2008.

2.5 The leachate from the rock heap will be treated by sedimentation and broad irrigation and pass through Tjärnpussen. The system will remove particles, oil and nitrogen. The National Board of Fisheries would like SKB to describe more clearly the degree of treatment achieved in the system, mainly with respect to nitrogen. The description should also explain how treatment will work in the winter and what pH the water will have when it is discharged into the cooling water channel. (National Board of Fisheries)

(SKB) Treatment in the rock heap and further in Tjärnpussen is expected to convert virtually all nitrogen in the leachate to nitrate, and 1–3 tonnes of nitrogen per year will be expelled as harmless nitrogen gas, see "Vattenhantering vid ett slutförvar för använt kärnbränsle i Forsmark – läge Söderviken", ("Management of water at a final repository for spent nuclear fuel in Forsmark – location Söderviken", in Swedish only), SKB P-10-19. The flows during the winter period will be minimal, increasing once again during the spring in conjunction with snowmelt. The system will thereby work when it is needed the most. The pH of the leachate will be checked and adjusted if necessary.

2.6 Drainage water will be generated during both construction and operation of the underground tunnels. This water will be treated by sedimentation and oil separation and then discharged into Söderviken. No nitrogen removal is planned, however, despite the fact that the amount of nitrogen is 1–4.5 t/y during the construction phase and 1 t/y during the operating phase. The applicant says that the discharged nitrogen will give rise to elevated nitrogen concentrations and increased primary production, which will however be limited due to dilution and low phosphorus concentrations in the receiving water. The National Board of Fisheries would like further clarification and elaboration of this argument. What are the nitrogen and phosphorus concentrations today and how much will they increase? Will oxygen conditions in the summer and winter be affected? It should also be described how the fish stocks will be affected by the increased nitrogen concentrations. Further, the National Board of Fisheries thinks that SKB should explain what the pH of the drainage water will be and whether/how it will have any effect on the receiving water. (National Board of Fisheries)

(SKB) The point of discharge for the drainage water will be immediately adjacent to the cooling water channel, resulting in a high degree of dilution. Furthermore, the nitrogen concentrations in the drainage water during operation will not exceed three milligrams per litre, which is below the level judged to be practically and economically treatable. The pH of the drainage water will be checked and adjusted if necessary.

2.7 SKB has modelled the effects of groundwater diversion on the water level in lakes and the water flow rate in streams. It is estimated that the annual mean water level in Bolundsfjärden Lake will decrease by 0.01 m, while the maximum decrease will be 0.02–0.04 m. As far as water flow rate is concerned, SKB has determined that the rate of inflow to Bolundsfjärden will decrease by up to 10%. But there is no calculation of how the rate of outflow from Bolundsfjärden will be affected. The National Board of Fisheries considers it of great importance that SKB show how the flow from Bolundsfjärden out into the sea at Norra Bassängen will be affected and what effects this will have on fish stocks. Since, according to SKB, these lakes and streams serve as spawning and nursery grounds for coastal fish, it is important that the flows not diminish so much that spawning and migrating fish have difficulty passing. (National Board of Fisheries)

(SKB) These questions are answered exhaustively in an appendix to the EIS ("Vattenverksamhet i Forsmark I. Bortledande av grundvatten från slutförvarsanläggningen för använt kärnbränsle". ("Water operations in Forsmark. Diversion of groundwater from the final repository for spent nuclear fuel", in Swedish only, SKB R-10-14). The assessment is that even in the calculated worst case, groundwater diversion will not affect the function of the lakes as nursery grounds.

2.8 SKB believes that the construction of the new bridge across the cooling water channel may cause turbidity. However, they have only said that turbid water may enter the channel and cause operating disturbances in the nuclear power plant. The National Board of Fisheries would also like SKB to explain whether turbid water can enter the sea and what effects this would have on fish stocks. (National Board of Fisheries)

(SKB) Measures are proposed to reduce turbidity and its possible consequences. These measures are presented in an appendix to the EIS ("Vattenverksamhet i Forsmark II. Slutförvarsanläggningen för använt kärnbränsle – vattenverksamheter ovan mark") ("Water operations in Forsmark II. The final repository for spent nuclear fuel – Water operations on the surface", in Swedish only), SKB R-10-15. Owing to the great dilution that takes place in the cooling water channel, the turbidity is expected to have insignificant ecological consequences.

2.9 Since the safety assessment is the basis for the assessment of long-term safety and thereby of the barrier system's durability and ability to prevent the release of radioactivity, the Council believes that it also plays an important role in the assessment of the environmental effects of the final repository. The safety assessment should therefore be included as an integral part of the environmental impact statement. If there is no safety assessment in the EIS, the Council therefore considers that it may be difficult to assess the environmental effects. (Swedish National Council for Nuclear Waste)

(SKB) The assessment of the final repository's post-closure safety, SR-Site, is comprehensive and is presented in separate documentation included in the applications under both the Environmental Code and the Nuclear Activities Act. A summary of SR-Site is provided in the EIS. See also SKB's general reply B ("The role of the safety assessment in the EIS").

2.10 In its review statement on SKB's RD&D programme 2007 (SOU 2008:70e), the Swedish National Council for Nuclear Waste said it is imperative that SKB should give a clear account of the judgements underlying site selection. Since long-term safety is the most important factor in site selection, the Council finds that the safety arguments underlying site selection must be based on two comprehensive safety assessments (i.e. two SR-Sites): one for Forsmark and one for Laxemar. The Council wishes to stress the importance of a scientifically correct comparison between the sites as a basis for site selection. (Swedish National Council for Nuclear Waste)

SKB has carried out an assessment of post-closure safety, SR-Site, which deals with Forsmark. This is in keeping with the provisions of the Nuclear Activities Act and discussions with SSM. The background material for the application under the Nuclear Activities Act also includes a report (SKB TR-10-54, "Comparative analysis of safety related site characteristics") where safety-related site characteristics are compared for Forsmark and Oskarshamn.

2.11 SKB has informed SSM that the application for a licence for the final repository will be based on the KBS-3 method. SSM is of the opinion that the purpose of the presentation of KBS-3H should be clarified in the EIS. (SSM)

SKB's application calls for vertical deposition (KBS-3V), which is available technology and satisfies the safety requirements. In the case of vertical deposition, the canisters are emplaced one by one, upright in deposition holes in the floors of rock tunnels. A variant of the KBS-3 method is KBS-3H, where the canisters are placed lying down in a row in horizontal tunnels. The two variants could even be combined within the final repository. The development work on horizontal deposition shows that the method is interesting and promising, but not yet sufficiently developed to be available. More research and development is required to determine whether it can be used. Only when and if a safety assessment shows that KBS-3H offers equivalent or improved safety will a switch to horizontal deposition be considered by SKB. Work is continuing on development of the technology for horizontal deposition.

2.12 According to the general rules of consideration in Chap. 2 of the Environmental Code, a site shall be selected that is suitable in order to achieve the purpose with minimum damage and detriment to human health and the environment. The EIS is the document that describes the consequences of the activity and supports site selection. SKB has informed SSM that the siting process will be described in a special appendix to the application. The authority concludes that the EIS needs to include a description of the selected site compared with other investigated sites so that it is clear that obviously better sites have not been rejected. (SSM)

(SKB) The EIS contains a general description of the siting process and a comparison of the two sites where site investigations have been conducted: Forsmark and Laxemar. See also SKB's general reply F ("Site selection and choice of method").

2.13 In a joint communication to SKB dated 22 October 2007 (SSI dnr. 2007/1562/26, SKI dnr. 2007/598), SKI and the Swedish Radiation Protection Authority (SSI) summarized their viewpoints on how SKB should supplement and present its study of supraregional groundwater modelling for eastern Småland. A summary of the conclusions drawn by SKB from the supplements and how they have influenced SKB's choice of site should be included in the EIS. SSI has also requested (5 March 2007 at meeting with the Forsmark Consultation and EIA Group) an account of the advantages and disadvantages of locating a repository in a recharge area versus in a discharge area as a function of time and taking into account future climate change. SSM has no other standpoint than the one previously expressed by SKI and SSI. (SSM)

(SKB) SKB's overall conclusion is that no systematic difference can be demonstrated between coastal and inland locations with regard to the occurrence of favourable flow conditions. The supplementary analyses presented in SKB R-10-43, "Storregional grundvattenmodellering – en känslighetsstudie av några utvalda konceptuella beskrivningar och förenklingar", ("Supraregional groundwater modelling – a sensitivity study of some selected conceptual descriptions and simplifications", in Swedish only), has not altered this conclusion. The main reason is that investigations and analyses have shown that local conditions, mainly the permeability of the bedrock, are crucial in determining whether a site is suitable for a final repository with respect to groundwater flow. The site investigations in Laxemar and Forsmark have confirmed this contention. Notwithstanding this, the groundwater flow from a repository location may include regional components characterized by long and

slow flow paths. However, it is not deemed possible by means of reasonable efforts to verify such conditions with sufficient reliability that they could be credited with any safety-enhancing function for a final repository.

In principle, it could be advantageous to locate a repository in a recharge area. At the same time, the investigations and analyses performed by SKB have confirmed out impression that local flow patterns, determined by local conditions, are of crucial importance for the suitability of individual sites with respect to groundwater flow.

2.14 The preliminary EIS states that SKB intends to elaborate the text and supplement it with particulars from SR-Site. SSM notes this and concurs that this needs to be done. It is the Authority's assessment that the description of long-term safety needs to be relatively comprehensive in the EIS, since it is the most important factor for the performance of the final repository. (SSM)

(SKB) The EIS should focus on identifying and describing the direct and indirect consequences of the planned activity. The assessment of post-closure safety shows that the activity does not have any radiological consequences of importance for human health and the environment.

Despite this, the description of post-closure safety is relatively comprehensive in the final version of the EIS. It explains, for example, how a number of "worst-case scenarios" have been studied within the framework of the safety assessment and what their effects would be.

SKB's ambition has been to make the description readily accessible. A much more extensive account is provided in another appendix to the applications, "SR-Site – Redovisning av säkerhet efter förslutning", ("SR-Site – Assessment of post-closure safety", in Swedish only). See also SKB's general reply B ("The role of the safety assessment in the EIS").

2.15 One purpose of the EIS is to give the public and concerned persons information on the project and its consequences. Long-term safety will be described in other documents that are not readily accessible for ordinary laymen. It is therefore necessary that the descriptions of long-term safety in the EIS uncertainties give the reader a picture of what has been investigated, what uncertainties remain and SKB's conclusions. It should include a general discussion of scenarios and risk factors. There needs to be a discussion of estimated effects and consequences of the scenarios that include discharges and releases to the biosphere.

SKB's point of departure for the account in the EIS is that long-term safety will be guaranteed. Another point of departure is that the evidence for this is presented in SR-Site. SSM understands SKB's points of departure, but nevertheless considers it suitable from a pedagogical point of view that unavoidable long-term consequences after closure of the repository be described in general terms. (SSM)

(SKB) The EIS should focus on identifying and describing the direct and indirect consequences of the planned activity. The assessment of post-closure safety shows that the activity does not have any radiological consequences of importance for human health and the environment. Despite this, the description of post-closure safety is relatively comprehensive in the final version of the EIS. It explains, for example, how a number of "worst-case scenarios" have been studied within the framework of the safety assessment and what their effects would be.

SKB's ambition has been to make the description readily accessible. A much more extensive account is provided in another appendix to the applications, "SR-Site –

Redovisning av säkerhet efter förslutning", ("SR-Site – Assessment of post-closure safety", in Swedish only). See also SKB's general reply B ("The role of the safety assessment in the EIS").

2.16 According to SKB, it will be possible to retrieve canisters after deposition. SSM's assessment is that it should be possible to retrieve canisters after initial operation and that the consequences of retrieval after initial operation should be described in the EIS. (SSM)

(SKB) If the spent nuclear fuel is not reprocessed (which is true of the fuel covered by SKB's applications), the Nuclear Activities Act requires final disposal. However, there is no requirement that the fuel should be "non-retrievable". SKB has conducted experiments in the Äspö HRL that show that it is possible to retrieve deposited canisters during the operating phase. The principle is to reverse the deposition sequence. Retrieval is possible even after closure of the repository, but would require great resources in the form of time and money. This is only possible if society makes a deliberate effort.

The EIS describes the environmental consequences of the applied-for activity, which does not include retrieval.

2.17 SSM notes that viewpoints have expressed at the consultations that SKB should have consult about long-term safety and future safety analysis reports.
SSM believes that it would not be unreasonable to let consultations under Chap. 6 of the Environmental Code include long-term safety, especially as this is a crucial factor in the upcoming licensing review. (SSM)

Throughout the consultation process, SKB has been clear on the fact that even if a given consultation occasion focuses on a given theme, it is always possible to ask any question dealing with interim storage, encapsulation and final disposal of spent nuclear fuel, including the post-closure safety of the repository. In fact, some consultation occasions have focused on post-closure safety. During 2007, consultations were held on the theme "Safety and radiation protection". The background material provided a general description of SKB's work with safety and radiation protection. An appendix contained a summary of the SR-Can safety assessment. The theme of the concluding consultation meeting on 3 May 2010 was the role of the safety assessment in the EIS. See also SKB's general reply B ("The role of the safety assessment in the EIS").

2.18 SKB has chosen to conclude the formal consultations in March 2010, about 10 months before SKB has planned to submit applications for licenses for interim storage, encapsulation and final disposal under the Nuclear Activities Act and for the final repository system under the Environmental Code. SSM judges that there is time, if needed, to hold certain supplementary consultations, e.g. concerning long-term safety. (SSM)

(SKB) At and following the consultation meetings in February 2010, several actors expressed a desire for further discussion of post-closure safety in the consultations. In response, SKB arranged a consultation meeting in Östhammar on 3 May 2010 on the theme "The role of the safety assessment in the EIS". An account was given at the meeting of SKB's work with safety assessments, along with a status report from the ongoing work on the SR-Site safety assessment. See also SKB's general replies A and B ("Conclusion of the consultations" and "The role of the safety assessment in the EIS").

2.19 One of the most important documents for long-term safety – SR-Site – is still in preparation when the applications are to be submitted, which means that the licensing review will be incomplete. There are many questions relating to long-term safety, as well as how much of the information will be included in the environmental impact statement. (Östhammar Municipality – municipal executive board)

(SKB) The EIS should focus on identifying and describing the direct and indirect consequences of the planned activity. The assessment of post-closure safety shows that the activity does not have any radiological consequences of importance for human health and the environment. Despite this, the description of post-closure safety is relatively comprehensive in the final version of the EIS. SKB's ambition has been to make the description readily accessible. A much more extensive account is provided in the appendix "SR-Site – Redovisning av säkerhet efter förslutning", ("SR-Site – Assessment of post-closure safety", in Swedish only). See also SKB's general reply B ("The role of the safety assessment in the EIS").

2.20 Both groups have questions concerning SKB's handling of the deposition variants KB-3V (reference design) and KBS-3H. How would a switch to KBS-3H be handled from a licensing viewpoint, and is the repository being planned physically to work for both variants? (Östhammar Municipality – municipal executive board)

(SKB) The applications apply for vertical deposition (KBS-3V), where the canisters are placed upright in deposition holes. In a modified version, the canisters can also be laid down in a row in horizontal tunnels in the rock (KBS-3H). The two variants could even be combined within the final repository. The development work on horizontal deposition shows that the method is interesting and promising, but not yet available. The development work continues. It has not been determined how a switch of method will be licensed by the Swedish Radiation Safety Authority.

2.21 With an extension of the final repository for short-lived radioactive waste, SFR, in Forsmark and construction of a possible final repository, both groups find that the cumulative effects and consequences must be presented more clearly when it comes to radiology, hydrology and other environmental impact (e.g. changes for most red-listed species compared with each species individually). (Östhammar Municipality – municipal executive board)

(SKB) Cumulative effects of e.g. the extension of SFR are described in Chapter 12 of the EIS. Locating several nuclear activities in the same area is not expected to lead to any health consequences as a result of radiation. The nuclear power plant, which accounts for most of the radioactive releases at Forsmark, contributes less than a hundredth of the relevant limit value, which is 0.1 millisievert (mSv) per year. This limit value can be compared with the mean individual dose in Sweden from all sources, which is four mSv per year. If several nuclear facilities are located in the same geographic area, the 0.1 mSv limit applies to their combined contributions. When it comes to post-closure safety as well, the requirements permit several repositories to be located within the same area.

A detailed account of cumulative effects for groundwater impact is provided in an appendix to the EIS: "Vattenverksamhet i Forsmark I. Bortledande av grundvatten från slutförvarsanläggningen för använt kärnbränsle", SKB R-10-14 ("Water operations in Forsmark I. Diversion of groundwater from the final repository for spent nuclear fuel", in Swedish only). See also SKB's general reply G ("Description of cumulative effects in the EIS").

2.22 SKB says that a premise for the environmental impact statement is that the activity does not have any radiological environmental consequences of importance for human health and the environment. SKB further states that since the final repository does not give rise to any radiological environmental consequences of importance, this matter is dealt with cursorily.

Are the requirements of the Environmental Code regarding long-term safety dealt with only cursorily in the final version of the environmental impact statement? (Östhammar Municipality – municipal executive board)

SKB believes that the account in the EIS satisfies the requirements of the Environmental Code. It is worth noting that the EIS is a part of the application under the Environmental Code, which means that everything cannot and should not be included in the EIS. See also SKB's general reply B ("The role of the safety assessment in the EIS").

2.23 The Safety Group expects that SKB will describe the cumulative radiological effects and consequences of both the final repository for spent nuclear fuel and the extended final repository for short-lived low- and intermediate-level waste, SFR, in SR-Site. (Östhammar Municipality – municipal executive board)

(SKB) SR-Site only deals with the final repository for spent nuclear fuel. The extended final repository for short-lived low- and intermediate-level waste, SFR, is dealt with in a separate application. A safety assessment covering SFR will be appended to this application. See also reply 2.21.

2.24 How the canisters are handled after they arrive from Sigyn and are transported and then placed inside the storage hall is not described in the EIS.

The Safety Group suggests that SKB describe this more clearly in the final environmental impact statement. (Östhammar Municipality – municipal executive board)

(SKB) The canisters will be transported down to the transloading hall at repository level via the ramp. This is done by a special vehicle developed for this purpose. In the transloading hall, the canister is transferred to the deposition machine, which carries the canister to the deposition tunnel. The canister will lie protected in the transport cask during all transport, except when it is being carried by the deposition machine. It is then protected by a radiation-shielding tube.

Transport and handling of the canisters is described only cursorily in the EIS and only for the purpose of identifying and assessing impact, effects and consequences for the environment. From this viewpoint, handling of the canisters is more a question for pre-closure safety. A detailed description of transport and handling of the encapsulated fuel is provided in the following document, which is included in SKB's applications under the Nuclear Activities Act: "Transport av inkapslat bränsle till slutförvaring i Forsmark", ("Transport of encapsulated fuel to the final repository in Forsmark", in Swedish only), SKBdoc id 1171993 version 3.0.

2.25 SKB considers KBS-3V to be the reference design. The design with horizontally deposited canisters, KBS-3H, is regarded as a variant. According to previous information, it may turn out in a few years that SKB will prefer to build the final repository according to the KBS-3H concept. The question is what conditions the Environmental Code and the Nuclear Activities Act impose on such a switch.

The Safety Group believes that SKB needs to explain clearly in the application how the matter will be handled if horizontal deposition of copper canisters, KBS-3H, turns out to be the prioritized design. (Östhammar Municipality – municipal executive board)

(SKB) The applications apply for vertical deposition (KBS-3V), where the canisters are placed upright in deposition holes. In a modified version, the canisters can also be laid down in a row in horizontal tunnels in the rock (KBS-3H). The two variants could even be combined within the final repository. The development work on horizontal deposition shows that the method is interesting and promising, but not yet available. The development work continues. It has not been determined how a switch of method will be licensed by the Swedish Radiation Safety Authority.

2.26 Three different locations are being discussed in Forsmark: the barracks village, the channel and Söderviken. Is Söderviken the best alternative with regard to long-term safety or have other advantages with this location – e.g. easier to build, detailed development plan, etc. – influenced the decision? Are there differences in level of knowledge between the three different locations with respect to where the site investigations have been conducted? (Östhammar Municipality – municipal executive board)

(SKB) The prospects for post-closure safety for the three locations were judged to be equivalent. The overall assessment of conditions above and below ground show that Söderviken is the most advantageous location, above all because a siting there best avoids the area's steeply dipping deformation zones, entailing advantages for constructability. The site investigation resulted in the selection of Söderviken. There are no differences in level of knowledge between the three locations.

2.27 The preliminary version of the environmental impact statement mentions the terms "preliminary safety analysis report" and "preliminary safety assessment", pages 276–277. Reference /10-29/ is cited. There it is explained that the manuscript is preliminary and applies to the operating phase.

Will SKB circulate the preliminary safety analysis report for review and consideration in the same way as the preliminary EIS? (Östhammar Municipality – municipal executive board)

(SKB) Reference /10-29/ (Chapter 8 safety assessment for operation of the final repository – PSAR operation) in the preliminary EIS is one of the documents included in the safety analysis report for operation of the final repository. The whole safety analysis report is included in the applications under the Nuclear Activities Act and the Environmental Code, but has not been subject to consultations like the EIS.

2.28 SKB writes: Due to temperature increase in the rock caused by heat from the canister, there is a risk of spalling in the rock around the canister when thermal expansion contributes to the rock stresses. Spalling can greatly increase the exchange of dissolved substances in fractures, and some of these substances can cause corrosion. In SR-Can it was assumed that spalling occurs in all deposition holes.

A follow-up question: What substances? How does the corrosion occur? (Östhammar Municipality – municipal executive board)

(SKB) It is dissolved sulphide in the groundwater that can cause corrosion of copper by formation of copper sulphide, Cu_2S. The corrosion is limited by how much sulphide can be transported to the copper surface, from the groundwater to the buffer and then through the buffer. Transport from the groundwater to the buffer can increase in rock subjected to thermal spalling, which also increases the corrosion rate.

2.29 SKB writes: Water has only been encountered at a few points below the 400 m level in the nearly 1,000 m deep boreholes in Forsmark. This is interpreted to mean that

there are very few water-conducting fractures below this level. At a depth of 500 metres, which is the approximate depth at which the repository area will be located, the average distance between water-conducting fractures is greater than 100 m. This means that the groundwater flow through the repository is limited. This entails great safety-related advantages for the copper canister and the long-term function of the bentonite clay, since water flow is a key component in the evaluation of buffer erosion and copper corrosion.

A follow-up question: How certain is the interpretation that there are few water-conducting fractures? The Safety Group considers it urgent that SKB be clear when it comes to uncertainties in the document. (Östhammar Municipality – municipal executive board)

(SKB) The site descriptive model for Forsmark serves as a basis for the evaluation of the site's suitability for the final repository. The site descriptive model is described in the report SKB TR-08-05. The description has been compiled in cooperation between the areas of expertise included in the site investigation. In cases where results point in the other direction, this is handled as an uncertainty. The report contains discussions of e.g. confidence in the site model. An account of how uncertainties and confidence in the site descriptive model are handled is provided in the report "Confidence assessment. Site descriptive modelling. SDM-Site Forsmark", SKB R-08-82.

2.30 SKB writes that a study is being conducted aimed at assessing risks to human health and the environment of non-radioactive substances in spent nuclear fuel and in the canister. The results of the study will be presented in the final environmental impact statement.

The Safety Group asks what the substances are. (Östhammar Municipality – municipal executive board)

(SKB) The study includes all substances that will be present in the canister, the insert and the spent nuclear fuel. After screening, priority was given to copper, uranium, nickel and chromium for further investigation, since they occur in very large quantities in a filled copper canister. Iron, copper, manganese and silver were prioritized due to technical requirements on the drinking water. Cadmium, cobalt, neodymium and lanthanum were also prioritized based on drinking water standards, plus a number of other substances based on environmental risk criteria. The report, SKB P-10-13, "Kemisk toxicitet hos ämnen som deponeras i slutförvaret för använt kärnbränsle", ("Chemical toxicity of substances deposited in the final repository for spent nuclear fuel", in Swedish only) can be downloaded via SKB's website.

2.31 SKB writes: The final repository is designed so that monitoring of e.g. radioactive releases should not be necessary. At present, no monitoring is therefore planned for this phase.

However, monitoring instruments for radioactive releases could increase confidence in safety.

The Safety Group believes that the possibility of post-closure monitoring should not be excluded. In the continued work, SKB should study the possible consequences of post-closure monitoring, mainly with a relatively short time horizon of e.g. a few generations. (Östhammar Municipality – municipal executive board)

(SKB) The application for a licence under the Environmental Code includes a proposed monitoring programme for the external environment. The proposed monitoring programme describes how the activity's environmental impact, as well

as the conditions issued by the environmental court, will be checked during the construction, operating and decommissioning phases. The monitoring may include e.g. the quality of diverted groundwater, the impact of groundwater lowering on groundwater and surface water levels, and noise and vibration during the construction and operating phases. At present, however, no monitoring of radioactive releases is planned for the post-closure period.

2.32 António Pereiras's comment

António Pereiras's comment on Chap. 3.6.1.1 about the American feasibility study from Sandia about Deep Boreholes reads: Deep Boreholes has received attention recently from the environmental movement as an alternative to KBS-3. Even though the technology for building a final repository based on the Deep Boreholes concept does not exist today and would probably require at least 30 years of intensive research and development with no guarantee of a favourable outcome, it would be interesting to have access to SKB's reference /3-10/ before the consultation meeting. However, it is encouraging that SKB intends to follow developments "in the field of disposal in deep boreholes". Unfortunately, Sandia's report on Deep Boreholes [4] is not mentioned in the EIS.

In my opinion, a preliminary review I conducted of this feasibility study by Sandia on Deep Boreholes gives a much too optimistic picture of the method's potential, perhaps due to its highly preliminary character and large gaps identified by the authors themselves. In this context it should be mentioned that a group of Swedish researchers recently received substantial financial support from the Swedish Research Council to purchase a drill that should be able to make small-bore boreholes to a depth of 3,000 to 4,000 metres. The project goes under the name of SDDP (Swedish Deep Drilling Programme) and is coordinated by Uppsala University. Although it is an intradisciplinary project it will undoubtedly yield interesting data and knowledge about Swedish rock at depths greater than 1,000 metres, so SKB should follow and possibly support certain research that may be of potential interest for long-term safety assessments of the Deep Boreholes alternative. This alternative could perhaps be of interest in the long run for small repositories (perhaps international regional repositories). (Östhammar Municipality – municipal executive board)

SKB is familiar with Sandia's report. SKB mentions the report in RD&D Programme 2010 and in an appendix to the applications entitled "Metodval – utvärdering av strategier och system för att ta hand använt kärnbränsle", SKB R-10-25 ("Choice of method – evaluation of strategies and systems for disposal of spent nuclear fuel", in Swedish only). SKB agrees with António Pereira that the report gives a much too optimistic picture of the method's potential. SKB intends to follow the work within the Swedish Deep Drilling Programme (SDDP).

Reference /3-10/ in the preliminary EIS is now available via SKB's website: SKB R-10-13, "Jämförelse mellan KBS-3-metoden och deponering i djupa borrhål för slutligt omhändertagande av använt kärnbränsle" ("Comparison between the KBS-3 method and disposal in deep boreholes for final disposal of spent nuclear fuel", in Swedish only).

2.33 Credibility and uncertainties in models

The question concerns the credibility and uncertainty in the models used to describe

a) how groundwater flows in the rock

b) transport of radionuclides through the rock

c) the rock and the occurrence of deformation zones in the rock (Östhammar Municipality – municipal executive board)

(SKB) The site descriptive model for Forsmark serves as a basis for the evaluation of the site's suitability for the final repository. The site descriptive model is described in the report SKB TR-08-05. The description has been compiled in cooperation between the areas of expertise included in the site investigation. In cases where results point in the other direction, this is handled as an uncertainty. The report contains discussions of e.g. confidence in the site model. An account of how uncertainties and confidence in the site descriptive model are handled is provided in the report "Confidence assessment. Site descriptive modelling. SDM-Site Forsmark, SKB R-08-82.

2.34 **Page 319:** ***Since dust from the rock heap accounts for a large portion of the particulate emissions, watering (with a sprinkler) can be used at and around the rock heap in order to keep dust from being suspended and dispersed.***

In order to prevent the spread of dust and particles, Östhammar Municipality thinks that SKB should propose conditions to the environmental court on how SKB should reduce air pollution by watering in conjunction with blasting so that most dust and particles are bound by the water, which is then treated. (Östhammar Municipality – municipal executive board)

(SKB) As regards particle emissions from the planned activity, the background material shows that SKB will be far below environmental quality standards for particles, see report SKB P-08-66, "Miljö- och hälsokonsekvenser av utsläpp till luft. Slutförvar Forsmark (inklusive Clab och inkapslingsanläggningen)". ("Environmental and health consequences of atmospheric emissions. Final repository in Forsmark, including Clab and the encapsulation plant".) Nevertheless, SKB intends to take steps as needed to reduce dust emissions with the aid of a sprinkler.

Except during the initial construction phase, blasting will take place under ground and dust and particles will be collected in the drainage water, which will then be purified by sedimentation and oil separation. Dust will mainly arise at the rock heap, in conjunction with crushing, and possibly in connection with removal of rock spoil from the pier at SFR. SKB has not proposed conditions for reduction of dust and particle emissions. See also SKB's general reply H ("SKB's proposal for conditions").

2.35 **Page 219:** ***Treatment plants will also be located outside the operations area to purify different types of contaminated water at the final repository. Waste water from toilets, showers, kitchens and other wet areas in the operations area will be collected and conducted to FKA's sewage treatment plant for treatment. Since the final repository will be located on the site where the sewage treatment plant is located today, a new treatment plant will be built west of the barracks village. Sedimentation ponds for leachate from the rock heap will be built on the area for the rock heap. Furthermore, a broad irrigation area and a collection pond for leachate will be built southwest of the rock heap and the lake, called Tjärnpussen, located next to the barracks village, see Figure 10-5.***

To prevent high concentrations of pollutants from being discharged into Öregrundsgrepen, Östhammar Municipality wants SKB to propose conditions to the environmental court regarding how SKB will reduce discharges of pollutants from the sewage treatment plant and also propose maximum levels of pollutants in the effluent. (Östhammar Municipality – municipal executive board)

SKB has not proposed conditions for discharges from the sewage treatment plant. See also SKB's general reply H ("SKB's proposal for conditions").

2.36 **Page 225:** ***During the construction phase it will take time before certain systems are built and commissioned, which will require temporary solutions before water management can take place as described below.***

To prevent high concentrations of pollutants from being discharged into Öregrundsgrepen, Östhammar Municipality wants SKB to propose conditions to the environmental court regarding how SKB will reduce discharges of pollutants during the construction phase and also propose maximum levels of pollutants in the effluent when temporary solutions for water management are used. (Östhammar Municipality – municipal executive board)

SKB has not proposed conditions for discharges of pollutants during the construction phase. See also SKB's general reply H ("SKB's proposal for conditions").

2.37 **Page 237:** ***As a part of the underground works, the rock around the facility will be sealed by grouting.***

To prevent the impact of sealants that can lead to ecotoxicological effects on the surrounding environment, Östhammar Municipality thinks that SKB should propose conditions to the environmental court to the effect that SKB may not use any sealants that can lead to ecotoxicological effects on the surrounding environment. When there are uncertainties regarding a sealant, the precautionary principle should be applied and the substance treated as if it can cause ecotoxicological effects on the surrounding environment. (Östhammar Municipality – municipal executive board)

(SKB) SKB will apply the precautionary principle in its choice of grout, for example. See also SKB's general reply H ("SKB's proposal for conditions").

2.38 **Page 241:** ***The highest noise levels in relation to guideline values – 50 dBA for construction noise in the evening and 35 dBA for industrial noise in the evening and at night – will occur in the evening, see Figure 10-21.***

In order to avoid noise disturbances at night, Östhammar Municipality thinks that SKB should propose conditions to the environmental court to the effect that SKB may not carry out noisy or disturbing work at night. (Östhammar Municipality – municipal executive board)

In the application under the Environmental Code, SKB proposes conditions regarding noise. See also SKB's general reply H ("SKB's proposal for conditions").

2.39 **Report P-08-64, to which SKB refers, states that sound from the static converter station can also be perceived at all measurement positions due to the tonal character of the sound with a fundamental tone at 100 Hz and repeated overtones.**

If this tone is strong enough to be classified as a pure tone, Östhammar Municipality thinks that SKB should take this into account when they report noise levels. (Östhammar Municipality – municipal executive board)

(SKB) According to SKB's noise study, the noise from the static converter station reaches the nearest residents, but noise from the final repository does not reach them.

2.40 **Page 242: Most of the transport activities will take place during the daytime.**

In order to avoid noise disturbances at night, Östhammar Municipality thinks that SKB should propose conditions to the environmental court to the effect that SKB may not carry out noisy, disturbing transport activities at night. (Östhammar Municipality – municipal executive board)

(SKB) In the application under the Environmental Code, SKB proposes conditions regarding noise. See also SKB's general reply H ("SKB's proposal for conditions").

2.41 **Construction of the final repository is estimated to take about 7 years. In view of the length of the construction period, Östhammar Municipality thinks that the**

level of ambition with regard to external noise should be higher than the guideline values indicated by the Swedish Environmental Protection Agency for construction noise. The guideline values indicated by the Swedish EPA for external industrial noise in conjunction with new industrial establishment should be applied instead. (Östhammar Municipality – municipal executive board)

(SKB) Due to the relatively long construction period, the noise from activities at the final repository is compared with the guideline values for both construction noise and industrial noise.

2.42 Will the spent fuel in the final repository be retrievable, and if so is it really a final repository? (Östhammar Municipality – municipal executive board)

(SKB) If the spent nuclear fuel is not reprocessed (which is true of the fuel covered by SKB's applications), the Nuclear Activities Act requires final disposal. However, there is no requirement that the fuel should be "non-retrievable". SKB has conducted experiments in the Äspö HRL that show that it is possible to retrieve deposited canisters during the operating phase. The principle is to reverse the deposition sequence. Retrieval is possible even after closure of the repository, but would require great resources in the form of time and money. This is only possible if society makes a deliberate effort.

The EIS describes the environmental consequences of the applied-for activity, which does not include retrieval.

2.43 Who owns the waste after the repository is closed? (Östhammar Municipality – municipal executive board)

(SKB) This is a question to which there is not yet a definite answer. Professor Per Cramér and colleagues at the Department of Law at the University of Gothenburg discuss this question in the final report from SKB's social science research, "Ansvarstagande i kärnbränslecykelns slutsteg – ett rättsligt perspektiv", ("Assumption of responsibility in the back end of the nuclear fuel cycle – a legal perspective", in Swedish only), SKB R-10-33. There it is noted that Gov. Bill 2005/06:183 clearly states that the reactor owner's responsibility under the Nuclear Activities Act ceases when the final repository has been closed and is then assumed by the state. The concrete implications of, or forms for, this transfer of responsibility are not specified in the Bill, however. Cramér says that it should be made clear that the state takes over as owner of the final repository and the spent nuclear fuel contained in the repository at the time responsibility is transferred.

2.44 What does SKB think that the Swedish Radiation Safety Authority has said regarding presentation of alternative methods? (Östhammar Municipality – municipal executive board)

(SKB) SKI's review and evaluation of SKB's RD&D programme 2007 comments specifically on the methods Partitioning and Transmutation (P&T) and Deep Boreholes. Regarding P&T, SKI states that they have "no objection to the announced increase in SKB's research efforts during the coming years".

As far as Deep Boreholes is concerned, SKI says that they support "SSI in its reasoning that SKB should produce more thoroughly researched and better supporting material on deep boreholes for a comparison with the KBS-3 method. SKI wishes, however, to emphasize that viewpoints expressed in previous RD&D reviews still

apply since SKI considers that Deep Boreholes cannot at present be regarded as a realistic alternative to the KBS-3 method.

SKI does not, however, agree with SSI that the supporting material needed by the authorities to be able to compare Deep Boreholes with the KBS-3 method needs to be reinforced prior to the application for construction of the repository for spent nuclear fuel".

An appendix to the applications describes SKB's choice method: "Metodval – utvärdering av strategier och system för att ta hand om använt kärnbränsle". ("Choice of method – evaluation of strategies and systems for disposal of spent nuclear fuel", in Swedish only). This is based on recently published reports that compare the KBS-3 method with the Deep Boreholes concept (SKB R-10-13), and the report "Principer, strategier och system för slutligt omhändertagande av använt kärnbränsle", ("Principles, strategies and systems for final disposal of spent nuclear fuel", in Swedish only), SKB R-10-12.

2.45 **Page 30:** ***Since the final repository does not give rise to any radiological environmental consequences of importance, this is only dealt with cursorily in the environmental impact statement, but all the more thoroughly in the special safety analysis report and its assessment of long-term safety.***

It is assumed that the final repository will not give rise to any radiological environmental consequences. The probability of such consequences is so low that it is not included in the preliminary EIS. How is this assessment made? Do the calculations take into account the fact that if the final repository should nevertheless give rise to radiological environmental consequences, these consequences could be very great? (Östhammar Municipality – municipal executive board)

(SKB) The EIS should focus on identifying and describing the direct and indirect consequences of the planned activity. The assessment of post-closure safety shows that the activity does not have any radiological consequences of importance for human health and the environment. Despite this, the description of post-closure safety is relatively comprehensive in the final version of the EIS. It explains, for example, how a number of "worst-case scenarios" have been studied within the framework of the safety assessment and what their effects would be.

SKB's ambition has been to make the description readily accessible. A much more extensive account is provided in another appendix to the applications, "SR-Site – Redovisning av säkerhet efter förslutning", ("SR-Site – Assessment of post-closure safety", in Swedish only). See also SKB's general reply B ("The role of the safety assessment in the EIS").

2.46 **Page 49:** ***General Siting Study 95 was a study on a national scale that was mainly based on the extensive body of background material which SKB had gradually gathered as a part of the research and development work that had been conducted since the late 1970s.***

Were the general siting studies done before the feasibility studies or vice versa? (Östhammar Municipality – municipal executive board)

(SKB) In a Government decision from May 1995, the Government asked for a general siting study. SKB published General Siting Study 95 in October 1995 in response to the Government's request. The feasibility studies were conducted between 1993 and 2000.

2.47 Page 52: *Siting on the coast or in the interior*

SKB describes various investigations regarding coastal or inland siting without referring to any report. Have the possible advantages of inland siting been adequately examined? (Östhammar Municipality – municipal executive board

SKB believes that the question of coastal or inland siting has been adequately examined. The question is discussed in an appendix to the applications, SKB R-01-42, "Platsval – lokalisering av slutförvaret för använt kärnbränsle", ("Site selection – siting of the final repository for spent nuclear fuel", in Swedish only). See also reply to question 2.13, page 189.

2.48 Page 63: *KBS-3H – a variant of the KBS-3 method*

How would a switch be made from KBS-3 V to KBS-3 H in terms of licensing? (Östhammar Municipality – municipal executive board)

(SKB) The applications apply for vertical deposition (KBS-3V), where the canisters are placed upright in deposition holes. In a modified version, the canisters can also be laid down in a row in horizontal tunnels in the rock (KBS-3H). The two variants could even be combined within the final repository. The development work on horizontal deposition shows that the method is interesting and promising, but not yet available. The development work continues. It has not been determined how a switch of method will be licensed by the Swedish Radiation Safety Authority.

2.49 When SKB has performed noise calculations, have they taken into account the noise created by rock drilling rigs in the initial work of blasting of the access ramp, skip shaft and ventilation shafts? (Östhammar Municipality – municipal executive board)

(SKB) Yes, this has been studied in the vibration study that has been conducted, see report SKB P-10-22, "Prognoser och restriktioner för vibrationer från bergschaktning och transporter. Slutförvar för använt kärnbränsle, Forsmark", ("Predictions and restrictions for vibrations from rock excavation and transport. Final repository for spent nuclear fuel, Forsmark", in Swedish only). Predictions of noise from rock drilling and blasting were made in this study.

2.50 Page 23, transport: The heavy transport that will go along highway 76 will expose many people along the route to noise in excess of the limit values. Östhammar Municipality believes that SKB should carry out an impact assessment of the environmental benefit of carrying bentonite by barge between Hargshamn and Forsmark. (Östhammar Municipality – municipal executive board)

(SKB) The question has been investigated in the study dealing with transport of material and passengers to and from the final repository, SKB R-08-49. The conclusion was that the Port of Forsmark does not have sufficient depth and breadth today in the channel and in the harbour basin for large vessels, which means that the port cannot be used for regular shipping of rock spoil for exports or imports of clay material. The port also lacks large enough port yards and quays as well as harbour areas where dust and noise can be accepted. Furthermore, there is no organization for general goods handling, loading and unloading of bulk goods, freight clearing and maintenance of maritime security.

2.51 Page 89: *The traffic load in Östhammar Municipality is seasonally dependent. Traffic in the municipality increases markedly in the summertime due to a large number of summer residents.*

Is the summertime increase in traffic included in SKB's calculations of traffic flows? A final repository in the Forsmark area will attract many visitors as well; is this traffic increase included in the calculations of traffic flows? (Östhammar Municipality – municipal executive board)

(SKB) The estimate of traffic on the road sections is based on the Swedish Transport Administration's (formerly the Swedish Road Administration) database of random measurements, which have been adjusted upwards based on their predictions for economic calculation values for the years 2018 and 2030. We assume that the summertime traffic increase is included in the database. Visitor traffic is included in SKB's transport study. See also reply 2.83, page 209.

2.52 Page 105: Östhammar Municipality thinks that all natural values should be summarized in a figure. (Östhammar Municipality – municipal executive board)

(SKB) It is very difficult to show all natural values in a single figure. Such a figure would contain a great deal of information, some of it overlapping, since certain natural values overlap, making it difficult to read.

2.53 Page 115: *An iron oxide mineralization was found during the site investigation southwest of the site investigation area. However, the deposit was judged to be too small to be economically worth mining today or in the future.*

How can SKB be certain that these ore deposits will not be economically profitable to mine in the future? Are these ore deposits claimed? Would it be possible for SKB or SKB's owners to claim these ore deposits? (Östhammar Municipality – municipal executive board)

(SKB) The ore deposit has no economic value today and is not expected to have it in the future either, but this is of course impossible to predict with absolute certainty. The possibility that it would nevertheless be mined has therefore been evaluated within the framework of the safety assessment with respect to the potential for hydraulic impact by/on the final repository. The conclusion is that no significant disturbances of this kind need be anticipated. The main reasons are the distance in combination with very low permeability in the geological unit where the final repository is located.

The deposit has not been claimed (January 2011). Claims (exploration permits) are granted to actors who intend to explore an area with respect to possible mineral extraction. SKB has no such intentions.

2.54 Page 223: *Investigation of the rock at repository level.*

What does SKB expect of these investigations? What is it in the rock that has not been investigated during the second part of the construction phase? (Östhammar Municipality – municipal executive board)

(SKB) Investigations at repository level will yield detailed knowledge that cannot be obtained from measurements in boreholes.

2.55 Page 223: *Initially, material will also have to be brought in from the outside for infilling. For this purpose, SKB plans to use rock spoil deposited along the pier at SFR when it was built. An estimated volume of 50,000–60,000 cubic metres can be taken from there, which is deemed sufficient until SKB excavates its own rock spoil.*

Will this rock contain any environmentally harmful pollutants?

There are plans to build wind turbines on the pier to SFR; will these plans be affected if SKB uses rock spoil from the pier? (Östhammar Municipality – municipal executive board)

It is uncertain whether SKB will use rock spoil from the pier to SFR. We have only investigated the possibility of taking material from there. The rock has been lying there for many years, exposed to precipitation and waves. If we use rock spoil from the pier, we expect to be able to handle it without any problems.

2.56 **Page 225:** ***The sewage treatment plant will be designed with enough capacity to treat waste water from the final repository as well /10-4/.***
When will FKA build the new sewage treatment plant? How far have they come with their licence application etc.? (Östhammar Municipality – municipal executive board)

(SKB) They have a licence and a building permit to build the sewage treatment plant. Preliminary start of construction is during 2011.

2.57 **Page 237:** ***The size of the groundwater seepage will depend on the depth and geometry of the facility, the hydraulic conductivity (permeability) of the rock and the sealing measures undertaken /10-10/.***
What is meant by the depth of the facility? (Östhammar Municipality – municipal executive board)

(SKB) The depth of the facility is the depth in the bedrock where deposition of canisters will take place. In this case, at a depth of about 500 metres.

2.58 **Page 238:** ***Table 10–9. Impact area (square kilometres) for lowering of groundwater table (drawdown), annual mean values for 2006. The calculations pertain to a hypothetical case with the whole repository open at the same time.***
What do these figures mean? Is the drawdown small or large compared with other similar activities? (Östhammar Municipality – municipal executive board)

(SKB) The table shows how the impact area for drawdown varies between different sealing cases. The more the rock is sealed with grout in conjunction with the rock works, the smaller the impact area will be, since less water seeps into the underground openings.

The impact area for drawdown is relatively limited in size, since drawdown mainly occurs along horizontal and vertical deformation zones (finger-like zones illustrated in the figures that show drawdown) instead of covering a larger, circular area.

2.59 **Page 240:** ***Besides blasting, rock crushing is the task that will cause the most noise.***
How much noise does it make compared with noise levels for other activities, for example rock crushing at Hargshamn? (Östhammar Municipality – municipal executive board)

(SKB) As far as noise from rock crushing is concerned, we have looked at measured values from other existing rock crushers. How much noise a rock crusher makes depends on the size of the crusher, how it is screened, what type of rock it crushes, the surrounding landscape, etc.

2.60 **Page 241, Figure 10-21, shows noise during the construction period in the evening. What are the noise levels like in the daytime during the construction phase? (Östhammar Municipality – municipal executive board)**

(SKB) Noise at night has a greater range than noise in the daytime in relation to relevant guideline values. We show the worst case.

2.61 **Page 251:** ***The discharges of drainage water will give rise to changes in the concentration of nitrogen in Asphällsfjärden and in Söderviken, which increases primary production (plankton, algae, vascular plants etc.).***

If it isn't possible to treat the drainage water, flushing water and seeping groundwater should be separated. The flushing water, which contains high concentrations of pollutants, could then be treated. (Östhammar Municipality – municipal executive board)

(SKB) The drainage water will be treated to remove particles and oil (by sedimentation and oil separation). Furthermore, the pH of the water will be checked and adjusted if necessary. The possibilities of separating flushing water and seeping groundwater will be explored.

2.62 **Page 251:** ***The leachate will have to be purified, since the nitrogen concentrations in the leachate are so high as to be toxic to aquatic organisms /10-4/.***

If the rock spoil is sold immediately without being placed on the rock heap, will SKB wash the rock spoil? (Östhammar Municipality – municipal executive board)

(SKB) Rock spoil is "washed" via precipitation and possibly sprinkling to reduce particle emissions, if deemed necessary. SKB does not plan to wash the rock spoil before it is sold.

2.63 **Page 253:** ***Waste is divided into hazardous and non-hazardous waste. Hazardous waste is managed separately from other waste and must be handled in a special way. Before the facility has been designed in detail, only a rough assessment of the waste quantities is possible.***

How will the hazardous, non-radioactive waste be treated? (Östhammar Municipality – municipal executive board)

SKB's objective is to limit the waste quantities. This will be achieved by a combination of good facility design and choice of materials, something which can also contribute to efficient sorting of materials when the facilities are dismantled or demolished.

Hazardous waste is managed separately from other waste and is kept in dumpsters pending collection.

2.64 **Page 293:** ***The groundwater at repository level must not contain dissolved oxygen either, since oxygen causes copper corrosion. The total capacity to prevent infiltration of dissolved oxygen during future glaciations is judged to be much better in Forsmark.***

No reference is given where this is described. (Östhammar Municipality – municipal executive board)

(SKB) The whole section was taken from the former post-closure safety assessment, SR-Can.

The final version of the EIS contains texts and results taken from the SR-Site post-closure safety assessment and a reference to this assessment.

2.65 **Page 216:** ***The repository tunnels will be built out as they are needed.***

It should be clarified what is meant by *"The repository tunnels will be built out as they are needed".* (Östhammar Municipality – municipal executive board)

(SKB) There will be a need to deposit 150–200 canisters per year. The repository is planned to be built out at such a rate that this number can be deposited.

2.66 **Page 293:** ***A future climate dominated by global warming is for the most part positive for the evolution of the repository, even in Laxemar.***

This is an inappropriate formulation. Our ambition is to limit global warming, but here it sounds as if it is something good and desirable. (Östhammar Municipality – municipal executive board)

(SKB) SKB's formulation relates to the evolution of the repository and nothing else.

2.67 **Page 303** [Note: assume that page 307 is what is meant]: ***Availability of phosphorus will limit vegetation growth, however. Since the receiving water is assessed to be relatively resilient, the impact is considered to be small and no major consequences are expected.***

A reference to a study that shows how and why the receiving water is resilient is desired. (Östhammar Municipality – municipal executive board)

(SKB) The receiving water is judged to be relatively resilient with respect to its size and the fact that it is open to the sea. Furthermore, the point of discharge for the drainage water will be immediately adjacent to the cooling water channel, resulting in a high degree of dilution. Details and assessments of effects and consequences of water discharge can be found in the report "Vattenhantering vid ett slutförvar för använt kärnbränsle i Forsmark – läge Söderviken", ("Management of water at a final repository for spent nuclear fuel in Forsmark – location Söderviken", in Swedish only), SKB P-10-19.

2.68 **Page 307:** ***12.1.1 Natural environment***

The water operations reports describe natural values in greater detail than the preliminary EIS does. It should be made clear that the water operations reports are a part of the EIS. (Östhammar Municipality – municipal executive board)

(SKB) The reports are appendices to the EIS and are included in the applications: SKB R-10-14, "Vattenverksamhet i Forsmark I. Bortledande av grundvatten från slutförvarsanläggningen för använt kärnbränsle". ("Water operations in Forsmark I. Diversion of groundwater from the final repository for spent nuclear fuel", in Swedish only), and SKB R-10-15, "Vattenverksamhet i Forsmark II. Slutförvarsanläggningen för använt kärnbränsle – vattenverksamheter ovan mark". ("Water operations in Forsmark II. The final repository for spent nuclear fuel – Water operations on the surface", in Swedish only). See also SKB's general reply E ("Slutförvarets placering i ett område med höga naturvärden").

2.69 **Page 309:** ***12.2.1 Cumulative effects in Forsmark***

Is there any limit on the size of the final repository? Does the existing repository or planned repositories limit its size (SFR and SFL)? (Östhammar Municipality – municipal executive board)

(SKB) All parts of the final repository are designed to accommodate the fuel that has been produced and is expected to be produced by today's nuclear power plants (and Barsebäck). When the repository is built, it will presumably be possible to increase capacity, if necessary, by utilizing the repository area more efficiently than today's repository layout permits. The size of the tectonic lens in which the repository is located limits the expansion potential. The lens continues towards the southeast, so a future extension would take place in that direction. However, investigations are required to determine whether this is possible. Another possibility could be to build another repository level below the one now planned.

SFR does not limit the size of the final repository for spent nuclear fuel. However, its extent towards the north and northwest is limited not only by the boundaries of the lens, but also by administrative limitations (detailed development plan and disposition over the land). Siting of SFL lies far in the future, and the set of requirements also remains to be developed. To the extent Forsmark is considered, it is of course important to select a site such that the repositories do not risk interfering with each other.

2.70 The reports on water operations contain many difficult words that should be explained. The glossary in the preliminary EIS should be supplemented with words from the water operations reports. (Östhammar Municipality – municipal executive board)

(SKB) Water operations and their impact, effects and consequences are described in the EIS. The appendices about water operations provide more in-depth and technical information on these matters than the EIS. An effort has been made to increase the readability of both the EIS and its appendices. The appendix on groundwater diversion in Forsmark has been supplemented with a glossary.

2.71 Östhammar Municipality thinks that the water operations reports should contain a non-technical summary. (Östhammar Municipality – municipal executive board)

(SKB) Water operations and their impact, effects and consequences are described in the EIS. The appendices about water operations can be regarded as technical background material on these matters, while what is said in the EIS about each facility is a non-technical summary. See also reply to question 2.70.

2.72 Page 29: *There is not enough scientific background material to permit an exact prediction of the consequences for vegetation and biodiversity due to changes in the hydrogeological and hydrological conditions /Sidenvall and Birgersson 1998, Forgård et al. 2000, Hamrén and Collinder 20XX/.*

If you don't know what the consequences will be, it is important that the environmental monitoring is broad so that all environmental consequences are detected. (Östhammar Municipality – municipal executive board)

(SKB) Environmental monitoring will be broad; different programmes for monitoring will be developed for different impacts.

2.73 Page 91: *A change of the hydrological conditions in a wetland (calcareous pond) where the pool frog occurs leads to poorer conditions for the frogs' spawning and habitat. Furthermore, a lowering of the groundwater table leads to drier conditions in the surrounding area, which can also lead to a deterioration in the conditions for the spread of the species. The ponds in the Forsmark area where the pool frog occurs are an important centre of distribution for the species.*

When SKB applies for an exemption under the Species Protection Ordinance, will SKB propose measures to compensate for deteriorations in the spreading potential of species? (Östhammar Municipality – municipal executive board)

(SKB) Two types of measures are planned to ensure that the necessary conditions for the pool frog are secured. New frog habitats in the form of ponds will be created, and if necessary water will be infiltrated into wetlands to ensure that they will continue to function as pool frog habitats. Infiltration is not planned in surrounding areas.

2.74 Has SKB done any modelling with regard to the risks of extinction and chances of survival of the threatened species in the area (population dynamics modelling) and the impact to which they would be exposed by the construction a final repository? (Östhammar Municipality – municipal executive board)

(SKB) SKB has performed species-specific assessments with regard to the local and regional prospects for species that are particularly sensitive and vulnerable (for example the pool frog). The assessments are included in the background material appended to SKB's application for an exemption under the Species Protection Ordinance, report SKB P-11-04.

2.75 The EIS does not tell whether copper and bentonite are in plentiful supply. Are they, or are there alternative materials? (Östhammar Municipality – Environment and Public Health Committee)

(SKB) The KBS-3 method is based on the use of copper and bentonite. The supply of these materials is plentiful. A total of about 45,000 tonnes of copper will be used for final disposal. Global production in 2007 was about 15.5 million tonnes (mine production). The equivalent figure for bentonite is about 3.6 million tonnes for final disposal, and global production in 2007 was about 15.7 million tonnes.

2.76 The Environment Office thinks that radiological environmental monitoring should be performed in the event of a disturbance, and that there should be established procedures for this. To dispel anxiety, radiological environmental monitoring should be performed during normal operation as well. It does not need to be as comprehensive. (Östhammar Municipality – Environment and Public Health Committee)

(SKB) Radiological environmental monitoring is already performed around all nuclear power plants, including the Forsmark NPP. There are no plans for additional environmental monitoring or release monitoring for the final repository, since no radioactivity will be released from the facility.

2.77 In addition to the waste being hazardous with respect to radioactivity and radiation, its decay products are toxic heavy metals. The Environment Office thinks that the toxicity of the waste and the canisters and their impact on the groundwater should be described in the EIS. (Östhammar Municipality – Environment and Public Health Committee)

(SKB) A study has been performed of the hazardousness to human health and the environment of all substances that will be present in the canister, the insert and the spent nuclear fuel, including both radioactive and non-radioactive substances.

The results of the study show that even with pessimistic assumptions, the concentrations in the receiving waters will be far below the concentration criteria, indicating that health and environmental risks are improbable. The main results are presented in the final version of the EIS. The report, SKB P-10-13, "Kemisk toxicitet hos ämnen som deponeras i slutförvaret för använt kärnbränsle", ("Chemical toxicity of substances deposited in the final repository for spent nuclear fuel", in Swedish only) can be downloaded via SKB's website.

2.78 The drainage water will contain both nitrogen and salt. How will the saline drainage water affect the receiving water? It has already been mentioned that primary production will increase due to nitrogen. On page 307 it says that the receiving water is resilient. How do we know this, and what does it mean? (Östhammar Municipality – Environment and Public Health Committee)

(SKB) The receiving water is judged to be relatively resilient with respect to its size and the fact that it is open to the sea. Furthermore, the point of discharge for the drainage water will be immediately adjacent to the cooling water channel, resulting in a high degree of dilution. The salinity of the drainage water is expected to be similar to that of the sea. Details and assessments of effects and consequences of water discharge can be found in the report "Vattenhantering vid ett slutförvar för använt kärnbränsle i Forsmark – läge Söderviken", ("Management of water at a final repository for spent nuclear fuel in Forsmark – location Söderviken", in Swedish only), SKB P-10-19.

2.79 The Environment Office thinks it should be mentioned that procedures should exist for monitoring stormwater management, for example that oil and sediment separation devices are serviced and emptied regularly (page 318). (Östhammar Municipality – Environment and Public Health Committee)

(SKB) The various impacts of the activity will be monitored in various ways by different types of monitoring programmes. All planned measurements and monitoring activities are not described in the EIS.

2.80 One private water well may be affected by groundwater lowering (drawdown). The EIS contains information on how the impact on the well will be monitored, for example by sampling and measurement of the groundwater table before construction and during operation (page 262). (Östhammar Municipality – Environment and Public Health Committee)

(SKB) The various impacts of the activity will be monitored in various ways by different types of monitoring programmes. All planned measurements and monitoring activities are not described in the EIS.

2.81 It should be explained more clearly that SKB will prevent the spread of dust at and around the rock heap by e.g. watering if necessary (page 318). (Östhammar Municipality – Environment and Public Health Committee)

(SKB) As regards particle emissions from the planned activity, the background material shows that SKB will be far below environmental quality standards for particles, see report SKB P-08-66, "Miljö- och hälsokonsekvenser av utsläpp till luft. Slutförvar Forsmark (inklusive Clab och inkapslingsanläggningen)". ("Environmental and health consequences of atmospheric emissions. Final repository in Forsmark, including Clab and the encapsulation plant".) Nevertheless, SKB intends to take steps as needed to reduce dust emissions with the aid of a sprinkler.

Except during the initial construction phase, blasting will take place under ground and dust and particles will be collected in the drainage water, which will then be treated by sedimentation and oil separation. Dust will mainly arise at the rock heap, in conjunction with crushing, and possibly in connection with removal of rock spoil from the pier at SFR. SKB has not proposed conditions for reduction of dust and particle emissions. See also SKB's general reply H ("SKB's proposal for conditions").

2.82 According to oral information from ISS Facility Services, it is common for the Barracks Village to have guests who stay there for a very long time. It may be for several months at a time, in both winter and summer. It also happens that guests stay at the Barracks Village for a year or more. For this reason, the Environment Office does not consider it correct to regard the new housing at Igelgrundet and the Barracks Village as only temporary housing. SKB should take this into consideration when it comes to noise from construction and operation of the final repository. It is urgent that those who work at the nuclear power plant or the final repository and who will stay at Igelgrundet and the Barracks Village can sleep peacefully, for both health and safety reasons (page 268). (Östhammar Municipality – Environment and Public Health Committee)

(SKB) The risk of disturbances at the existing barracks village has been studied, and the conclusion is that the camp should eventually be shut down. One of the reasons for this is noise from construction of the final repository. The noise load has also been studied for FKA's planned new facility at Igelgrundet. The conclusion is that

relevant guideline values are met during both the construction and the operating phases. There may nevertheless be reason to show special consideration, for example by adjusting the times for particularly noisy activities at the final repository in order to reduce the disturbances.

2.83 The average volume of traffic is shown on page 228. The traffic quantity varies a great deal during the summer and winter. It would be good if SKB could also show how the traffic varies seasonally. The Environment Office is worried that the amount of traffic will be very great during certain periods. It would be good if SKB and the Swedish Road Administration could discuss a solution for residents along highway 76 who will be exposed to a great deal of traffic noise, in view of the fact that the number of vehicle trips will increase considerably during the construction phase, e.g. about 50% more vehicle trips at Johannisfors in 2018. It would be interesting to compare today's heavy goods traffic with the heavy goods traffic to which the final repository will give rise during construction and operation. (Östhammar Municipality – Environment and Public Health Committee)

(SKB) The estimate of traffic on the road sections is based on the Swedish Transport Administration's (formerly the Swedish Road Administration) database of random measurements, which have been adjusted upwards based on their predictions for economic calculation values for the years 2018 and 2030. We assume that the summertime traffic increase is included in the database. Visitor traffic is included in SKB's transport study.

The noise study that has been done concludes that noise barriers for the additional properties exposed to high noise levels is generally not economically justified unless measures are simultaneously adopted to improve the sound environment for the properties located closest to the road. These properties are already exposed to sound levels above the guideline values due to the general traffic.

The Swedish Transport Administration is responsible for building roads and making sure they can take the traffic they have to bear. We are well aware of the fact that this is an important issue and are holding discussions with the Swedish Transport Administration, among others. SKB has an interest in a good road and wants to mitigate the environmental impact as far as possible.

2.84 According to section 12.2 about cumulative effects, SFR will be extended at the same time as the final repository is being built. How has this been taken into consideration in calculating the transport volume and noise levels? (Östhammar Municipality – Environment and Public Health Committee)

(SKB) Shipments of rock from the extension of SFR are included in the transport study and the noise study is based on data from the transport study.

2.85 Where does the water for infiltration come from and how will the site be affected by the loss of water? (page 261) (Östhammar Municipality – Environment and Public Health Committee)

SKB has studied several sources of infiltration water. The water from Bruksdammen has been judged to be chemically suitable. There is plenty of water for infiltration, if necessary. The details are presented in an appendix to the EIS ("Vattenverksamhet i Forsmark I. Bortledande av grundvatten från slutförvarsanläggningen för använt kärnbränsle" ("Water operations in Forsmark. Diversion of groundwater from the final repository for spent nuclear fuel", in Swedish only), SKB R-10-14.

2.86 The conclusions of the long-term safety assessment should be given a more prominent role in the "non-technical summary" because they serve as a very important basis for the assessment of the environmental impact. (County Administrative Board in Uppsala County)

(SKB) In the non-technical summary in the final version of the EIS, the conclusions regarding post-closure safety have been given the same attention as other aspects. See also SKB's general reply B ("The role of the safety assessment in the EIS").

2.87 When it comes to the account of the chemical-toxic environmental impact that is included in the environmental impact statement, the risk assessment should include both the radioactive and the non-radioactive substances that will be present in the facility. (County Administrative Board in Uppsala County)

(SKB) A study has been conducted of the hazard posed to human health and the environment by all substances in the canister, the insert and the spent nuclear fuel, including both radioactive and non-radioactive substances.

The results of the study show that even with pessimistic assumptions, the concentrations in the receiving waters will be far below the concentration criteria, indicating that health and environmental risks are improbable. The main results are presented in the final version of the EIS. The report, SKB P-10-13, "Kemisk toxicitet hos ämnen som deponeras i slutförvaret för använt kärnbränsle" ("Chemical toxicity of substances deposited in the final repository for spent nuclear fuel", in Swedish only) can be downloaded via SKB's website.

2.88 According to Chapter 6, Section 7, point 4 of the Environmental Code, an EIS shall contain a description of alternative sites, if any, and alternative designs, together with an explanation of why a specific alternative was not chosen. This can be done convincingly by comparing the six other test sites, which represent different bedrock characteristics, with conditions in Forsmark and Oskarshamn with the aid of existing data. The presentation could consist of a table where the characteristics of the different sites are compared with each other. (County Administrative Board in Uppsala County)

(SKB) Such a table is provided in the final version of the EIS.

2.89 Reasonable alternative designs/methods to the KBS-3 method that have been studied within the framework of the RD&D programmes should also be described briefly in the EIS, in addition to the more detailed account promised as an appendix in the application. The account can consist e.g. of a table comparing advantages and disadvantages. (County Administrative Board in Uppsala County)

(SKB) The final version of the EIS contains a table where different methods are compared with regard to different requirements, including environmental requirements and safety requirements.

2.90 When it comes to the natural environment and land use, the County Administrative Board notes that the work of guaranteeing the conservation of the pool frog in the Forsmark area is not being pursued in consultation with the County Administrative Board. The County Administrative Board can contribute species knowledge and familiarity with the area as coordinator for action programmes for the threatened pool frog and for the rich fen biotope. (County Administrative Board in Uppsala County)

SKB concurs with the County Administrative Board's assessment.

2.91 With regard to the section on diversion of groundwater from the final repository for spent nuclear fuel, different models have been used. Regarding the model MOUSE-

SHE and the modelling tool Darcy Tools, the applicant should get opinions from independent experts. The County Administrative Board is not qualified to judge whether the models can be used for the applied-for measures or whether they have been used in a correct manner. The County Administrative Board will assume that the models are correct and well-founded and will only examine effects and protective measures in the upcoming licensing process. (County Administrative Board in Uppsala County)

(SKB) An exhaustive description of the models, including a discussion of uncertainty and confidence, is provided in an appendix to the EIS: "Vattenverksamhet i Forsmark I. Bortledande av grundvatten från slutförvarsanläggningen för använt kärnbränsle" ("Water operations in Forsmark I. Diversion of groundwater from the final repository for spent nuclear fuel", in Swedish only), SKB R-10-14.

2.92 Small changes in the groundwater in the area can have consequences. It is important that the applicant has checked that there are no licensed or other ongoing activities even in outer areas that could be affected, e.g. wells, land drainage systems, etc. (County Administrative Board in Uppsala County)

(SKB) Other water operations in the area have been inventoried. Possible consequences for wells and other water operations are described in an appendix to the EIS: Vattenverksamhet i Forsmark I. Bortledande av grundvatten från slutförvarsanläggningen för använt kärnbränsle" ("Water operations in Forsmark I. Diversion of groundwater from the final repository for spent nuclear fuel", in Swedish only), SKB R-10-14.

2.93 Alternatives report

With regard to the selection of a site for the final repository, a clearer comparison should be made between the chosen sites in Forsmark and Laxemar and other investigated sites with different bedrock characteristics in order to obtain a better geological breadth in the selection process and with a clear explanation of why other sites have been rejected. (County Administrative Board in Kalmar County)

(SKB) This has been clarified in the final version of the EIS. See also SKB's general reply F ("Site selection and choice of method").

2.94 In the "scoping report" under heading 3.2.3 Alternative designs *Final repository*, KBS-3H and KBS-3V are described as alternative designs. In the preliminary EIS, however, they are described as variants of the KBS-3 method. The County Administrative Board is also doubtful as to whether the two variants can be regarded as alternative designs according to Chap. 6 of the Environmental Code. (County Administrative Board in Kalmar County)

(SKB) KBS-3H is described as a variant of KBS-3V and is not an alternative design.

2.95 The nuclear waste company SKB must produce a preliminary version of the safety assessment that must be included in the application before the application is submitted and the document must be the subject of consultations. (MKG)

(SKB) In 2007, "Safety and radiation protection" was the theme of a consultation meeting. The background material consisted of a general description of SKB's work with safety and radiation protection. One of the appendices was a summary of the then recently published safety assessment SR-Can, which was an initial evaluation of post-closure safety for a final repository for spent nuclear fuel at Forsmark and Laxemar. The theme of the concluding consultation meeting in Östhammar on 3 May 2010 was "The role of the safety assessment in the environmental impact

statement". See also SKB's general replies A and B ("Conclusion of the consultations" and "The role of the safety assessment in the EIS").

2.96 The nuclear waste company SKB must produce a preliminary version of the documents on alternative methods and sites that must be included in the application before the application is submitted and the documents must be the subject of consultations. (MKG)

(SKB) Both the method for final disposal and siting of the final repository have been themes for consultations. See also SKB's general reply A ("Conclusion of the consultations").

2.97 The consultations must continue until a complete body of background material for site selection is available. (MKG)

(SKB) As the applicant it is our responsibility to identify a site for the facility in the applications for a final repository for spent nuclear fuel. SKB argues that the site is good enough both in the applications themselves and in an appendix to the applications. See also SKB's general reply A ("Conclusion of the consultations").

2.98 The consultations must continue until a complete body of background material for site selection is available, including a new and fair assessment of the alternative method Deep Boreholes. (MKG)

(SKB) As the applicant it is our responsibility to identify a method for disposal of the spent nuclear fuel in the applications for a final repository for spent nuclear fuel. SKB argues that the method is good enough both in the applications themselves and in an appendix to the applications. See also SKB's general reply A ("Conclusion of the consultations").

2.99 The nuclear waste company SKB has in the consultations avoided consulting about the consequences for natural values in the Forsmark area, despite the fact that great natural values are threatened by the final repository project. (MKG)

SKB has been clear throughout the consultation process about the fact that there are great natural values in the Forsmark area. The preliminary version of the EIS and the preliminary versions of the water operations reports have been the subject of consultations and discuss these types of questions. See also SKB's general reply E ("The final repository's location in an area with high natural values").

2.100 The nuclear waste company SKB does not handle barrier matters satisfactorily, particularly natural barriers. (MKG)

SKB has worked with barrier matters intensively for 30 years and does not share this opinion, but notes the viewpoint.

2.101 The nuclear waste company SKB conceals in the consultation the fact that one safety function of a KBS final repository is dilution of radioactivity in the event of a leak. (MKG)

(SKB) We do not take credit for dilution as a safety function, but calculate with dilution effects in analyses of the dispersion of any radionuclides released from the Spent Fuel Repository. We have said this clearly in the consultations, see for example the minutes from the consultation meeting with national conservation and environmental organizations on 4 May 2005, the meeting with local conservation and environmental organizations in Östhammar Municipality on 13 May 2005, the

public meeting in Östhammar Municipality on 4 June 2005, and public meetings in Oskarshamn Municipality on 31 May and Östhammar Municipality on 1 June 2006.

2.102 The preliminary EIS has shortcomings in how it handles the question of retrievability. (MKG)

(SKB) The EIS describes the environmental impact of the applied-for activity, which does not include retrieval.

2.103 The preliminary EIS lacks descriptions of how other countries handle the question of barriers and the question of retrievability. (MKG)

(SKB) In keeping with conventional EIS practice, SKB has chosen to focus the EIS on the applied-for activity.

2.104 The nuclear power company's KBS method, which is dependent on engineered artificial barriers, should not be used for a final repository for spent nuclear fuel. (MKG)

(SKB) The barriers in a repository according to the KBS-3 method consist of naturally occurring materials: bentonite clay, copper metal and the Swedish bedrock.

2.105 It has not been proven that the copper canister or the clay buffer will behave in the final repository as theoretically assumed by the nuclear power company, and more research is needed to investigate the problems with copper corrosion and. (MKG)

SKB's assessment is that we now have a sufficient scientific and technical knowledge base to submit the applications. The methodology for assessment of post-closure safety is highly advanced. Qualified safety assessments will continue to be an integral part of the execution of the Nuclear Fuel Programme. In order to gain a deeper understanding and reduce the uncertainties in the assessment, we will in our upcoming research programme concentrate on a few key issues such as corrosion of copper and processes that may affect the buffer material.

2.106 The KBS method is poorly suited to the dry Forsmark rock, and it is important that the nuclear waste company conduct experimental studies in a similar rock. (MKG)

(SKB) If the rock is dry, that means that there cannot be any transport of released radionuclides. The water that reaches the bentonite clay is absorbed by the clay and prevented from reaching the canister. Nothing can happen before the clay is saturated with water. Then the clay retards the transport of any radionuclides released from the canister, through the clay and out into the rock.

2.107 If the KBS method is to be used, the repository should be located as deep as possible, at a depth of around 1,000 metres. (MKG)

SKB intends to build the final repository at a depth of around 500 metres. This depth has been chosen in consideration of many factors, such as the water flow in the bedrock, the salinity and temperature of the water, rock stresses, constructability in rock, and the risk of drilling from the surface. The alternatives of building the repository at smaller or greater depth have both been considered, but judged to be inferior.

2.108 It is unsuitable to locate a final repository for spent nuclear fuel in a tectonic shear zone, such as in Forsmark. (MKG)

(SKB) Tectonic lenses are characterized by the fact that they have remained more intact through geological history than the surrounding rock. The lens in Forsmark was formed more than 1,800 million years ago and has since then been subjected to

highly varying rock stresses, for example during glaciations. The fact that the lens is still relatively intact indicates that there is little risk that tectonic stresses will cause any fracturing in the future. Furthermore, as a precautionary measure, deposition in or near fracture zones where rock movements could occur is avoided.

2.109 The nuclear waste company SKB's handling of the risks to a final repository during ice ages is inadequate. (MKG)

(SKB) The risks to a final repository during ice ages are handled above all in the assessment of post-closure safety, SR-Site, and its appendices.

2.110 The nuclear fuel company SKB must, in the environmental impact statement appended to the application, show the consequences of worst-case scenarios for leakage after 1,000 and 10,000 years after closure of a final repository. (MKG)

(SKB) Scenarios are handled above in the assessment of post-closure safety, SR-Site, and its appendices.

2.111 The nuclear waste company SKB must, in the environmental impact statement appended to the application, present scenarios for inadvertent intrusion in the final repository. (MKG)

(SKB) Scenarios concerning inadvertent intrusion are dealt with above all in the assessment of post-closure safety, SR-Site, and its appendices.

2.112 The nuclear waste company SKB's description of the impact of radiation on man and the environment is inadequate. (MKG)

(SKB) Questions related to the impact of radiation on man and the environment are dealt with above all in the assessment of post-closure safety, SR-Site, and its appendices.

2.113 The nuclear waste company SKB must, in the safety assessment and the environmental impact statement appended to the application, present scenarios and consequences for long-term risks of nuclear weapons proliferation. (MKG)

(SKB) Scenarios and consequences for long-term risks of nuclear weapons proliferation are not dealt with in either the EIS or the assessment of post-closure safety, SR-Site. The subject does not belong in these documents. In accordance with SSM's regulation SSMFS 2008:37, SR-Site deals only with inadvertent intrusion.

2.114 The nuclear waste company SKB must, in the safety assessment and the environmental impact statement appended to the application, present scenarios and consequences for long-term risks of speculative intrusion. (MKG)

(SKB) Scenarios and consequences of speculative intrusion are not dealt with in either the EIS or the assessment of post-closure safety, SR-Site. The subject does not belong in these documents. In accordance with SSM's regulation SSMFS 2008:37, SR-Site deals only with inadvertent intrusion.

2.115 The Deep Boreholes alternative must be evaluated further so that it can be fairly compared with the KBS method. (MKG)

SKB has developed a method for safe disposal of spent nuclear fuel, the KBS-3 method. SKB has on numerous occasions compared the KBS-3 method with the concept of depositing spent nuclear fuel in deep boreholes. Based on the results of the comparisons, SKB finds no reason to develop the Deep Boreholes concept any

further. Relevant reports are SKB R-10-25: "Metodval – utvärdering av strategier och system för att ta hand om använt kärnbränsle" ("Choice of method – evaluation of strategies and systems for disposal of spent nuclear fuel"); R-10-12: "Principer, strategier och system för slutligt omhändertagande av använt kärnbränsle" ("Principles, strategies and systems for final disposal of spent nuclear fuel"); and R-10-13: "Jämförelse mellan KBS-3 metoden och deponering i djupa borrhål för slutligt omhändertagande av använt kärnbränsle" ("Comparison between the KBS-3 method and disposal in deep boreholes for final disposal of spent nuclear fuel") (all reports in Swedish only). See also SKB's general reply F ("Site selection and choice of method").

2.116 The nuclear waste company SKB's site selection process has not been systematic or based on pre-established criteria and has thereby not had a focus on long-term environmental safety. (MKG)

(SKB) The post-closure safety of the final repository has been the most important aspect in the site selection process.

2.117 The heavy flow of water closer to the surface in Forsmark makes the site unsuitable for a final repository. (MKG)

(SKB) The water flow in the near-surface rock is above all a construction-related problem. The water flow does not make the site unsuitable for the final repository.

2.118 The Forsmark area contains great natural and recreational values and is therefore unsuitable as a site for the final repository. (MKG)

(SKB) We will take existing interests into consideration and give an account of our deliberations in the EIS. The area is also of national interest for final disposal of spent nuclear fuel. See also SKB's general reply E ("The final repository's location in an area with high natural values").

2.119 A final repository according to the KBS method should be located inland where groundwater recharge occurs. (MKG)

SKB believes that the question of coastal or inland siting has been adequately examined. The question is discussed in another appendix to the applications, SKB R-10-42, "Platsval – lokalisering av slutförvaret för använt kärnbränsle", ("Site selection – siting of the final repository for spent nuclear fuel", in Swedish only). See also reply to question 2.13, page 189.

2.120 A final repository system should not be located on the coast due to the risk of sea level rise linked to climate change. (MKG)

(SKB) Sea level rise linked to climate change has been taken into account in SKB's work and will not entail any problems for the final repository.

2.121 The Swedish Society for Nature Conservation and the Swedish NGO Office for Nuclear Waste Review, MKG, consider it unwise to locate a final repository system near a nuclear power plant. (MKG)

(SKB) SKB does not regard nearness to a nuclear power plant as a disadvantage. On the contrary, nearness offers advantages in the form of an opportunity to make use of existing competence and infrastructure. See also SKB's general reply D ("Consequences of interruption in the work").

2.122 The nuclear waste company SKB must report the cumulative effects of the final repository together with all other nuclear activities on both sides of the Baltic Sea. (MKG)

SKB's applications include interim storage, encapsulation and final disposal of spent nuclear fuel in Sweden. See also SKB's general reply G ("Description of cumulative effects in the EIS").

2.123 The nuclear waste company SKB must problematize the question of transferring information about the final repository to future generations. (MKG)

SKB is working with the problem of information transfer to future generations, both national and international. The problem should be solved by the time the final repository is to be closed, in about 50 years.

Sweden is for example participating in the work in an OECD/NEA project. In the project, the participating countries will jointly study how we can cross-reference information on each other's final repositories, what strategies can be chosen for information preservation, etc.

2.124 The selected site is suitable in terms of the fact that the area is already contaminated. Radioactivity in the area is extremely high, and using already contaminated areas for future repositories can be regarded as smart. In comparison with the level of radioactivity in the soil in Chernobyl in 1986, 20,000 Bq/m^2, the level of radioactivity offshore of Forsmark is up to 150,000 Bq/m^2 according to information from the Helsinki Commission. (See appended article in Oskarshamns-Tidningen and SERO-journalen.) (SERO)

SKB notes the viewpoint.

2.125 The high radioactivity in the water offshore of Forsmark and the radioactivity present in the land area around Forsmark (which will be released from the soil in drainage water) includes substances such as cesium-137, uranium-235, plutonium, strontium and other radionuclides that were released at the time of the Chernobyl disaster. (See appendix by Professor Frank von Hippel – composition of "Spent Fuel".) Cesium-137 is accumulated in the muscles of humans and animals, while strontium is stored in the skeleton. (SERO)

(SKB) Two ponds next to Söderviken will be completely filled in and a third will be partially filled in. No land drainage is planned. SKB notes the information about possible release of radionuclides.

2.126 Via water drainage and runoff, radionuclides will be leached from excavation activities and excavation spoil will to the offshore marine area, which is already radioactively contaminated. (SERO)

(SKB) The EIS contains information and clear descriptions of how we will handle the spoil and any problems that can be anticipated. SKB judges that we can handle this material without problems. See also reply to question 2.129, page 217.

2.127 Removal of shot rock from the pier will take place in an area that is contaminated with cesium-137 and other fission products. Also leakage from SFR? (See appendix – landfill harbour pier.) (SERO)

(SKB) The cesium-137 in the sediments stems primarily from the Chernobyl accident. No radioactive substances are leaking from SFR to the surrounding environment.

2.128 Bridges and transport across the intake channel for cooling water are directly unsuitable. An accident or sabotage where one or more trucks fall or are dumped

into the channel cannot be permitted. All bridges and transport across the channel should be eliminated.

• Can entail a risk of disruptions of reactor cooling.

• Can entail a risk of loss of cooling of the interim storage facility for spent fuel (see appendix – Spent Fuel Pool Storage and SERO's consultation response SOU 2009:88). (SERO)

(SKB) The road bridge is planned so that shipments of e.g. spent nuclear fuel from the industrial port to the final repository can be carried out separately from shipments to and from the Forsmark Nuclear Power Plant, which is an important traffic safety measure. See also SKB's general reply D ("Consequences of interruption in the work").

2.129 Excavation spoil from bottom sediment in Forsmark - Radioactivity in the Baltic Sea

The consultation report and the EIS do contain any information on radioactivity in the soil and bottom sediment for the planned work area at Forsmark.

- **Radioactivity in bottom sediment with a focus on the final repository area outside the Forsmark Nuclear Power Plant. (Appendix on sediment in the Baltic Sea and radioactivity in fish, animals and mushrooms in inland catchment areas linked to the Forsmark area.)**
- **Excavation and excavation spoil will, via water drainage and runoff, transport radioactive substances from the land to the offshore water area.**
- **Removal of shot rock (about 50,000 m^3) from the pier will take place in an area that is contaminated with cesium-137 and other fission products. Also leakage from SFR? (See appendix – Radioactivity.) (SERO)**

(SKB) The radioactivity that is present in the Baltic Sea mainly stems from the accident in Chernobyl. SSM has information on the radioactivity in the sea. There is a monitoring programme for sampling of radionuclides around the nuclear power plants, and the results are reported to SSM.

The EIS contains information and clear descriptions of how we will handle the excavated rock spoil and any problems that can be anticipated. SKB judges that we can handle this material without problems.

It is uncertain whether SKB will use rock spoil from the pier to SFR. We have only investigated the possibility of taking material from there. The rock has been lying there for many years, exposed to precipitation and waves. If we use rock spoil from the pier, we expect to be able to handle it without any problems.

2.130 Unsuitable bridges across cooling water channels

Bridges and transport across the intake channel for cooling water are directly unsuitable.

An accident or sabotage where one or more trucks fall or are dumped into the channel cannot be permitted. All bridges and transport across cooling water channels should be prohibited. (SERO)

(SKB) The road bridge is planned so that shipments of e.g. spent nuclear fuel from the industrial port to the final repository can be carried out separately from shipments to and from the Forsmark Nuclear Power Plant, which is an important traffic safety measure.

2.131 Marking of the repository for radioactive waste

The repository is intended to function for many generations in the future. In order to protect future generations from harm due to ignorance of the existence of

the repository, the facility must be marked in a manner that is both durable and understandable without knowledge of the languages of today. The EIS should contain a proposal for the design of such marking. (SERO)

SKB is working with the problem of information transfer to future generations, both national and international. The problem should be solved by the time the final repository is to be closed, in about 50 years.

Sweden is for example participating in the work in an OECD/NEA project. In the project, the participating countries will jointly study how we can cross-reference information on each other's final repositories, what strategies can be chosen for information preservation, etc.

2.132 What will happen if the Baltic Sea breaks through when the repository is half-full?

A disadvantage of locating the final repository on the Baltic Sea is that any leakage from the repository can run out into the sea without being discovered for a long time. Such a leakage would be almost impossible to stop and definitely impossible to take back. In view of the fact that the sediments offshore of Forsmark are already heavily burdened with radioactivity, extra contamination could cause considerable harm. For this reason, an inland location of the facility at least 30 km from the reactors in Forsmark would be preferable.

An additional risk that is not mentioned in the EIS proposal is the risk that an earthquake could open a fracture between the Baltic Sea and the repository when the repository is half-full. Since a large fracture would be impossible to seal, the repository would have to be abandoned. With a location further from the coast, the risk of sea breakthrough decreases, as does the risk of leakage to the sea. (SERO)

SKB notes the viewpoint, but observes at the same time that the distance between the final repository and the Baltic Sea is relatively great, several hundred metres.

2.133 In our opinion the consultations should not have been concluded until the safety assessment for the whole project (SR Site) is finished. In our opinion, the long-term safety evaluations in the EIS rest on very shaky ground, since they were based on a safety assessment from 2006 (SR Can) and many new factors have come to light since then, such as copper corrosion and the questionable ability of the bentonite clay to isolate the canisters. (Döderhult Nature Conservation Society)

SKB has a sufficient scientific and technical knowledge base to submit the applications for licensing review. The methodology for assessment of post-closure safety is highly advanced. Qualified safety assessments will continue to be an integral part of the execution of the Nuclear Fuel Programme. In order to gain a deeper understanding and reduce the uncertainties in the assessment, we will in our upcoming research programme concentrate on a few key issues such as corrosion of copper and processes that may affect the buffer material. See also SKB's general reply A ("Conclusion of the consultations").

2.134 The consultation material compiled by SKB provides a good description of several of the sensitive natural environments in the area around the planned final repository in Forsmark, but there is no comprehensive description and conclusions of the investigations conducted in and around Forsmark, particularly with respect to the aquatic environments. (Uppland Foundation)

(SKB) Chapter 7 in the EIS contains a comprehensive description of the area's natural values. More detailed descriptions of the area's natural values can be found in the background material on which the impact statements are based, for example the reports "Konsekvensbedömning av påverkan på naturvärden av anläggande och drift

av slutförvar för använt kärnbränsle, Forsmark" ("Assessment of impact on natural values of construction and operation of a final repository for spent nuclear fuel in Forsmark"), SKB P-10-15 (in Swedish only) and "Vattenverksamhet i Forsmark. Ekologisk fältinventering och naturvärdesklassificering samt beskrivning av skogsproduktionsmark" ("Water operations in Forsmark. Ecological field inventory of natural value classification and description of forest production land"), SKB R-10-16 (in Swedish only). Consequences for aquatic environments are very limited.

2.135 From the Uppland Foundation we wish to voice our concern that groundwater lowering in conjunction with the construction of the final repository may have a negative impact on the Kallriga nature reserve and bordering areas. The shallow bays in the area are very sensitive to anthropogenic lowering of the groundwater. They would soon silt up and become overgrown if the groundwater is lowered, preventing new lakes from forming in the landscape. This is an irreversible process that would harm the unique natural values that are dependent on these environments. (Uppland Foundation)

SKB notes the viewpoint. SKB has conducted in-depth studies of the possible consequences for the sensitive wetlands that characterize the area. Modelling of groundwater impact and ecological inventories cover those parts of the Kallriga nature reserve located closest to SKB's planned activity. This is described in detail in an appendix to the EIS, "Vattenverksamhet i Forsmark I. Bortledande av grundvatten från slutförvarsanläggningen för använt kärnbränsle." ("Water operations in Forsmark I. Diversion of groundwater from the final repository for spent nuclear fuel", in Swedish only), SKB R-10-14. See also SKB's general reply E ("The final repository's location in an area with high natural values").

2.136 During the construction phase, the report says that temporary solutions will be used for management of drainage water from the underground facility, leachate from the rock heap and stormwater. It is of great importance that this be done in such a way that the aquatic values (e.g. bottom vegetation and fish) in Asphällsfjärden and outside areas are not adversely affected.

During the operating phase, drainage water will be discharged into Söderviken (a part of Asphällsfjärden) after gradual sedimentation and separation of oil but without removal of nitrogen and without checking of e.g. pH. According to the report, the annual input of nitrogen will be about 0.2–0.9 tonne. The effect of the nitrogen load on the receiving water has been judged by SKB to be limited in the form of increased primary production, but it should be monitored to minimize the risk that the bottom vegetation will be adversely affected. pH levels should also be checked when drainage water is discharged, since the volumes amount to around 1,700–3,400 m^3/day and extreme values could have an adverse impact on biota. (Uppland Foundation)

(SKB) During the initial construction phase it is natural that certain systems – such as systems for management of drainage water, leachate and stormwater – are temporary. The temporary solutions for water management at the final repository will be similar in function to the subsequent permanent systems.

The discharge point for the drainage water will be located right next to the cooling water channel, resulting in a high degree of dilution. The pH of the drainage water will be checked regularly. SKB intends to further investigate the possibility of separating flushing water (high nitrogen content) from seeping groundwater (low nitrogen content) for the purpose of being able to remove nitrogen from the flushing water.

2.137 The Uppland Foundation considers it extremely important that the function of Norra Bassängen as a spawning area for the coastal fish in the area be monitored so that groundwater lowering and other actions do not hinder or prevent fish migration, spawning and hatching of roe in the area. Furthermore, the report should be supplemented with information from the publications mentioned above that deal with fry recruitment and shallow sea bays in the area around Forsmark, along with an impact assessment of how the construction, operating and closure phases of a final repository will affect the coastal fish. (Uppland Foundation)

(SKB) The question of possible impact on spawning areas for fish has been examined within the framework of studies of the effects and consequences of groundwater lowering. The groundwater lowering in the Forsmark area is expected to give rise to a very small lowering of the water level in Bolundsfjärden and Norra Bassängen and is not judged to affect the function of the lakes as nursery grounds. This is described in greater detail in an appendix to the EIS, "Vattenverksamhet i Forsmark I. Bortledande av grundvatten från slutförvarsanläggningen för använt kärnbränsle." ("Water operations in Forsmark I. Diversion of groundwater from the final repository for spent nuclear fuel", in Swedish only), SKB R-10-14.

2.138 The district around Forsmark is a wilderness that harbours several species of predator. The risk that the increased traffic through the area will cause disturbance has not been studied, nor what impact this traffic may have in the form of an increased number of wildlife accidents. The noise level in the area during different periods consists of transport and construction noise. The report does not explain how this will affect the predators and other fauna in the area. (Uppland Foundation)

SKB has studied the impact and consequences on e.g. the natural environment, hunting, outdoor activities and the cultural environment in SKB P-07-150: "Nulägesanalys samt bedömning av konsekvenser för rekreation och friluftsliv av ett slutförvar i Forsmark" ("Current situation analysis and assessment of consequences of a final repository in Forsmark for recreation and outdoor activities", in Swedish only). The EIS presents the consequences, which are deemed to be considerable.

The final repository will entail a slight increase in traffic in the area. The number of wildlife accidents will therefore increase, but only a little. SKB's assessment is that the final repository will entail little or no measurable impact on the general behaviour of the animals.

2.139 Vattenfall Eldistribution AB provides information on existing and planned power lines, wind farm and transformer station. (Vattenfall Eldistribution AB)

SKB notes Vattenfall's information and planning regarding new construction.

2.140 It is clear from the EIS that the traffic generated by the final repository will be distributed among the roads in the region. National road 76 is particularly identified as the road along which the traffic will increase in particular, mainly due to transport between the plant in Oskarshamn and the final repository in Forsmark. In this connection, the Swedish Road Administration would like to draw attention to road 288, which is an important link between Uppsala and northeastern Uppland today. The importance of the road will increase further due to the siting of the final repository in Forsmark. A discussion is under way between SKB, Östhammar Municipality and the Swedish Road Administration regarding the future use and design of road 288. (The Swedish Road Administration, now the Swedish Transport Administration)

SKB notes the information.

2.141 Fiskarfjärden, situated in the southern part of the impact area, gets most its water from a couple of springs in the middle of the lake's bottom. There is a clear risk that it will be harmed by a lowering of the groundwater head in the rock. The model calculations indicate an "insignificant lowering of the water level", but it is not clear whether allowance has been made in the calculations for the source of the water or whether, as in the case of Bolundsfjärden, it has been assumed that the lake is fed by surface water. (Society for Nature Conservation in Uppsala County)

(SKB) The modelling work takes into account the fact that water flows into and out of certain lakes via streams. Groundwater lowering calculations are based on a worst-case scenario with the entire repository (all tunnels) open simultaneously. Nevertheless, the results of the calculations show a lake level lowering that is less than five millimetres. A detailed account of the modelling work and the results is provided in an appendix to the EIS, "Vattenverksamhet i Forsmark I. Bortledande av grundvatten från slutförvarsanläggningen för använt kärnbränsle", ("Water operations in Forsmark I. Diversion of groundwater from the final repository for spent nuclear fuel, in Swedish only), SKB R-10-14 and its references.

2.142 How will reduced biodiversity in the Forsmark area affect nearby areas? It is concluded that "groundwater diversion from the final repository will lead to considerable harm to the area of national interest for nature conservation called Forsmark-Kallrigafjärden". However, the Kallrigafjärden area, a Natura 2000 site, is not judged to be affected since it contains several wetlands. (Society for Nature Conservation in Uppsala County)

(SKB) According to the Swedish EPA's handbook "Riksintresse för naturvård och friluftsliv" ("National interest for nature conservation and outdoor activities", in Swedish only), even small changes can lead to considerable harm to the national interest. SKB's assessment is that there is a risk of considerable harm since environments that comprise the basis for the national interest may be affected by groundwater lowering. At the same time, SKB will take steps to limit the magnitude of the impact on the groundwater table (sealing of the rock) and to mitigate the consequences of groundwater lowering (preparedness for infiltration in sensitive wetlands). Furthermore, we will draw up a management plan for SKB's land in Forsmark that will promote the area's natural values.

The Natura 2000 site Kallrigafjärden is located on the outskirts of the impact area for groundwater lowering, and the area's natural values are expected to be affected to an insignificant degree, even in the worst case.

Details on SKB's assessments are presented in the EIS and in the report SKB R-10-17: "Bortledande av grundvatten från slutförvarsanläggningen i Forsmark. Beskrivning av konsekvenser för naturvärden och skogsproduktion", ("Diversion of groundwater from the final repository in Forsmark. Description of consequences for natural values and forest production", in Swedish only).

2.143 How will a deterioration in the area's biological status affect biodiversity in a large perspective? The area is unusual in a regional perspective. (Society for Nature Conservation in Uppsala County)

(SKB) It is mainly a lowering of the groundwater level that threatens to affect the area's ecological values. Groundwater lowering will make parts of the area drier. In the case of the forested areas, this will lead to a reduction in the fraction of wet or damp forest areas. Forest areas will therefore offer fewer environments for the spe-

cies that thrive in these environments. At the same time it is important to bear in mind that the impact assessments are based on a worst-case scenario with the whole repository open at the same time. Moreover, there are other factors linked to the management of the forest that are important for the biodiversity of the forest, such as the age of the forest and the fraction of deadwood.

SKB will draw up a management plan for the properties we own. Aside from the cultivated forested areas, it is our ambition that the management of the area should be aimed at preserving and promoting the area's natural values.

In the case of wetlands with very high natural values that risk being affected by groundwater lowering, we will have preparedness for infiltrating water if necessary to counteract the effects of the groundwater lowering. In connection with the work on the management plan, ways of limiting terrestrialization of wetlands will also be studied.

Considering the planned measures and given that the management of the area will be adapted to the local natural values, there are good prospects that the area's biological status will not be adversely affected in a large perspective.

2.144 Several unusual bird species thrive in the forests in the Forsmark area. Will the forest be changed in such a way that e.g. woodpeckers will not want to live there? (Society for Nature Conservation in Uppsala County)

SKB's activities in the forested areas are planned to be limited. As during the site investigations, personnel who need to work outside the industrial area will undergo training that will include environmental aspects and the ecology of the site. At the same time, management of the forest (e.g. age and fraction of deadwood) will play an important role for its biodiversity. SKB will draw up a management plan for the properties we own. The management plan will include nature conservation initiatives for the forested areas. This means, for example, that conditions for many forest-dwelling birds will be improved as the forest gets older. All in all there are good prospects that forest birds will continue to thrive in Forsmark.

2.145 The provincial government is of the opinion that an environmental impact statement concerning interim storage, encapsulation and final disposal of spent nuclear fuel should contain a detailed account of all important environmental aspects. The most important environmental aspect for the final repository is long-term safety, which is really not dealt with since a reference is made to SR-Site, which is not ready. The provincial government emphasizes that the most important aspects of long-term safety must be addressed in the environmental impact statement. It isn't enough to refer to a report that isn't ready. (Åland's Provincial Government)

(SKB) Post-closure safety of the final repository is given more room in the final version of the EIS, which is one of the appendices to the applications. The SR-Site safety assessment is extensive and is presented in separate documentation, which is also an appendix to the applications. SR-Site shows that the activity in the final repository for spent nuclear fuel does not have any significant radiological impact on human health and the environment. The EIS therefore contains only a summary of conclusions and important results from SR-Site. See also SKB's general reply B ("The role of the safety assessment in the EIS").

2.146 The provincial government would like to further stress that nuclear power is not a renewable energy source and is thus non sustainable in the long term. There is a risk that Åland will two final repositories for spent nuclear fuel within a short

distance: Olkiluoto and Forsmark. The provincial government opposes this development. (Åland's Provincial Government)

SKB notes the viewpoint.

2.147 The provincial government considers it to be of the utmost importance that a sufficiently safe and sustainable method be chosen for final disposal of spent nuclear fuel. Responsibility for this must not be passed onto coming generations. (Åland's Provincial Government)

SKB concurs.

2.148 The provincial government considers it to be of the utmost importance that an inland alternative for final disposal of spent nuclear fuel be thoroughly investigated. The provincial government is particularly interested in whether the waste will be transported by sea to the planned final repository and assumes that a thorough study will be made before such an alternative is chosen. In view of the Baltic Sea's sensitive marine environment, the provincial government questions whether sea transport of nuclear waste is at all suitable. (Åland's Provincial Government)

(SKB) Inland locations have been considered. SKB's feasibility studies included eight municipalities. Some of the siting alternatives evaluated at that time were inland locations. However, in selecting sites for the site investigations, priority was given to the coastal locations in Simpevarp and Forsmark based on requirements and preferences regarding the bedrock, the industrial establishment and societal aspects. The process is described in detail in SKB's report SKB TR-01-03: "Integrated account of method, site selection and programme prior to the site investigation phase" (RD&D-K). An account of SKB's siting work is given in a separate appendix to the applications: "Site selection – siting of the final repository for spent nuclear fuel", (SKB R-11-07). See also SKB's general reply F ("Site selection and choice of method").

SKB's ship m/s Sigyn has transported unencapsulated spent nuclear fuel from the nuclear power plants to interim storage in Clab for more than 25 years. Transport of encapsulated spent nuclear fuel from the encapsulation plant to the final repository will take place in the same way, except that the fuel will not be contained in copper canisters in the transport casks. The number of sea shipments of spent nuclear fuel from the encapsulation plant on the Simpevarp Peninsula to the final repository in Forsmark will be about 15 per year. This entails a marginal increase in the total number of sea shipments in the area.

2.149 The final repository will be used over a mind-bogglingly long period of time. The environmental impact assessment must take into account climatological and geological changes over hundreds of thousands of years. It goes without saying that today's conceptualization and evaluation of risks and impact factors during this span of time are quite inadequate, as are the parameters available to us. An initial observation is therefore that the final repository must be accessible for physical relocation in the event the site is found to be unsuitable for its purpose in the long term or that the waste can be destroyed or disposed of (recycled) in another way due to new technology. (Eckerö Municipality, Åland)

(SKB) It is possible to retrieve deposited canisters during the operating period of the final repository. The deposited canisters can be retrieved even after the repository has been closed and sealed, but this would require great resources in the form of time and money. This is only possible if society makes a deliberate effort.

2.150 Eckerö Municipality notes that the Baltic Sea is one of the world's most polluted seas today. The Baltic Sea and its marine environment is highly vulnerable to all kinds of pollution due to the low rate of inflow of fresh salt water through the Danish straits. As a result, the Baltic Sea, with a mean depth of 60 metres, both absorbs and accumulates emissions and toxic pollutants. Current reports indicate continued nutrient enrichment in parts of the Baltic Sea, causing a progressive deterioration of the aquatic environment.

The Baltic Sea is of fundamental importance to Åland for the preservation of the province's maritime culture and character, as well as for tourism, recreation and industry. Radioactive contamination of the Baltic Sea has already reached an alarming level, making it one of the world's most radioactive seas.

Radioactive fallout from nuclear weapons tests, the reactor accident in Chernobyl, illegal dumping and discharge of cooling water from nuclear power reactors are important factors here, along with other emissions from densely populated and industrially developed catchment areas in the nine coastal countries with roughly 80 million inhabitants that use the Baltic Sea as receiving water.

Eckerö Municipality is strongly against any type of final repository that is located beneath the surface of the sea or in coastal areas. (Eckerö Municipality, Åland)

SKB fully understands Eckerö Municipality's concern about the environmental situation in the Baltic Sea. However, the final repository is designed not to cause significant impact on human health and the environment, which is confirmed by the assessment of post-closure safety, SR-Site, and is a prerequisite for granting of a licence for the activity.

2.151 The long-term risks for contamination of the aquatic environment cannot be ruled out or ignored. The EIS also cites the need for reinforcing stability measures due to the rock stress that distinguishes the bedrock in Forsmark. This rock stress is much higher than is normal in the Swedish bedrock, and at the alternative site. The surface rock in Forsmark is also fractured down to a depth of a hundred metres "and can be highly water-bearing" according to SKB's earlier report on the final repository for spent nuclear fuel in Forsmark – background and reasons for site selection 2009-06-04. The environmental legislation's general precautionary measures entail that an inland-based site is preferable from the viewpoint of remedial measures. The value of local popular acceptance that has been included in the guideline criteria for selection of the final disposal site would appear to lack relevance over the timespans encompassed by the EIS. The EIS can therefore be criticized for not having been open or unbiased on this point. (Eckerö Municipality, Åland)

(SKB) The final repository is designed not to cause significant impact on human health and the environment, which is confirmed by the assessment of post-closure safety, SR-Site, and is a prerequisite for granting of a licence for the activity.

SKB has repeatedly studied the possible advantages and disadvantages of siting the final repository on the coast versus inland. The question has been whether long flow paths (and long circulation times) for groundwater from inland locations can offer advantages from a safety viewpoint. An overall conclusion is that local conditions are more important than supraregional ones. An account of SKB's siting work, including conclusions of the studies regarding groundwater flow, is provided in a separate appendix to the applications. See also SKB's general reply F ("Site selection and choice of method"). See also reply to question 2.13, page 189.

2.152 In conclusion, Eckerö Municipality notes that the choice of Forsmark for the final repository necessitates extensive, regular sea shipments of nuclear fuel waste from the encapsulation plant in Simpevarp and its port to the Port of Forsmark.

Svensk Kärnbränslehantering AB has cited increased costs for the choice of Forsmark compared with the terminal vehicle transport that is sufficient in Oskarshamn, but the studies do not deal specifically or adequately with the associated risk situation at sea. Eckerö Municipality therefore wishes to add that the sea shipments of nuclear fuel waste are planned to be routed through one of the Baltic Sea's most intensive sea lanes west of the coast of Åland. The intensity of the traffic and the handling of nuclear fuel waste during loading and unloading as well as during transport entails additional risks to the maritime environment resulting from collisions and other accidents, hijackings, terrorist attacks or carelessness. Furthermore, costly loss-preventive measures such as salvage efforts may be necessary.

It is worth pointing out that it is virtually impossible to stop radioactivity from spreading and accumulating once it has reached a water basin, making it much worse than e.g. an oil spill in terms of cleanup. The risk of further exposure to radioactive contamination that poses a threat to both human health and the marine environment in the densely populated near-coastal Baltic Sea landscape must therefore be taken very seriously. (Eckerö Municipality, Åland)

SKB's ship m/s Sigyn has transported unencapsulated spent nuclear fuel from the nuclear power plant to interim storage in Clab for more than 25 years. Transport of encapsulated spent nuclear fuel from the encapsulation plant to the final repository will take place in the same way, except that the fuel will not be contained in copper canisters in the transport casks. The number of shipments of spent nuclear fuel from the encapsulation plant on the Simpevarp Peninsula to the final repository in Forsmark will be about 15 per year. This entails a marginal increase in the total number of sea shipments in the area.

2.153 Åland is located only about 60 km from the proposed final repository at Forsmark. Safety, and above all the risk of leakage of radioactive substances to the Baltic Sea, is therefore the most important issue for us. (ÅNOM)

(SKB) Possible discharges of radionuclides to the Baltic Sea or other receiving bodies of water is the most important issue for SKB as well. This is examined in the assessment of post-closure safety, SR-Site, which is appended to the applications.

2.154 The absence of this fundamental document [Note: the assessment of post-closure safety, SR-Site] **forces us to question the entire consultation process regarding the preliminary EIS as well as the purpose of the consultation meeting. If we cannot consult on the most important document of all regarding the question of whether the final repository at Forsmark will hold up in the long term, what is the point of the consultation? (ÅNOM)**

Throughout the consultation process, SKB has been clear on the fact that even if a given consultation occasion focuses on a given theme, it is always possible to ask any question dealing with interim storage, encapsulation and final disposal of spent nuclear fuel, including the post-closure safety of the repository. In fact, some consultation occasions have focused on post-closure safety. During 2007, consultations were held on the theme "Safety and radiation protection". The background material provided a general description of SKB's work with safety and radiation protection. An appendix contained a summary of the SR-Can safety assessment. The theme of the concluding consultation meeting on 3 May 2010 was the role of the safety assessment in the EIS. See also SKB's general reply B ("The role of the safety assessment in the EIS").

2.155 As we mentioned earlier, it is impossible for us to comment on the most important part of the EIS, the long-term safety assessment, since SR-Site still does not exist when the consultation is being concluded. This also makes us wonder: is the purpose of the EIS to build a final repository or to use the KBS-3 method? If it is the latter, what is the point of this consultation meeting? (ÅNOM)

SKB believes that it is important to distinguish between consultations according to the Environmental Code and the review that is part of the licensing process. The consultations shall, according to the Environmental Code (Chap. 6, Sec. 4), be concerned with the siting, scope, design and environmental impact of the activity and the content and design of the environmental impact statement.

The assessment of post-closure safety, SR-Site, is one of the central documents in the licensing process and forms part of the application documentation under both the Environmental Code and the Nuclear Activities Act. Both of these applications will be circulated for consideration by the environmental court and SSM, providing ample opportunity for review and comments on content, calculations and conclusions in the applications. See also SKB's general replies A and B ("Conclusion of the consultations" and "The role of the safety assessment in the EIS").

2.156 We also wish to point out here that the burden of proof regarding long-term safety rests with SKB. Saying that you don't understand the mechanism behind the KTH results is far from a satisfactory answer. It doesn't matter that the KTH researchers might be wrong. What matter is that, as the Swedish National Council for Nuclear Waste says, "The KTH group's results could thus be correct". SKB must therefore be able to prove with certainty which corrosion processes will occur during the life of the copper canister and how these process will be handled. (ÅNOM)

SKB is aware that we have the burden of proof for showing that post-closure safety can be achieved. As far as the results regarding copper corrosion presented by the KTH researchers are concerned, we are not convinced that the conclusions drawn from the experiments are correct. SKB has nevertheless analyzed what the consequences would be if the conclusions are correct. Our conclusion is that the results and conclusions of the KTH researchers, should they prove to be correct, are not of critical importance for the post-closure safety of the final repository. Other corrosion processes will be critical instead.

2.157 A final repository for spent nuclear fuel is such an important and long-term issue that the necessary time must be allowed to make sure that the repository will last, especially if independent researchers have arrived at other results regarding corrosion of the copper canister. We are talking here about something that has to last for 100,000 years, preferably a million years, and there must not be any questions concerning safety or any artificial timetables for achieving the goal, which in this case is disposal of the spent nuclear fuel. It is better to allow another 20 years for further study and do it right than to rush through the process with today's uncertainties, as you are doing now. Which raises the question: Why is SKB in such a hurry? (ÅNOM)

SKB is not in a hurry. Our task is to develop a method for safe final disposal of Sweden's spent nuclear fuel. A large project was commenced in the late 1970s for the purpose of developing a method and finding a suitable site for a final repository. We have now developed a method and selected a site, and are ready to submit applications for licensing review. SKB believes that we should avoid placing burdens on future generations, which means that the waste problem should essentially be

solved by the generations who have enjoyed the benefits of the electricity produced by nuclear power.

2.158 The bedrock. We are further aware that questions have arisen concerning the choice of bedrock. Once again it is impossible for us to determine whether SKB has answered these questions satisfactorily, since we have not had access to the long-term safety assessment SR-Site. Independent researchers have raised serious doubts regarding long-term geological safety in the rock in Forsmark, which is after all a crucial factor with regard to the long-term safety of the proposed KBS-3 method. (ÅNOM)

(SKB) It is clear from SR-Site that a final repository for spent nuclear fuel sited at Forsmark meets the requirements regarding post-closure safety. See also SKB's general reply F ("Site selection and choice of method").

2.159 Cumulative effects on Åland

Åland is located midway between the proposed final repository at Forsmark and the proposed final repository in Finland (based on the same KBS-3 method) at Olkiluoto. Within the same radius there are also five nuclear power plants in operation, one reactor under construction and possibly another one, depending on the Finnish parliament's decision regarding the expansion of nuclear power in Finland. One problem for those of us living in Åland is that this consultation process only concerns the proposed final repository at Forsmark. The Finnish processes concerning the final repository will only deal with the Finnish final repository. If someone in the future wants to increase the power capacity of one or more of the aforementioned reactors, or build one or more new reactors or possibly expand the aforementioned final repositories, the review of the application in question will only deal with that particular project. When and how will the cumulative effects of all nuclear facilities around Åland be considered? We understand that SKB is only responsible for the proposed final repository at Forsmark, but inasmuch as the Finnish proposal is based on the same method, and inasmuch as SKB and its Finnish counterpart Posiva share both knowledge and research, couldn't at least an estimate be made of the short- and long-term cumulative effects on the environment and human health for those who live midway between the two similar facilities? (ÅNOM)

(SKB) It is true that SKB is only responsible for the final repository in Forsmark, not for Posiva's repository in Finland. The viewpoint has been expressed that SKB should also consider the cumulative effects that can arise due to the final repository for spent nuclear fuel that Finland plans to build near Olkiluoto. SKB does not intend to do this. To begin with, it can be observed that a prerequisite for licensing of the final repositories that are planned in Sweden and Finland is that the countries' regulatory requirements are met.

The question of environmental impact caused by activities in other countries is dealt with under other rules. SKB, via the Swedish EPA, is conducting consultations under the Espoo Convention with the countries around the Baltic Sea. These consultations focus on transboundary environmental impact. Similarly, Finland is conducting consultations with the countries around the Baltic Sea, including Sweden, on the possible transboundary environmental impact caused by their planned final repository and nuclear power plant.

The other and concluding portion of the Espoo consultations with the Baltic Sea countries concerning the Swedish final repository for spent nuclear fuel will be carried out after the applications have been submitted. The basis for the consulta-

tions will be the part of the safety analysis report that deals with the post-closure safety of the final repository, SR-Site, and the EIS. See also SKB's general reply G ("Description of cumulative effects in the EIS").

2.160 The no action alternative. We believe that SKB has interpreted the no action alternative too narrowly. This is no ordinary facility, nor will there be any rival to the final repository in Sweden, even if a better method is found later on. We only have one chance to do this right, and both human health and the environment during the next 100,000 years depend on our getting it right now. We therefore have to ask the following questions: Is now the best time to do this? Do we know enough to proceed? Have we really found the best method and the best site, or just the best method so far and the best site so far?

In order to help us answer these questions, we demand that SKB report on the likelihood that other methods will be developed (which have too many uncertainties today) and the likelihood that a better version of the KBS-3 method will be found if the final repository is not built now. (ÅNOM)

SKB considers that, after many years of work, we now have both a suitable method and a suitable site for the final repository. SKB considers that present-day knowledge is sufficient to proceed, which means that applications can be submitted and reviewed. SKB finds no reason to speculate about the likelihood of other methods being developed. See also SKB's general replies C and F ("The No action alternative – scope and main features" and "Site selection and choice of method").

2.161 Site selection – Nearness to the Baltic Sea. The proposal, involving two final repositories (one in Forsmark and the other in Olkiluoto, on the Baltic Sea coast), both based on the same method, a method which SKB assumes will leak at some time during the next 100,000 years, is far too risky and highly irresponsible towards future generations. We are thereby strongly opposed to a near-coastal alternative. (ÅNOM)

(SKB) It is evident from SR-Site that a final repository for spent nuclear fuel sited at Forsmark meets relevant requirements with regard to post-closure safety. SKB believes that the question of coastal or inland siting has been adequately examined. The question is discussed in another appendix to the applications, SKB R-10-42, "Platsval – lokalisering av slutförvaret för använt kärnbränsle", ("Site selection – siting of the final repository for spent nuclear fuel", in Swedish only). See also reply to question 2.13, page 189.

2.162 We are concerned about the fact that SKB has not sought "the best site" but rather "the best possible site", with perhaps too narrow a definition of what is possible. One reason for our concern is that we have understood from SKB that the KBS-3 method requires a relatively wet rock in order for the bentonite clay to function, whereas Forsmark is relatively dry, in comparison with the other investigated sites. (ÅNOM)

(SKB) It is evident from SR-Site that a final repository for spent nuclear fuel sited at Forsmark meets relevant requirements with regard to post-closure safety. SR-Site is based on the properties of the bedrock in Forsmark, for example as regards water content.

If the rock is dry, that means that there cannot be any transport of released radionuclides. The water that reaches the bentonite clay is absorbed by the clay and prevented from reaching the canister. Nothing can happen before the clay is saturated with water. Then the clay retards the transport of any radionuclides released from the canister, through the clay and out into the rock.

2.163 In our opinion, a more responsible attitude would be to build the final repository at least 30 km from today's nuclear power plants. We propose 30 km because it is the radius for the evacuation area around Chernobyl following the accident. (ÅNOM)

(SKB) The processes that occur in the final repository are not rapid ones. If the deposition process has to be interrupted there are no environmental consequences. See also SKB's general reply D ("Consequences of interruption in the work").

2.164 It is also frightening that the plans for the final repository include construction of a bridge that crosses the cooling water channel for all three Forsmark reactors and transport of encapsulated waste from the port to the final repository over the bridge. Has an account been given of the consequences, in particular for the power plant's water supply and safety, of a possible terrorist attack on the bridge where the bridge collapses with a fully-loaded canister vehicle on it? (ÅNOM)

(SKB) The road bridge is planned so that shipments of e.g. spent nuclear fuel from the industrial port to the final repository can be carried out separately from shipments to and from the Forsmark Nuclear Power Plant, which is an important traffic safety measure.

2.165 We also question the plans to blast and build tunnels beneath the reactor building(s). (ÅNOM)

SKB has studied this and found that it will not entail any problems.

2.166 Bentonite erosion

We are aware that there are also questions concerning the erosion of the bentonite clay which SKB plans to use in the final repository. Once again a vital part of the method is being questioned and a meaningful consultation process is not possible unless we have access to SKB's study of this matter. All comments on the importance of peer review also apply here. (ÅNOM)

(SKB) The methodology for assessment of post-closure safety is well advanced. In order to deepen our understanding and reduce uncertainties in future assessments of post-closure safety, SKB will continue to focus on the key questions concerning copper corrosion and processes that could affect the buffer material.

2.167 "The multiple barrier system"

The KBS-3 method is often described as a "multiple barrier system" where the three barriers are copper, bentonite clay and bedrock. We find this description to be misleading. To be sure, there are three levels in the system. But all three are dependent on each other to keep the waste isolated during the disposal period. (ÅNOM)

(SKB) It is correct that there is a dependence between the barriers.

2.168 A fundamental principle in all engineering is that all functions that are important for safety should have a built-in redundancy, in other words there should be several independent components, each of which by itself guarantees safety. Considering the consequences of a leakage, we demand this. The disposal method should be based on at least two (preferably more) different components, that are in no way dependent on each other to work, but could each guarantee the long-term safety of the final repository with or without the others. (ÅNOM)

(SKB) The consequences if one or more of the barriers does not work as intended are examined in the SR-Can safety assessment. In summary, the assessment shows that even with completely unrealistic assumptions of early failure of all canisters

and loss of all buffer material, the long-term consequences are comparable to those of natural background radiation.

2.169 Retrievability

There has been discussion of retrievability, both in the Swedish National Council for Nuclear Waste's state-of-the-art report 2010 and at the consultation meeting of 6 February 2010. We are surprised at this, since our understanding of the Swedish Nuclear Activities Act is that non-retrievability is one of the requirements in the Act's definition of final disposal. We may be wrong about this, but it would be helpful to hear how SKB (and SSM) interprets this. (ÅNOM)

(SKB) If the spent nuclear fuel is not reprocessed (which is true of the fuel covered by SKB's applications), the Nuclear Activities Act requires final disposal. However, there is no requirement that the fuel should be "non-retrievable". It is possible to retrieve deposited canisters during the operating period of the final repository. Retrieval is possible even after closure of the repository, but would require great resources in the form of time and money. This is only possible if society makes a deliberate effort.

2.170 Our perspective is that 100,000 years (or a million years, which is also used in the EIS) is such an incredibly long time that the possibility must be considered that problems may arise with the canisters and that "re-encapsulation" of fuel may be necessary. (ÅNOM)

SKB does not assume that "re-encapsulation" will be necessary, but that the final repository will function without monitoring or institutional controls. The KBS-3 method has been developed under this assumption.

2.171 But regardless of whether one is for or against retrievability as a requirement on the final repository, there is a problem with the proposed repository in this regard. The KBS-3 method promises that the waste will be both isolated and retrievable. On the one hand, the proposed method is designed so that the waste will not be retrievable (to the extent that the waste does not require monitoring after a relative short time in the rock). This means that it is difficult to check or retrieve the canisters, or in any case difficult to do this in a safe manner, and expensive to try. On the other hand it is relatively easy to reach the canisters – if it is possible to dig 500 m down through granite then it is possible to do it through clay as well. For example, a future dictator who doesn't care about the health of the workers or the nearby residents could do so relatively easily. It is also possible that future generations could break into the repository without knowing what is down there. From a retrievability viewpoint you could say that the KBS-3 method is the worst of two worlds. (ÅNOM)

(SKB) From a retrievability viewpoint the KBS-3 method is the best of two worlds. The KBS-3 repository will be designed so that retrieval is not necessary, but if future generations would like to retrieve the spent nuclear fuel it is possible.

2.172 Retrievability entails a risk for proliferation of material that could be used to produce nuclear weapons. This is a very serious issue that has been completely overlooked in the EIS. We demand that SKB explain what they could do to guarantee that the waste will not be used to make nuclear weapons and describe what methods exist or could be developed for SKB to treat the waste in such a way that it cannot be used to make nuclear weapons. (ÅNOM)

(SKB) It is possible to retrieve spent nuclear fuel that has been deposited according to the KBS-3 method, even after closure. However, retrieval would be a large-scale enterprise requiring the participation of society. It should also be noted that the spent nuclear fuel is not a suitable raw material for making nuclear weapons.

2.173 The EIS makes patently incorrect claims. For example, it says on page 37 that "after 100,000 years the radiotoxicity of the spent fuel will have declined to the same level as that of the natural uranium mineral from which it was fabricated." This is not true – there will be much higher levels of U-238 as well as the more radioactive U-235 and U-234. The bar graph on page 38 appears to show that the radioactivity declines to 0.0005% of its original value after 100,000 years, but most of the remaining material is uranium. Since the uranium's half-life is several billion years, there will be virtually no change in its quantity over the 100,000 years shown in the graph on page 38. (ECRR)

SKB has compared how toxic – radioactive – the spent nuclear fuel is after 100,000 years with the radioactivity of the quantity of uranium ore originally mined to produce it. However, the uranium is spread over a larger volume in the mine or deposit from which it was originally extracted. In other words, the comparison is relevant if one considers the total quantities.

2.174 According to the text on page 43, the safety assessments that have been carried out of the KBS-3 method have shown that the final repository with copper canisters surrounded by bentonite is resistant to the stresses that can arise in connection with future earthquakes and glaciations. What is meant by "resistant" in this case? Can't the canister break apart? Can't leakage of radionuclides occur via the backfilled tunnel system? (EK Miljökonsult AB)

(SKB) The material has been chosen and the canister is designed to resist corrosion and mechanical forces resulting from movements in the rock caused by earthquakes and climate change. As long as the canister is intact, no radionuclides can escape into the environment.

The canisters are surrounded by bentonite clay, which constitutes a buffer against minor rock movements and prevents corrosive substances from getting into the canister. The clay also effectively absorbs radionuclides that are released if the canister is damaged.

The assessment of post-closure safety examines scenarios with damaged canisters and radionuclide release. The assumption in the environmental impact statement is that SSM's risk criterion can be fulfilled. Otherwise we won't get a licence to build and operate the Spent Fuel Repository.

2.175 The description of Laxemar shows that the subarea where a final repository could be sited has plenty of space and thereby large margins. According to the text, this offers flexibility and good opportunities to deal with any geological surprises. Has a similar assessment been made for Forsmark? (EK Miljökonsult AB)

(SKB) The rock in Forsmark is better suited for a final repository than the rock in Laxemar, so the same flexibility is not needed for "geological surprises". The available space is limited by the size of the tectonic lens. This allows some extension of the planned repository.

2.176 The last paragraph that deals with the long-term safety assessment includes a calculation of radioactive releases to the environment. What area has been investigated? Do these calculations also include Gräsö, the Öregrund area and Östhammar? What were the results? (EK Miljökonsult AB)

(SKB) Hydrogeological calculations have been carried out to obtain a picture of where any released radionuclides would end up. The model that was used includes Öregrundsgrepen and part of Gräsö.

In the calculations, the water pathways from the deposition holes are followed by studying how particles "released" from each individual deposition hole are transported to the receiving body of water. The particles will take different paths depending on when they are released. This is due to the fact that conditions in the area will change as a result of land uplift and future ice ages.

Particles released within a short time, around 1,000 years, after repository closure will for the most part end up almost directly above the repository. Particles released at a later date, roughly 5,000–10,000 years after repository closure, will end up slightly farther towards the northeast, due to the fact that land uplift has displaced the shoreline towards the northeast. A detailed account of the hydrogeological calculations is provided in the report "Groundwater flow modelling of periods with temperate climate conditions – Forsmark", SKB R-09-20.

The release points revealed by the hydrogeological calculations serve as input to the subsequent biosphere modelling.

2.177 Fracture density in Forsmark is only reported at greater depths than 400 m. What is the fracture density in shallower rock? (EK Miljökonsult AB)

(SKB) There are long, water-bearing horizontal fractures within the upper approximately 150 metres of the rock in Forsmark. A well drilled here yields on average 20 times more water than the average well in Sweden. Fracture frequency varies between the boreholes, but can be said to lie between three and ten fractures per metre. Below about 200 metres the rock is completely dry and fracture-poor.

2.178 Under the heading "Risk and safety" in Table 10-18 and Table 12-2, it says that the consequences of an unexpectedly large seepage of water are smaller in Laxemar than in Forsmark. Based on this it can be assumed that the fracture density in superficial rock in Forsmark is greater than in Laxemar, but this is not clear from the text. (EK Miljökonsult AB)

(SKB) In superficial rock, the fracture density can – with local variations – be higher in Forsmark than in Laxemar, but this conclusion cannot be drawn from the cited tables. What is compared in the tables is the possible consequences of unplanned large water seepage, which are also dependent upon conditions on the surface. Due to the sensitive natural environment in Forsmark, the consequences for the natural values there can be greater than in Laxemar.

2.179 The account of water flux in the rock in Forsmark is unclear. According to the first paragraph on page 100, the water flux in the near-surface system is estimated to be 1,000–10,000 times higher than in the deeper flow system. What depths are being compared? Is it only a comparison of different rock levels, or does it also include the soil layers? (EK Miljökonsult AB)

(SKB) The near-surface system includes both the soil layer and the rock. The information on the deeper flow system comes from the site investigations, which included borehole measurements down to a depth of about 1,000 metres.

2.180 What tests have been performed in the boreholes? What were the results? (EK Miljökonsult AB)

(SKB) SKB's programme for the concluding part of the site investigation in Forsmark is presented in the report SKB R-04-75: "Program för fortsatta undersökningar av geosfär och biosfär. Platsundersökning Forsmark" ("Programme for

further investigations of geosphere and biosphere. Site Investigation Forsmark", in Swedish only). It included investigations and tests on the ground surface (including flora and fauna), in the soil layers and in the rock.

Various kinds of drilling are used for direct investigations of soil and rock, beneath the observable surface. Drilling makes it possible to take samples of the material in the form of cuttings or cores, directly during drilling, and then provides access for a wide range of borehole-based methods for investigating the properties of the rock (such as mineral distribution, physical properties, fractures, loads) and the groundwater (permeability, flows, chemical composition). Drilling is a kind of random sampling of geological materials, with obvious limitations in that the material sampled exhibits wide spatial variation. The way to get around this is to combine the information from boreholes with knowledge of conditions on the surface (for example from geological mapping) and investigation methods able to "capture" properties over areas or volumes (for example airborne and ground geophysical surveys, borehole radar, seismic methods and hydraulic tests).

The results from the site investigation were used for the site modelling for Forsmark described in the report TR-08-05, "Site description of Forsmark at completion of the site investigation phase", and in a more popular version, "Berättelsen om Forsmark" ("The story of Forsmark", in Swedish only), ISBN 978-91-977862-3-2. Both reports can be downloaded or ordered via SKB's website.

2.181 Cumulative effects Forsmark. Information is lacking on building plans in Östhammar Municipality and what the effects of this could be. (EK Miljökonsult AB)

(SKB) There are no detailed plans for the establishment of activities nearby that could cause cumulative effects together with the final repository.

2.182 Information is lacking on cumulative effects regarding tourism. (EK Miljökonsult AB)

SKB's assessment is that of the existing facilities and activities (the nuclear power plant, SFR) and those that are planned (the Spent Fuel Repository and the wind farm), it is mainly the Spent Fuel Repository that will attract interest. The greatest consequences are expected to result from an increase in the transport volume, and they are included in the transport forecasts. Possible positive consequences of increased tourism have not been included in the EIS, however.

2.183 It is not clear what effects a wind farm may have on the bottom sediments, the marine fauna and the superficial rock that could cause cumulative effects together with the construction of a final repository. Could the wind farm cause more fractures to form in superficial rock or could the wind farm cause the number of superficial fractures to decrease, since they will be sealed in connection with the construction and foundation work? (EK Miljökonsult AB)

(SKB) The impact of the wind farm on the bottom sediments, the marine fauna and the superficial rock is not included in the description of the environmental consequences for the Spent Fuel Repository. Construction of the wind farm is not expected to affect the bedrock in any way that could have consequences for the safety of the Spent Fuel Repository.

2.184 Construction phase. What temporary solutions are planned for treatment of wastewater, drainage water and leachate during the first few years? (EK Miljökonsult AB)

(SKB) During the initial construction phase it is natural that certain systems – such as systems for management of drainage water, leachate and stormwater – are temporary. The temporary solutions for water management at the final repository will be similar in function to the subsequent permanent systems.

2.185 It is unclear how the stormwater will be managed. (EK Miljökonsult AB)

(SKB) The stormwater that is formed during establishment of the operations area is planned to be managed according to the principle of local stormwater management (LSM). The purpose of LSM is to minimize the quantities of stormwater that are generated (for example by minimizing paved surfaces) and to manage the stormwater at the source (for example by creating infiltration surfaces). Taken together, this means that no stormwater flow needs to be diverted from the facility. Stormwater management is described in the EIS and in the report SKB P-10-19: "Vattenhantering vid ett slutförvar för använt kärnbränsle i Forsmark – läge Söderviken" ("Management of water at a final repository for spent nuclear fuel in Forsmark – location Söderviken", in Swedish only).

2.186 What type of water will be used to mitigate the consequences of groundwater lowering in the wetlands? (EK Miljökonsult AB)

SKB has studied several sources of infiltration water. The water from Bruksdammen has been judged to be chemically suitable. There is plenty of water for infiltration, if necessary. Details are presented in an appendix to the EIS, "Vattenverksamhet i Forsmark I. Bortledande av grundvatten från slutförvarsanläggningen för använt kärnbränsle." ("Water operations in Forsmark I. Diversion of groundwater from the final repository for spent nuclear fuel", in Swedish only), SKB R-10-14.

2.187 After injection of grouting agent into the tunnel system to prevent seepage of groundwater, the permeability of the rock is expected to be about 1×10^{-8} m/s, according to the EIS. This means that drainage water will be formed that may contain residues of the grouting agent. How will negative effects of this be avoided? (EK Miljökonsult AB)

(SKB) Drainage water will pass through basins for oil separation and particle sedimentation. The water will be analyzed regularly with respect to pH, among other things. SKB will mainly use cementitious grout to seal the rock. Up to the start of construction we will follow the development of grouting methods and agents so that we can then choose a method and an agent that will entail as little risk as possible to the surrounding environment.

2.188 What does the need for sealing of the tunnel system look like in Forsmark compared with in Laxemar? How much sealant will be needed and what do the risks for spreading of sealant via the drainage water look like on the two sites? What could the consequences be and how can sealant be prevented from spreading to the environment? Is injection grouting the best sealing method for the whole tunnel system on both sites? (EK Miljökonsult AB)

(SKB) The need for sealing of the tunnel system differs between the sites, since the properties of the rock differ. For example, the fracture frequency at repository depth is lower in Forsmark than in Laxemar. A specific sealing strategy, based on proven sealing methods, has been defined for different parts of the facility and is described in "Underground design Forsmark. Layout D2", SKB R-08-116. At the

same time, SKB will follow the development of grouting methods and agents so that we can then choose a method and an agent that will entail as little risk as possible to the surrounding environment.

2.189 The drainage water may contain grouting agent. Will this be removed in the treatment processes? (EK Miljökonsult AB)

(SKB) Drainage water will pass through basins for oil separation and particle sedimentation. The water will be analyzed regularly with respect to pH, among other things. SKB will mainly use cementitious grout to seal the rock. Up to the start of construction we will follow the development of grouting methods and agents so that we can then choose a method and an agent that will entail as little risk as possible to the surrounding environment.

2.190 Can it lead to any negative effects if the drainage water is diverted to FKA's sewage treatment plant? How will the present-day treatment process be affected? (EK Miljökonsult AB)

SKB does not plan to divert the drainage water to FKA's sewage treatment plant, since the nitrogen concentrations in the drainage water are expected to be low during operation (no more than three milligrams per litre). It would entail an increased load on the sewage treatment plant without doing any real good. The drainage water will, however, be treated to remove particles and oil residues. Furthermore, SKB will further study the possibility of separating flushing water (the water that is used immediately after blasting and contains high nitrogen concentrations) and seeping groundwater (with low nitrogen concentrations).

2.191 In order to save energy, the ventilation will be demand-controlled according to the EIS. What parameters will be measured that determine the ventilation requirement in the tunnel? How will a good working environment be ensured? (EK Miljökonsult AB)

(SKB) The purpose of the ventilation system is to supply the facilities on the ground surface and underground with air so that a suitable environment is obtained for personnel, equipment and activities. As regards the underground parts, the system will ventilate away radon, diesel fumes, explosion gases and smoke gases in the event of fire. Large air flows are desired for venting of explosion gases, for example, so that the gases can be aired out quickly. Important control parameters are supply air temperature and humidity in relation to desired temperature and humidity. This is a working environment issue that is not dealt with in the EIS, but in working environment plans.

2.192 A type of groundwater-borne radioactive contamination that is not dealt with in the EIS is leakage via tunnel systems that will be built. How watertight will the tunnel be after closure? (EK Miljökonsult AB)

(SKB) When all the holes in a deposition tunnel are filled with canisters the tunnel is backfilled with compacted blocks of bentonite in combination with bentonite pellets and sealed with a concrete plug in the mouth of the deposition tunnel.

When all spent nuclear fuel has been deposited and SKB has obtained permission from the authorities for closure, closure of the entire underground facility will commence. How closure is to be carried out has not yet been determined, since it lies far in the future, but SKB's current strategy is to backfill the main and transport

tunnels in the same way as the deposition tunnels and to backfill the central area with crushed rock. The lower part of the shafts and the ramp is backfilled with bentonite and the upper part with crushed rock.

After closure the tunnel system will fill with water. Bentonite is a clay that swells in contact with water, which makes it difficult for water to penetrate. There will be no freely flowing groundwater in the backfilled underground openings that could spread released radionuclides.

The assessment of post-closure safety, SR-Site, examines scenarios with damaged canisters and radionuclide release. A prerequisite for SKB to get a licence to build and operate the Spent Fuel Repository is that we can show that SSM's risk criterion can be fulfilled.

2.193 Can the risk of contamination be greater in Forsmark than in Laxemar due to groundwater communication via the sealed tunnel to shallower fracture systems in the rock? (EK Miljökonsult AB)

(SKB) No, the risk for spreading of released radionuclides is not greater in Forsmark than in Laxemar.

2.194 There is no bridge between Öregrund and Gräsö. Goods and people are transported today by the Swedish Road Administration's ferry. Most of Gräsö is situated within the inner emergency zone for Forsmark (i.e. 12–15 km from the Forsmark Nuclear Power Plant). Many people live on and visit the island in the summer (about 10,000 persons at any one time). There is one (1) road from the ferry berth running in a north-south direction across the entire island that has to carry all goods and passenger traffic. What are the risks in the event of an evacuation of the island in the summertime when a large number of people are on the island?

How long would it take to evacuate the island to a safe place? How great would the exposure be? Can the risks of negative consequences be reduced? (EK Miljökonsult AB)

(SKB) The question of the Spent Fuel Repository and its location near the nuclear power plant in Forsmark has been discussed and studied. If a major release of radioactivity were to occur from the nuclear power plant, it could create serious problems in the nearby area, but there would not be any major impact on the Spent Fuel Repository since no rapid processes occur there. See also SKB's general reply D ("Consequences of interruption in the work").

SKB is not aware of the evacuation plans in the event of an accident at the nuclear power plant.

2.195 As I understand it, the repository will be built out in stages, so that the 100 initially deposited canisters will be exposed to tens of thousands of shock waves when the blasting is done for the remaining 5,900 canisters.

It seems remarkable and counter to common sense that Sweden's most sensitive repository with an operating period of 100,000 years will be subjected to tens of thousands of shock waves that are furthermore likely to be very violent in the homogeneous rock.

I question this incremental building method and find the EIS deficient for its lack of both studies and a discussion of what effects these shock waves will have on the already deposited canisters and thereby on the safety and function of the whole repository.

I am talking about what will happen to the canister as such and what will happen inside the canister in terms of nuclear and temperature aspects, but also what

will happen to the repository's plugs and seals, the surrounding rock, etc. (Janeric Thelin)

(SKB) The underground part of the final repository will be built out in stages with parallel deposition of spent nuclear fuel canisters. The following main activities will be pursued during routine operation:

- Rock works: Detailed characterization of the rock and excavation of new deposition tunnels.
- Deposition works: Deposition of canisters in prepared deposition holes and backfilling and plugging of deposition tunnels.

The rock works are kept separate from the deposition of canisters by means of a partition wall in the main tunnel, from which all deposition tunnels radiate. As the deposition and rock works progress, new partitions walls are installed in the main tunnel. The previous partition walls remain in place, but are opened for passage.

The question of the size of the shock waves that can be withstood by the rock and the canisters has been analyzed and there are limits on the size of the shock waves that can be tolerated. Blasting will be done in such a way that the shock waves are well below the limit values.

3 Common issues

3.1 It is important that the consultations held according to Chapter 6 of the Environmental Code prior to submitting an application for a licence to build a final repository not be limited by the framework which SKB says applies for the consultations. According to the company, only certain special meetings are consultation meetings. But SKB has discussed the final repository with different actors since the mid-1970s. The consultations also include the entire process of reviews of SKB's RD&D research programmes that has been going on since the mid-1980s, the national consultations that have occurred between meetings and correspondence between SKB and the Swedish Nuclear Power Inspectorate, SKI, the Swedish Radiation Protection Authority, SSI, and the Swedish Radiation Safety Authority and their experts, as well as other meetings and information exchanges which SKB has had in the process of arriving at a final repository solution. (MKG)

(SKB) It is correct that SKB has discussed the final repository with a number of actors for a long time, and in different contexts. There is, however, a difference between (1) the work within the framework of the RD&D process, (2) the consultations held with SSM according to the Government decision stemming from the review of the RD&D supplement in 2001, and (3) the consultations held in accordance with the sixth chapter of the Environmental Code. The latter consultations began in 2002 and were concluded in May 2010.

3.2 Through the years it has been difficult to get the activity operator to lend a sympathetic ear to the viewpoints expressed in the consultations. This applies not only to the viewpoints of the environmental organizations but also to viewpoints expressed by all actors in the nuclear waste field. The activity operator has for the most part elected to pursue its own policy and has used the consultations more to inform than to solicit viewpoints. (MKG)

(SKB) Consultations according to the sixth chapter of the Environmental Code shall deal with the siting, scope, design and environmental impact of the activity and the content and design of the EIS. SKB contends that this is precisely what the

consultations have been about, and we have listened to and heeded the viewpoints that have emerged from the consultations.

The consultation report shows clearly what the consultations have involved, who has participated, what discussions have been held and how the viewpoints that have emerged have been acted on.

3.3 The Coast Guard notes that the preliminary environmental impact statement does not include an exhaustive account of the consequences of the planned increase in sea transport of spent nuclear fuel. (Swedish Coast Guard)

(SKB) The number of sea shipments of spent nuclear fuel from the encapsulation plant on the Simpevarp Peninsula to the final repository in Forsmark will be about 15 per year. This entails a marginal increase in the total number of sea shipments in the area, and the environment impact is therefore also judged to increase marginally.

3.4 The Swedish National Council for Nuclear Waste believes that a coherent and clarifying account should be given in the environmental impact statement of alternative methods for the final disposal of spent nuclear fuel where SKB compares the different environmental effects caused by the alternatives and explains why they opted for the chosen method. In the report on alternative final disposal methods, the environmental impact statement should also describe other comparable methods for disposing of the spent nuclear fuel (see Chap. 6, Sec. 7, para. 3). The Swedish National Council for Nuclear Waste believes that partitioning and transmutation is such a comparable method that should be described in the environmental impact statement. (Swedish National Council for Nuclear Waste)

SKB's choice of method is presented in an appendix to the applications, "Metodval – utvärdering av strategier och system för att ta hand om det använda kärnbränslet" ("Choice of method – evaluation of strategies and systems for disposal of spent nuclear fuel", in Swedish only), SKB R-10-25. The report describes the grounds for SKB's choice of the KBS-3 method and the reasons why other methods have been dismissed. See also SKB's general reply F ("Site selection and choice of method").

3.5 A description of the no action alternative is given in the preliminary environmental impact statement. The Swedish National Council for Nuclear Waste does not consider the no action alternative to be a long-term sustainable solution, but does believe that effects and consequences of possible delays in the process, which could result in the no action alternative's being considered (if only for a limited time), should also be described and assessed. (Swedish National Council for Nuclear Waste)

(SKB) The requirement in the Environmental Code that a no action alternative shall be included in the EIS means that the EIS must contain a description of what will happen if the applied-for activity is not implemented. In this case, what will happen is continued storage of the spent nuclear fuel in Clab. The likelihood and consequences of this are described in the EIS. See also SKB's general reply C ("The no action alternative – scope and main features").

3.6 The Swedish National Council for Nuclear Waste is of the opinion that the EIS should, in accordance with the Environmental Code, describe the whole system and its impact on the environment during all of its phases. The Council thereby contends that decommissioning and dismantling of Clab and the encapsulation plant should be included in the final environmental impact statement. (Swedish National Council for Nuclear Waste)

(SKB) The EIS deals with the environmental impact of the activities at Clab, the encapsulation plant and the final repository, including the transport required for the activities, during the construction, operating and decommissioning phases.

3.7 In the opinion of the Swedish National Council for Nuclear Waste, the environmental impact statement should also identify and describe factors in the environs of the final repository that could affect the safety of the activity, for example the nearness of the final repository to the nuclear power plant in Forsmark. It should also include an assessment of how these factors could affect the final repository and what adverse environmental effects they could give rise to (cf. Chap. 6, Sec. 3, second paragraph). (Swedish National Council for Nuclear Waste)

(SKB) The environmental risk analysis – SKB P-09-78, "Miljöriskanalys för Clab, inkapslingsanläggning och slutförvarsanläggning" ("Environmental risk analysis for Clab, encapsulation plant and final repository", in Swedish only) – deals with non-radiological environmental risks associated with planned activities in and transport to and from the interim storage facility Clab, the encapsulation plant and the final repository during the construction, operating, decommissioning and closure phases. The risks that are taken up are those that (1) impact the environment, (2) are present in the environment and impact the activity (e.g. the Forsmark nuclear power plant) and (3) impact within the activity.

SKB sees no problem with the nearness of the final repository to the nuclear power plant, since the activity in the final repository does not involve any steps that require quick responses. See also SKB's general reply D ("Consequences of interruption in the work").

3.8 SKB states in section 12.6 that reconciliation with environmental objectives will be presented in a sub-appendix that is not included with the consultation version of the EIS but will be presented in the final version that accompanies the applications. The Regional Council is critical of this approach, i.e. taking the environmental objectives into account afterwards, and says that SKB should have taken regional environmental objectives and the county's regional development programme etc. into account from the start in the work with the EIS. (Regional Council in Kalmar County)

(SKB) The environmental objectives have existed all the time as assessment criteria in the studies we have done as a basis for the design of the encapsulation plant and the final repository. The appendix is merely an account of how the planned activities for final disposal of the spent nuclear fuel affect the probability that the objectives will be fulfilled. It was not ready when the consultation version of the EIS was sent out. In the EIS, the environmental objectives are used as a "yardstick" for the environmental impact assessment.

3.9 In their regional development programme, the politicians of Kalmar County have set up clear objectives for the county's energy and climate efforts. Kalmar County shall be a pioneering region in efforts to reduce greenhouse emissions at the same time as the county shall achieve sustainable growth.

One of the objectives is that Kalmar County shall be a fossil-fuel-free region by 2030. The county is working intensively with these questions and has set up a number of interim goals along the way. The Regional Council would like SKB, in its EIS and its licence application, to live up to the county's ambitions regarding a fossil-fuel-free region and show clearly how they can contribute to fulfilling the county's energy and climate objectives while setting a good example. The basic principle should be that construction and operation of Clink should be carbon-

neutral. For this reason, the EIS should report the consequences of fossil-fuel-free transport, construction, administration and activity.

The Regional Council says, for example, that it is not enough to report the environmental impact of diesel-fuelled transport by Sigyn and road transport by petrol- or diesel-fuelled vehicles. The EIS should also report the environmental impact of operating Sigyn with biogas and operating all vehicles with alternative fuels (e.g. biogas, ethanol, RME, biomass-based/synthetic diesel). (Regional Council in Kalmar County)

SKB strives to live up to the county's ambitions and will, wherever possible, use alternative fuels for activity-related transport and the best available technology to limit emissions of carbon dioxide in conjunction with the construction and operation of the facilities.

3.10 Best possible energy efficiency is of the utmost importance for a sound economy, minimum environmental impact and good regional development. The Regional Council wishes to emphasize the importance of SKB's using the best available technology to optimize energy efficiency in both construction and operation. (Regional Council in Kalmar County)

SKB will use the best available technology to optimize energy efficiency; for example, heat is planned to be extracted from the cooling water to heat the encapsulation plant.

3.11 The Regional Council calls for an assessment of the impact on traffic safety, including accident risks. (Regional Council in Kalmar County)

(SKB) The environmental risk analysis – SKB P-09-78, "Miljöriskanalys för Clab, inkapslingsanläggning och slutförvarsanläggning" ("Environmental risk analysis for Clab, encapsulation plant and final repository", in Swedish only) deals with non-radiological environmental risks associated with planned activities in and transport to and from the interim storage facility Clab, the encapsulation plant and the final repository during the construction, operating, decommissioning and closure phases. The report also includes associated transport activities and traffic risks.

3.12 SSM's responsibility is to oversee nuclear safety and radiation protection, and it is the description of these areas that the authority assesses in particular in its review of the EIS that is included in the application for a licence for interim storage, encapsulation and final disposal. It is therefore important that the description of effects and consequences in these areas is clear. (SSM)

(SKB) An overall description of matters related to nuclear safety and radiation protection is provided in the EIS. More detailed descriptions are provided in other appendices to the applications, such as the safety analysis report for operation of the final repository (SR-Drift) and the report on post-closure safety (SR-Site).

3.13 At the consultation meeting between SKB and SSM on 18 Feb. 2010, the Authority expressed its opinion that measures to reduce releases of radionuclides to air and water should be described in a way that makes it clear what measures are feasible and what the consequences will be. (SSM)

(SKB) Additional study and practical tests are required to determine whether the measures can be implemented in a manner that does not adversely affect nuclear safety, radiation protection and waste management at the plant. Only then can the consequences be studied.

3.14 In a communication dated 1 Dec. 2006 (Dnr SKI 2006/558), at a meeting with SKB on 25 January 2008, and in a communication dated 27 February 2008 (Dnr SKI 2007/1 155), the Swedish Nuclear Power Inspectorate (SKI) presented the Inspectorate's assessment of the requirements they believe can be made on an alternatives report in the EIS. SKB has said that they intend to publish separate reports with detailed descriptions of choice of method and site. SSM has no objections to SKB's collecting parts of the alternatives report in a special appendix, but in that case it must be clearly stated in the EIS that reference is made to a background report. Even if SKB chooses to refer to a background report for the main account of alternatives, SSM believes that the account in the EIS should be so comprehensive (and structured) that it is not necessary to go to the alternatives appendix to get a clear overview of the alternatives that have been investigated, considered and rejected. (SSM)

(SKB) Alternatives regarding method and site are reported in the EIS. The alternatives report there provides a clear overview of the alternatives that have been investigated, considered and rejected. More detailed accounts can be found in other appendices to the applications. See also SKB's general reply F ("Site selection and choice of method").

3.15 SSM's assessment is that the alternatives report in the preliminary EIS is difficult to grasp and needs to be restructured. (SSM)

SKB has restructured and clarified the alternatives report to make it more cogent and easier to read.

3.16 When reviewing the final EIS, it is important that SSM knows what SKB means with the terms used in the alternatives report. The Authority advises SKB to use the same terms in its alternatives report as those that are used in the legislation and to define any other terms they use (e.g. variants, strategies, etc.) in relation to them. (SSM)

SKB has restructured and clarified the alternatives report to make it more cogent and easier to read.

3.17 At present, the spent nuclear fuel is transported by the ship Sigyn. SSM notes that SKB does not discuss any alternatives for transport of the spent nuclear fuel. In SSM's opinion, a formal discussion may be needed of alternative modes of transport. (SSM)

(SKB) In order for SKB's transportation system as a whole to be as efficient as possible, thereby minimizing costs and environmental impact, the additional canister shipments will be integrated in the existing system for transportation of radioactive waste and spent fuel.

3.18 SSM considers that SKB needs to provide a clearer description of the consequences if the applied-for activity is not realized on schedule.

The Authority believes that the consequences of the no action alternative need to be described to an extent that shows that the applied-for activity is warranted.

For example, a scenario for increased storage in Clab from 8,000 tonnes to 10,000 tonnes should be described, along with the requisite measures to increase the storage capacity if necessary. SSM asserts that a description of the consequences if increased storage in Clab is not permitted also needs to be included in the account. (SSM)

(SKB) The requirement in the Environmental Code that a no action alternative shall be included in the EIS means that the EIS must contain a description of what will happen if the applied-for activity is not implemented. In this case, what will happen is continued storage of the spent nuclear fuel in Clab. The possibilities and consequences of this are described in the EIS, which also describes how the storage

capacity in Clab can be increased. The consequences of denying permission for increased storage in Clab are not described, since this would entail speculation. See also SKB's general reply C ("The no action alternative – scope and main features").

3.19 An important document that is needed to make sure that all issues brought up during the consultations have been dealt with by the company is the consultation report. However, Östhammar Municipality is aware of the fact that this document can be difficult to compile during ongoing consultations, and SKB has previously published consultation reports annually. (Östhammar Municipality – municipal executive board)

(SKB) Minutes from all consultation meetings, as well as all viewpoints received with SKB's replies, are available via SKB's website (in Swedish only). Questions and viewpoints as well as SKB's comments and replies have been presented in annual compilations from the consultations. These are also available via SKB's website (including English versions). The consultation report is a sub-appendix to the EIS. Both the consultation report and the EIS are appended to the applications.

3.20 As a part of its review, the EIA Group has also considered questions in the preliminary EIS that can be proposed in the application as conditions for an activity. For this reason it is very urgent that it be made clear in the application which documents are actually included in the application and are not just background reports without legal importance. This applies to both the application itself and appendices such as the EIS and SR-Site. This is of importance for which documents and proposals for solutions will be included within the general condition for the environmental court, i.e. that "the activity shall essentially be conducted in accordance with the application", as well as which documents have been the subject of consultations. Both groups have identified several background reports that are lacking in the preliminary EIS. (Östhammar Municipality – municipal executive board)

(SKB) The applications themselves (the "top documents") clearly stipulate which documents are included in the application documentation. The consultation report stipulates which documents have been the subject of consultations. Of the application documentation, only the EIS has been the subject of consultations.

3.21 It is important that the referenced reports and investigations not be too old to permit conclusions to be drawn regarding the current situation. An example is how "today's commuting situation" is described with reference to a report from 2003. If the material is still relevant this is not a problem, but it is important to make it clear that the figures have been updated. (Östhammar Municipality – municipal executive board)

Wherever possible, SKB has used fresh data for the studies on which the EIA work is based. Regarding transportation and today's commuting situation, the commuting pattern in the area has not changed appreciably since 2003. Information on the commuting pattern has been used to judge how SKB's contribution to an increased transport volume (due to the planned activity) will be distributed over the road network.

3.22 Both groups bring up questions regarding quality assurance (uncertainties, credibility of models, discovery of deficiencies in the system, measures to address deficiencies, external review, etc.), which needs to be described much more clearly. Östhammar Municipality has previously posed a series of questions dealing with this subject, on which we also need some further information now. (Östhammar Municipality – municipal executive board)

(SKB) An important part of the work of quality assurance in general is to constantly be open, to question, discuss and verify. It is a question of approach and attitude. SKB is aware of the risk of "being content and resting on one's laurels" and is constantly working to resist this tendency.

SKB has an integrated management system that applies to the entire organization and that includes governance and management with respect to safety, quality, environment, working environment and finances. The system is certified to ISO 9001:2000 and 14001:2004. The management system is a body of rules governing how activities are to be carried out and documented, who carries out various activities where decisions are made. The management system has two purposes. The first is that the company should have a planned and quality-assured mode of working. The second is to serve as a tool for effective support in the daily work.

3.23 The system is based on a given "flow" of canisters scheduled for deposition. What happens if a disturbance occurs that requires a slowdown in the pace of deposition? What storage capacity is calculated to be needed in Oskarshamn as well as in Forsmark, Östhammar? (Östhammar Municipality – municipal executive board)

(SKB) As far as possible disturbances and mishaps are concerned, we go through all events that could conceivably occur and adapt the design of the facilities and the activities to avoid dangerous mishaps. One reason for this is to avoid disturbances in the deposition process.

If disturbances in the deposition process should nonetheless occur, the encapsulation process can be interrupted. Only a few canisters of spent nuclear fuel are handled at a time in the encapsulation and deposition process. Some canisters could be on their way to Forsmark and some canisters could be in Forsmark awaiting deposition. We are thus talking about a small number of canisters that have to be taken care of for the duration of the disturbance. They can be kept both in the terminal building at the final repository and at the encapsulation plant. There is room for about 10 casks in the terminal building at the final repository.

3.24 The EIS contains quite a few statements that may be well-founded but are not backed by arguments as to why they are true, particularly when it comes to radionuclide releases. Even though these claims may be true during normal operation, disturbances could occur that might give rise to releases. (Östhammar Municipality – municipal executive board)

(SKB) The EIS reports releases both during normal operation and in the event of disturbances and mishaps.

3.25 It is important that as much as possible of the material comparing the sites in Laxemar, Oskarshamn, and in Forsmark, Östhammar, is described in a similar manner with similar units, for example chloride concentrations at the surface, uncertainties in fracture frequencies, the same map material for e.g. groundwater lowering (there are no equivalents to Figs. 10-19) and fracture zones (Figs. 3-14 versus Figs. 3-16) in the document. (Östhammar Municipality – municipal executive board)

(SKB) The background material to the EIS has been compiled with the same level of ambition and degree of detail for both sites. However, the account in the EIS of the alternative siting of the final repository in Laxemar is less detailed and focuses mainly on differences in relation to the final repository in Forsmark. The two chapters are therefore not exactly the same.

3.26 SKB has made it clear that the application they intend to submit is based on the current nuclear fuel programme. Nevertheless, Östhammar Municipality would like to point out that legislation is being considered which (if it is implemented) will entail changes for nuclear power and consequently management of its wastes and that entails both replacement of reactors and new types of reactors. (Östhammar Municipality – municipal executive board)

(SKB) The applications under the Environmental Code and the Nuclear Activities Act which SKB submitted in March 2011 apply to the spent nuclear fuel from the reactors in Forsmark, Oskarshamn and Ringhals, which are in operation, and Barsebäck, which is shut down. The estimate of the quantity of spent nuclear fuel is based on the assumption that the reactors in Forsmark and Ringhals will be operated for 50 years and the reactors in Oskarshamn for 60 years.

This will result in about 12,000 tonnes of spent nuclear fuel, which will be encapsulated in about 6,000 canisters. If it turns out that spent nuclear fuel from new reactors has to be disposed of, this will have to be dealt with in a new application later on.

3.27 In view of this, Östhammar Municipality considers it urgent that it be stipulated somewhere how SKB will address, communicate and consult on these issues [Note: more spent nuclear fuel from other types of reactors] **if it won't be included in this application. (Östhammar Municipality – municipal executive board)**

(SKB) If it turns out that spent nuclear fuel from new reactors has to be disposed of, this will be dealt with in a new application, which will include a new environmental impact statement and entail new consultations.

3.28 One question concerns the amount of storage space needed for canisters that are on their way to deposition. This could be needed if operational disturbances occur that prevent canisters from being deposited at the rate of one canister per day (200 per year) as planned. In this case, extra storage space will be needed for canisters awaiting deposition in both Oskarshamn and Forsmark.

How many canisters does the final repository's storage area hold, and how many will be stored there during normal operation? How many canisters does Clink's storage area hold (logistical and safety aspects)? (Östhammar Municipality – municipal executive board)

(SKB) If operational disturbances occur, the encapsulation and deposition process may be interrupted. There will then be a few canisters in the encapsulation plant and the final repository that may need to be taken care of for the duration of the disturbance. See also reply 3.23.

3.29 SKB writes that provided that all types of mishaps and disturbances have been identified in the preliminary safety assessment and that they are discovered and handled properly if they occur, long-term safety will not be affected by disturbances or mishaps during operation.

One question is what the consequences might be if all mishaps and disturbances are not identified, discovered and handled correctly. (Östhammar Municipality – municipal executive board)

(SKB) The EIS focuses on describing effects and consequences for man and the environment during normal operation. Consequences in connection with disturbances and mishaps are dealt with in separate documentation, SR-Drift, which is included in the applications. The assessment of post-closure safety, SR-Site, which

is also included in the applications, deals with the consequences if the barriers do not perform as intended.

3.30 **Page 11, Background, 3rd paragraph:** ***The Swedish reactors would then give rise to a total of about 12,000 tonnes of spent nuclear fuel (which is equivalent to about 6,000 canisters, see below).***

What does SKB mean by "see below"? We would appreciate clear references, and "see below" is not a clear reference. (Östhammar Municipality – municipal executive board)

(SKB) This has been changed with a clearer text reference in the final version of the EIS.

3.31 **Page 77, Table 5-1:** ***Objective scope in description of impact, effects and consequences for Clab, Clink and the final repository.***

Is "objective scope" the right heading in the table? (Östhammar Municipality – municipal executive board)

(SKB) The heading was intended to mean "Essential scope". It has been changed to "Scope" in the final version of the EIS.

3.32 **Page 316:** ***The only possible transboundary environmental impact would be if radionuclides were dispersed from Clab, the encapsulation plant or the final repository or in connection with transport of the encapsulated nuclear fuel.***

It is inappropriate to make light of radionuclide release by referring to it as "the only possible environmental impact". (Östhammar Municipality – municipal executive board)

(SKB) The formulation on page 316 referred to the fact that only releases of radionuclides could cause *transboundary* environmental impact.

3.33 **Scientific articles are reviewed before they are published in scientific journals. How does SKB review its reports before they are published on the website? Are SKB's reports reviewed by independent reviewers? (Östhammar Municipality – municipal executive board)**

SKB's reports undergo factual and quality review before they are published. This review mainly takes place internally at SKB. Certain reports, for example the assessment of post-closure safety, SR-Site, and its background reports are also reviewed by international experts.

3.34 **Page 12, bulleted list under "The KBS-3 method":** ***Östhammar Municipality considers it important to include a reference to the legal text, convention or agreement where the formulation of each requirement is found.*** **(Östhammar Municipality – municipal executive board)**

(SKB) References to the legal text are provided in Chapter 2.1 of both the preliminary and final EIS.

3.35 **Page 12:** ***The waste must be disposed of inside the country, if this can be done in a safe manner.***

Is there any other alternative than disposal of the waste inside the country? (Östhammar Municipality – municipal executive board)

(SKB) No, there is no alternative to disposing of the waste inside the country. The 1997 Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, called the Nuclear Waste Convention, states

that the waste "should, as far as is compatible with the safety of the management of such material, be disposed of in the state in which it was generated". In Sweden we can dispose of the waste in a safe manner, which SKB has therefore used as the point of departure for its work.

3.36 **Page 77:** ***The spent nuclear fuel will be encapsulated and will not give rise to any radioactive releases to the environment. Extraordinary events are analyzed for the operating phase and after closure of the final repository (long-term or post-closure safety).***

Page 78: ***In the SR-Site safety assessment, which deals with long-term safety in the final repository, releases of radionuclides to the environs are calculated.***

Page 303: ***The facilities have been designed for this purpose so that no radiological consequences of significance for human health and the environment will occur.***

This should be explained more in the EIS. Shortcomings in long-term safety can have consequences for man and the environment, and should therefore be reported in the EIS. (Östhammar Municipality – municipal executive board)

(SKB) The EIS should focus on identifying and describing the direct and indirect consequences of the planned activity. The assessment of post-closure safety shows that the activity does not have any radiological consequences of importance for human health and the environment. Despite this, the description of post-closure safety is relatively comprehensive in the final version of the EIS. It explains, for example, how a number of "worst-case scenarios" have been studied within the framework of the safety assessment and what their effects would be.

SKB's ambition has been to make the description readily accessible. A much more extensive account is provided in another appendix to the applications, "SR-Site – Redovisning av säkerhet efter förslutning", ("SR-Site – Assessment of post-closure safety", in Swedish only). See also SKB's general reply B ("The role of the safety assessment in the EIS").

3.37 **Page 75:** ***Figure 5–1. Scope of activities and facilities described within the framework of the environmental impact statement.***

Östhammar Municipality considers that assembly and inspection of canisters should be included in the EIS. (Östhammar Municipality – municipal executive board)

(SKB) The activity in the canister factory will be dealt with later in a separate process under the Environmental Code.

3.38 **Anxiety (psychological detriment) is only dealt with superficially. Psychosocial effects and anxiety caused by a final repository are dealt with on page 308. The anxiety caused by a final repository is not solely linked to nuclear accidents. People are also worried about the accidents that will be caused by the increase in traffic volume. Anxiety caused by these reasons should be dealt with more thoroughly in the EIS. (Östhammar Municipality – municipal executive board)**

(SKB) No studies have been done of other possible sources of anxiety caused by the applied-for activity. Risks due to the increased traffic volume are taken up in the environmental risk analysis (SKB P-09-78), which deals with non-nuclear environmental risks associated with planned activities in the interim storage facility Clab, the encapsulation plant and the final repository during the construction, operating, decommissioning and closure phases.

3.39 Page 33: ***Radiation doses shall be limited as far as possible with regard to economic and societal factors. The most effective measure that does not entail unreasonable costs shall be implemented to limit releases.***

Is it SKB, the environmental court or the Swedish Radiation Safety Authority who decides how much a release-limiting measure may cost? (Östhammar Municipality – municipal executive board)

(SKB) The Government, the Swedish Radiation Safety Authority and the environmental court can all decide whether they find SKB's assessments in the licence applications of what constitutes reasonable measures correct or not.

3.40 Page 178: ***The transport cask is licensed to IAEA requirements for type B packages.***

It should be described what a type B package is. What are the requirements on a type B package? Are regular inspections made of type B packages? (Östhammar Municipality – municipal executive board)

(SKB) A type B transport cask must be designed and manufactured in accordance with the requirements for type B packages in the IAEA's transport recommendations. It must be possible to handle the cask during transport without additional radiation shielding. The cask must also meet requirements on strength and heat resistance, and be able to dissipate the decay heat emitted by the fuel so that neither the canister nor the surface of the cask gets too hot.

3.41 Page 142: ***A total of 1.46 million tonnes of fossil carbon dioxide was emitted in the county in 2002. Cars, non-road mobile machinery and industry are the foremost sources. Traffic accounted for about 50 percent of the carbon dioxide emissions in the county in 2003 /7-24/.***

Why has SKB used figures from 2002? Have these values changed since 2002–2003? (Östhammar Municipality – municipal executive board)

Wherever possible, SKB has used fresh data for the studies on which the EIA work is based. New data on emissions of carbon dioxide in the county have not been prioritized, however, since they have not been deemed to make a significant difference for the environmental impact assessment.

Fossil carbon dioxide emissions in Kalmar County were reduced by 14,400 tonnes per year during the period 2006 and 2010, partly as a result of the Swedish Environmental Protection Agency's climate investment programme (Klimp).

3.42 Page 241: Are aquatic organisms affected by noise and vibration? (Östhammar Municipality – municipal executive board)

(SKB) The possible impact of noise and vibration on aquatic organisms has not been considered or studied in the background material for the EIS. Experience exists of the impact of noise on aquatic organisms caused by activities on and under water (i.e. the noise source is on the surface of the water or in the water), but not by activities on land.

3.43 Page 297: ***No action alternative.***

SKB should explain under what conditions they may be forced to resort to the no action alternative? (Östhammar Municipality – municipal executive board)

(SKB) The no action alternative entails that final disposal is not realized, which in this case entails continued storage in Clab of the spent nuclear fuel. See also SKB's general reply C ("The no action alternative – scope and main features").

3.44 **Page 297:** ***In addition to the fact that the no action alternative may require an increase in Clab's storage capacity, the storage period may also need to be prolonged.***

What would the consequences of the no action alternative be if SKB should fail to get a licence to build Clab 3? (Östhammar Municipality – municipal executive board)

(SKB) If the applied-for activity is not implemented and a licence is not obtained to build Clab 3, the spent nuclear fuel will have to be disposed of in another manner. For example, the fuel may be left at the nuclear power plants for a longer time, it may be interim-stored dry, or a combination of these and other alternatives may be utilized. See also SKB's general reply C ("The no action alternative – scope and main features").

3.45 **There are many reports that have not yet been published. The municipality wishes to be informed when these reports become available on SKB's website. (Östhammar Municipality – municipal executive board)**

SKB publishes the reports as they are completed. Our ambition has been that all reports referred to in the application documentation should be in print and available via our website when the applications are submitted.

3.46 **The differences between reprocessing and partitioning and transmutation (P&T) should be described more clearly. What reprocessing entails is not explained. It should be mentioned that reprocessing is currently prohibited by Swedish law, with a reference to the relevant law (see page 44, 3.6.2). There are no references to the section on partitioning and transmutation. (Östhammar Municipality – Environment and Public Health Committee)**

(SKB) Reprocessing is not formally prohibited by Swedish law, but it is not being considered for the spent nuclear fuel for which SKB has submitted applications. The description of reprocessing and P&T in the EIS is purposely fairly general. A much more detailed description is provided in another appendix to the applications, SKB R-10-25, "Metodval – utvärdering av strategier och system för att ta hand om använt kärnbränsle" ("Choice of method – evaluation of strategies and systems for disposal of spent nuclear fuel", in Swedish only).

3.47 **For those who do not live along the transport routes or near the planned final repository, questions concerning radiotoxicity, radiological risks and radiation safety are probably by far the most important. It is likely that the plans for a final repository for spent nuclear fuel create anxiety and uncertainty, since the waste is so dangerous and the span of time is so incomprehensible too many people. According to Chap. 9, Sec. 3 of the Environmental Code, anxiety can be just as detrimental to human health as noise, dust, etc. There is a court case where an activity did not receive a permit because the surrounding residents felt strong anxiety, even though the probability that a disturbance or mishap would occur was very small (see the Latex Case, KN 36/77). The Environment Office considers nuclear activity to be the kind of activity that can create strong anxiety.**

One purpose of the consultations and the EIS is to provide information on the planned activity. The Environment Office thinks that SKB should give a more detailed account of the safety issues in the EIS. Anxiety and uncertainty diminish with increasing knowledge. The radiotoxicity of the waste, and the risks of radioactive releases and radiation in connection with disturbances and mishaps, need to be thoroughly reported. Questions that need answers include: How hazardous is the waste without a canister? How hazardous is it for the environment if a canister is damaged so severely that the waste is exposed? What measures will SKB take to minimize the risk of disturbance or mishap? What measures will SKB

take to minimize the risk of release in the event of disturbance or mishap?

According to the assessment of long-term safety, the activity will not have any radiological consequences of significance for human health and the environment (page 30). It will therefore be dealt with cursorily in the EIS and in greater detail in the safety analysis report, which is not finished yet. The Environment Office is doubtful about this conclusion that the activity will not have radiological consequences. What is there to say that someone in a thousand years may not get it into their head to break into the final repository in order to extract copper and iron, for example? What are the radiological consequences of such a scenario? The EIS shows that after 100,000 years the spent fuel is as radiotoxic as the natural uranium mineral it was fabricated from. It is not clear how long it takes before the spent fuel is harmless to humans (page 37).

In view of the above viewpoints regarding safety questions, more parts of the safety analysis report should be included in the EIS (pp. 30, 37, 246 and pp. 276, 277 and 278). (Östhammar Municipality – Environment and Public Health Committee)

(SKB) Relevant arguments and conclusions from the safety analysis reports, SR-Drift and SR-Site, are included in the EIS to the extent SKB considers reasonable. Both the safety analysis reports are included in the applications.

3.48 Points of departure

It says at the bottom of page 29 that *"It is assumed that more detailed conditions for the licences will be formulated by the Swedish Radiation Safety Authority and the environmental court".*

SKB thus assumes that the environmental court formulates conditions. Two types of conditions will be relevant for the final repository system: conditions relating to nuclear safety and radiation protection and conditions relating to conventional environmental requirements. When it comes to conventional environmental requirements, the municipality wants SKB to propose conditions that are then circulated for consideration and comment before the environmental court pronounces its judgement.

This procedure is logical, since SKB defines important environmental aspects, i.e. activities that have or may have considerable significant environmental impact, as well as their effects and consequences. In the case of environmental aspects that are judged to lead to unacceptable consequences, SKB proposes protective and precautionary measures that are in some cases backed by conditions. Normally these conditions are formulated in the actual application, but conditions that are directly linked to protective and precautionary measures can nonetheless be noted in the EIS. In this way the EIS gives the reader a good overview and an understanding for the measures proposed by SKB with regard to the activity's environmental aspects.

The municipality therefore wants SKB to clarify in the EIS the following aspects of each activity that can have a significant environmental impact:

- Impact
- Effects
- Consequences
- Precautionary/protective measures
- Notations of whether conditions are linked to precautionary/protective measures

An example is noise, where the effects (e.g. number of disturbed persons at a certain sound level) and the consequences (importance for those who are disturbed) are reported, along with which, if any, precautionary and protective measures are planned (to eliminate or mitigate the disturbance), and whether conditions are proposed (to ensure that the precautionary or protective measures are complied with). (Oskarshamn Municipality)

(SKB) The EIS describes the applied-for activity, its impact and what effects and consequences it gives rise to, as well as what measures we intend to adopt to eliminate or mitigate the consequences. On the other hand, no conditions are proposed in the EIS. Conditions are, however, proposed in the actual application under the Environmental Code, the so-called "top document". See also SKB's general reply H ("SKB's proposals for conditions").

3.49 Scope and content of the application

The scope of the application is described in section 4. Regarding Clab, SKB is applying for permission to continue its current operation, which means that no significant change of Clab is planned.

The activity description on page 153 gives figures on today's storage and capacity in Clab. The data show that the remaining capacity is 3,000 tonnes. Clab is reported to have received 218 tonnes in 2008. If it is assumed that this amount will be the annual quantity in the future as well, Clab will be full in 13 years, i.e. by 2023. At about this time, according to the timetable on page 79, trial operation of Clink and the final repository will start. This means there is no marginal storage capacity in Clab, and if there is a margin it should be clarified in the EIS. A delay in the licensing process and/or the construction of the final repository system could lead to a stoppage in the disposal of spent nuclear fuel from the nuclear power plants.

The municipality would like to know how SKB plans to handle a delay in the start of operation the final repository. The municipality would like to have the following information at least:

- **a forecast of the quantities of spent nuclear fuel which the Swedish nuclear power plants are expected to generate during the period 2010–2030,**
- **whether the quantities in the previous point include replacement reactors with a higher power capacity,**
- **storage possibilities and storage capacity for spent nuclear fuel before the fuel reaches Clab,**
- **if and how Clab can be rebuilt to increase its capacity, and how much this will increase the capacity of Clab,**
- **whether a rebuild of Clab requires a licence, and if so the estimated time required to obtain such a licence,**
- **whether another licensable activity is required to handle a delay, and if so the estimated time to obtain such a licence.**

Furthermore, the municipality wishes to know:

- **the storage capacity for encapsulated fuel in Clink,**
- **the storage capacity for encapsulated fuel at the final repository.**

(Oskarshamn Municipality)

SKB plans to commence trial operation of the Nuclear Fuel Repository and Clink in 2025. Clab currently has a licence to store 8,000 tonnes of fuel (counted as uranium). According to today's forecasts, this amount will be reached in around 2023. At about the same time, all the storage positions will be filled. This means that SKB needs to take steps to increase Clab's storage capacity.

Two types of storage canisters are used for fuel in Clab: standard storage canisters and compact storage canisters, which permit denser storage. Using only compact storage canisters would increase the physical storage capacity in Clab and delay the time when Clab is full until about 2029.

Besides spent nuclear fuel, long-lived nuclear waste is also stored in Clab in the form of core components and control rods. In the late 1990s, SKB investigated

the possibility of compacting the BWR control rods. This would reduce the space needed for them by half, which would delay the time when Clab becomes full by two years. If the control rods are compacted and all spent fuel is stored in compact storage canisters, Clab will be full in around 2031.

Another alternative could be to find other solutions for interim storage of the core components and the control rods. One possible solution is to switch to dry interim storage. If an alternative solution for interim storage of all core components and control rods can be found and if only compact storage canisters are used for the spent nuclear fuel, all storage positions in Clab will be filled by 2037.

If it should prove necessary, it is also possible to extend Clab with a third rock cavern with storage pools. But this would only be considered in the event of a very great delay of the Nuclear Fuel Programme. If Clab is extended by a third rock cavern, the facility could receive fuel for another 20 to 25 years.

The early reactors, which were built and commissioned in the 1970s before Clab was put into operation in 1985, had a fuel storage capacity of many years. Subsequent reactors were designed with a storage capacity of only a few years. At-plant fuel storage capacity has decreased over the years, since certain positions have been reserved for different purposes, for example fresh fuel, storage of core scrap and boxes. Furthermore, the burnup of the fuel has increased, which means it must be stored at the nuclear power plant for a longer time before being transported to Clab.

The intention is to produce canisters in Clink at the same rate as they are transported to the final repository for deposition. Storage of filled canisters is therefore done in the transport casks, which are kept in the separately located terminal building pending transport. In the current preliminary design of the transportation system there are 23 transport casks, each containing one canister. There are no areas for storage of filled canisters in the encapsulation plant. The terminal building at the final repository has room for about 10 casks.

3.50 According to Chap. 6 of the Environmental Code, the EIS should contain at least one alternative plus the no action alternative. The proposed EIS should therefore be clarified as regards both the alternatives report and the no action alternative. The EIS should clearly explain why other alternatives have been rejected. (County Administrative Board in Kalmar County)

According to SKB, the final version of the EIS describes the different alternatives, the no action alternative and the reasons why a given alternative has been chosen. See also SKB's general replies C and F ("The No action alternative – scope and main features" and "Site selection and choice of method").

3.51 Strategies, methods, designs, variants etc.
It would facilitate reading and review of the EIS if the above terms were harmonized with those used in the Environmental Code. The Environmental Code's terminology should therefore be reflected in a simple and clear fashion in the terms used in the EIS to facilitate an understanding of to what degree the Environmental Code's requirements are met. (County Administrative Board in Kalmar County)

(SKB) The use of different terms has been revised. The Environmental Code's terminology is used in sense intended therein.

3.52 The RD&D process and the consultations between the nuclear waste company and the regulatory authorities that have been going on for some time must be considered to be a part of the consultations under the Environmental Code. (MKG)

(SKB) The consultations under the Environmental Code prior to licence applications for interim storage, encapsulation and final disposal of spent nuclear fuel commenced in 2002. They were concluded and closed for viewpoints on 17 May 2010 after a concluding consultation meeting in Östhammar on 3 May. SKB has always been clear about which meetings were included in these consultations. The RD&D process, as well as the consultations held by reason of Government decisions, lie outside the consultations under the Environmental Code.

3.53 If the consultations are concluded without a complete body of background material regarding long-term environmental safety, alternative methods and siting, the prerequisites for a fully adequate environmental impact statement, EIS, cannot be said to be fulfilled. (MKG)

SKB believes that it is important to distinguish between consultations according to the Environmental Code and the review that is part of the licensing process. The consultations shall, according to the Environmental Code (Chap. 6, Sec. 4), be concerned with the siting, scope, design and environmental impact of the activity and the content and design of the environmental impact statement.

Consultations on the preliminary EIS have been held, as well as on the preliminary assessment of post-closure safety, where SR-Can comprised a part of the background material for the consultations on the theme "Safety and radiation protection", May–June 2007.

The final version of the EIS, the assessment of post-closure safety and the reports on choice of method and site selection are central documents in both the application under Chapter 9 of the Environmental Code and the application under the Nuclear Activities Act. Both of these applications will be circulated for consideration by the environmental court and SSM, providing ample opportunity for review and comments on content, calculations and conclusions in the applications. See also SKB's general reply A ("Conclusion of the consultations").

3.54 The nuclear waste company SKB has not had the intention of using the public consultations to improve the background material for the environmental impact statement, EIS. Furthermore, the company has opposed the participation of the environmental organizations in parts of the consultations. (MKG)

SKB is of another opinion, but notes the viewpoint.

3.55 The nuclear waste company SKB has shown no interest in having a dialogue in the consultations and has only wanted to present its own view of various issues. The NGOs would like to have continued consultations on long-term safety, alternative methods and siting and would like the public consultation meetings on these matters to be held at a national level in Stockholm under someone else's auspices than the nuclear waste company. (MKG)

(SKB) The consultations prior to applications for interim storage, encapsulation and final disposal of spent nuclear fuel commenced in 2002. They were concluded and closed for viewpoints on 17 May 2010 after a concluding consultation meeting in Östhammar on 3 May. SKB notes MKG's wishes. See also SKB's general reply A ("Conclusion of the consultations").

3.56 In the consultations, the nuclear waste company SKB has consistently toned down the environmental threat posed by the nuclear waste to be disposed of. (MKG)

SKB is of another opinion, but notes the viewpoint. SKB's opinion is that the spent nuclear fuel is hazardous if it is not handled properly. That is why SKB has developed the KBS-3 method – to dispose of the spent nuclear fuel in a safe manner.

3.57 An important reason why the consultations within the RD&D process about alternative methods, alternative siting and long-term environmental safety have not worked is that the nuclear waste department at the Swedish Nuclear Power Inspectorate, SKI, exercised inadequate oversight over the work of the nuclear waste company during the 1980s, 1990s and up to the beginning of the 21st century. (MKG)

SKB notes the viewpoint.

3.58 It has been unclear what role the county administrative boards in Kalmar and Uppsala have had in the regional consultations (the Oskarshamn EIA Forum and the Forsmark Consultation and EIA Group), which may have affected their independent status. (MKG)

SKB is of another opinion, but notes the viewpoint. For example, the parties in the Oskarshamn EIA Forum compiled joint documents (the "Base Document" and "Work Forms") where the roles of the participating parties are defined. There it says that the role of each group is only advisory. The participants in the group are not bound to make decisions in accordance with the group's viewpoints. The matters that are dealt with are taken up at the initiative of the participants.

3.59 The nuclear waste company has – via the venue, conduct and minutes of the meetings – controlled the public consultations to achieve its own purposes. (MKG)

SKB's strategy has been to hold the meetings near the planned facilities to make it easier for concerned members of the public to attend.

SKB has listened to the viewpoints presented and has in many cases changed the forms of the consultations based on the judgement that the changes could result in a better consultation process. We have, for example, been criticized for allowing our presentations to take up most of the meeting time. In response to this criticism, we have allowed plenty of time for participants' questions at most of the consultation meetings.

SKB notes MKG's viewpoint that we have controlled the public consultations via the minutes that have been taken. At public consultation meetings the meeting has appointed persons to check and sign the minutes. The minutes are available via SKB's website, where all viewpoints received are also posted (in Swedish only).

3.60 It is important that the consultation report in the application also include the most important viewpoints offered in the national consultations that have been held, in addition to the public and regional consultations. (MKG)

(SKB) The consultation report summarizes the most important viewpoints from the consultations under the Environmental Code. The complete documentation from all consultation occasions under the Environmental Code is available via SKB's website. The minutes from SKB's consultations with SKI and SSI (after the merger with SSM) are also posted there in accordance with the Government decision.

3.61 The KBS method has not been developed based on the purposes stipulated in the preliminary EIS. (MKG)

SKB is of another opinion, but notes the viewpoint.

3.62 The KBS method does not fulfil the purposes of preventing nuclear weapons proliferation and not needing monitoring. (MKG)

SKB is of another opinion, but notes the viewpoint.

3.63 The alternative method of Deep Boreholes fulfils all the purposes set up by the nuclear waste company, including the purposes of preventing nuclear weapons proliferation and not needing monitoring. (MKG)

SKB is of another opinion, but notes the viewpoint.

3.64 The nuclear waste company SKB downgrades the Environmental Code and its general rules of consideration in discussions of the purpose of the final repository project. (MKG)

SKB does not understand the statement. We believe we have good arguments showing that the KBS-3 method fulfils the general rules of consideration.

3.65 The nuclear waste company SKB has had sole responsibility for and the necessary means to develop the alternative method of Deep Boreholes, so the company cannot reject the method as an alternative simply because "it is not available". (MKG)

(SKB) The reactor owners have jointly formed SKB with the mission of managing and disposing of the nuclear waste and spent nuclear fuel from the Swedish reactors. We have developed a method for safe disposal of spent nuclear fuel, the KBS-3 method. SKB has no responsibility for developing the particular concept of disposing of the spent nuclear fuel in deep boreholes. We have, however, compared the KBS-3 method with disposal in deep boreholes on many occasions. Based on the results of the comparisons, we have not found any reason to develop the Deep Boreholes concept further.

3.66 The nuclear waste company's method of reporting alternative methods in the preliminary EIS has serious shortcomings. (MKG)

(SKB) The EIS contains an account of other methods. SKB's choice of method is presented in a special appendix to the applications, SKB R-10-25, "Metodval – utvärdering av strategier och system för att ta hand om använt kärnbränsle" ("Choice of method – evaluation of strategies and systems for disposal of spent nuclear fuel", in Swedish only). This appendix contains a more detailed presentation of methods for managing spent nuclear fuel, on what grounds SKB has chosen the KBS-3 method and reasons why other methods have been dismissed. See also SKB's general reply F ("Site selection and choice of method").

3.67 Other methods should be studied besides Clab for long-term interim storage as a no action alternative. (MKG)

(SKB) A no action alternative should describe what happens if the applied-for activity is not implemented. In this case, what will happen is continued storage of the spent nuclear fuel in Clab. The likelihood and consequences of this are described in the EIS. See also SKB's general reply C ("The no action alternative – scope and main features").

3.68 There is a need to study, as a no action alternative, what the realization of various future energy scenarios means for the importance of a KBS repository. (MKG)

(SKB) Speculations regarding future energy scenarios do not belong in the EIS, which is concerned with interim storage, encapsulation and final disposal of spent nuclear fuel, since this would entail speculative argumentation. See also SKB's general reply C ("The no action alternative – scope and main features").

3.69 The nuclear waste company SKB must offer a better problematization of problems in connection with construction and operation. (MKG)

(SKB) The EIS presents the environmental consequences associated with construction and operation of the facilities. Consequences of disturbances in conjunction with the construction of the facilities are dealt with in the safety analysis report for operation (SR-Drift) of each facility, which is included in the applications.

3.70 There is no information whatsoever in the documentation regarding Article 2 of the Treaty Establishing the European Atomic Energy Community, which says:
In order to perform its task, the Community shall, as provided in this Treaty:
b) establish uniform safety standards to protect the health of workers and of the general public and ensure that they are applied. (SERO)

SKB notes the viewpoint. Sweden's adherence to international treaties is not SKB's responsibility. We comply with Swedish legislation and how the international treaties etc. are implemented in this legislation.

3.71 There is no information whatsoever about measures according to the EU's Water Framework Directive (2000/60/EC). (SERO)

SKB notes the viewpoint. Sweden's adherence to international treaties is not SKB's responsibility. We are observant of the matter and comply with Swedish legislation and how the international treaties etc. are implemented in this legislation.

3.72 Scope
We consider the scope of the EIS to be too narrow. SKB should also present environmental impact statements for mining and processing of copper and iron, canister fabrication, mining and transport of bentonite, and facilities for operational and decommissioning waste with regard to Clab and Clink. (Döderhult Nature Conservation Society)

The scope of the environmental impact statement used by SKB is in accordance with accepted EIS practice.

3.73 Canister shipments by sea
The ship m/s Sigyn is getting old and will probably need to be replaced before or at the time the final repository is put into operation. We note the lack of a description of the requirements that will be made on the new ship and an assessment of the effects and consequences of the shipments on the marine environment. Similarly, we note the lack of a description of a possible terrorist attack on m/s Sigyn. (Döderhult Nature Conservation Society)

(SKB) m/s Sigyn will be replaced and the new ship will meet high standards with regard to safety and environmental performance. The effects and consequences of the sea shipments, as well as any risks, are dealt with in the EIS. It should be borne in mind that SKB's shipments are few in comparison with other shipments on the Baltic Sea.

3.74 Noise

Assessments of both construction noise and industrial noise in rural settings should be based on lower guideline values than those that apply in densely built-up areas. Noise is perceived as more disturbing in an otherwise quiet setting than in an already noisy setting.

What basis does SKB have for saying that residents will not be disturbed? (Döderhult Nature Conservation Society)

In its studies, SKB has assumed current guideline values and evaluated the possible consequences for residents on this basis.

3.75 Road transport

The same argument should be used for transport noise in a rural setting as for industrial and construction noise. How has SKB judged disturbances to residents caused by traffic? More residents will be subjected to traffic noise. What are the consequences of this? The traffic noise along highway 743 has two peaks during the day (morning and evening). The noise levels at these peaks should be reported, along with the consequences of these traffic peaks with regard to both noise and traffic safety.

We would like to see an impact statement of the effect the traffic increase may have on traffic safety for both humans and animals. (Döderhult Nature Conservation Society)

SKB assumes current guideline values in its impact assessments, which are reported in the EIS. Noise from additional traffic and traffic safety are taken up in the EIS. Traffic safety is also dealt with in the environmental risk analysis which SKB has published, SKB P-09-78: "Miljöriskanalys för Clab, inkapslingsanläggning och slutförvarsanläggning" ("Environmental risk analysis for Clab, encapsulation plant and final repository", in Swedish only).

3.76 Crucial premises for the final repository project

We believe the following are crucial premises that should govern the contents and quality of the EIS:

- **The danger posed by the nuclear waste to human health and the environment.**
- **The long time perspective.**
- **The ethical dimension, with responsible towards future generations.**
- **The risk for proliferation of nuclear material.**
- **The goals and purposes of the environmental legislation.**
- **The precautionary principle, which shall apply in the case of safety- and environment-related uncertainties for the sake of future generations.**

Owing to the nature of the waste and the complexity of the project, Oss/The Waste Network contend that extraordinary demands are made on the activity operator's environmental impact statement and safety analysis report. These demands are much more far-reaching than those usually made on a major industrial project. (Oss and The Waste Network)

(SKB) The aspects brought up by Oss are dealt with in the documents included in the applications, including the safety analysis report and the EIS. The documentation included in SKB's applications is extraordinary compared with the usual practice for major industrial projects, not least as regards the safety analysis report. See also SKB's general reply B ("The role of the safety assessment in the EIS").

3.77 With the support of the Environmental Code, the EIA Directive and the Swedish EPA's general recommendations, we believe that the EIS should offer the following:

- **A means to determine whether the most suitable method and site have been chosen in terms of environment and safety. And whether the choices have been preceded by systematic selection processes and based on predetermined environment-related performance criteria.**
- **An alternatives report of such scope and depth that it is possible to compare the impact, effects and environmental consequences of the alternatives with those of the chosen solution.**
- **Qualitative and quantitative presentation and assessment of direct and indirect short-, intermediate- long-term cumulative effects and consequences of the chosen solution. (Oss and The Waste Network)**

SKB notes the viewpoint and notes that the EIS contains reasons for choice of method, site and alternative as requested by Oss. These matters are dealt with thoroughly in other documents included in the applications, see also SKB's general reply F ("Site selection and choice of method").

3.78 Shortcomings of the preliminary EIS The shortcomings we consider the document to have are linked to the activity operator's purpose with the document. In other words, how environmental aspects are evaluated in relation to other industrial factors.

The shortcomings in the document can also be seen as being the result of a less successful EIA process, where the activity operator's tight control has impaired the identification of environmental weaknesses and shortcomings in the project. The crucial shortcoming of the EIS is that it doesn't live up to the aforementioned unique premises for this project. It hinders an assessment of whether the chosen solution is the most suitable from an environmental, safety and sustainability viewpoint.

The most important issues in the final repository project concern the choice of method, the alternatives report and long-term safety, and these issues have been given the least attention in the preliminary EIS.

In short we wish to point out the following shortcomings:

- **Unclear purpose and target group for the document.**
- **Too broad a reach and insufficient focus on effects and environmental consequences.**
- **The EIS only deals with the construction and operating periods.**
- **Lack of an account of the project's long-term environmental effects and consequences.**
- **Non-credible assumption that no leakage will occur in the final repository.**
- **Inadequate and misleading account of the method and site selection process.**
- **Deficient account of alternative methods.**
- **Unclear link between uncertainties and their possible effects and environmental consequences.**
- **Excessively tight control of the consultation process.**
- **Lack of alternative solutions for off-site heavy transport**
- **A complete account of the protection of natural values and planned compensatory measures is lacking (Oss and The Waste Network)**

SKB notes these viewpoints concerning the shortcomings of the EIS. In SKB's opinion, the contents of the EIS comply with the requirements of the Environmental Code and accepted practice. Certain matters are dealt with cursorily in the EIS, but in greater detail in other documentation that is included in the applications, see also SKB's general replies B and F ("The role of the safety assessment in the EIS" and "Site selection and choice of method").

3.79 We therefore demand that SKB produce a preliminary but largely complete version of all background documents and appendices to the EIS, including the SR-Site long-term safety assessment. We also demand that the consultation process continue afterwards so that we can have a formal consultation process around long-term safety. (ÅNOM)

SKB believes that it is important to distinguish between consultations according to the Environmental Code and the review that is part of the licensing process. The consultations shall, according to the Environmental Code (Chap. 6, Sec. 4), be concerned with the siting, scope, design and environmental impact of the activity and the content and design of the environmental impact statement.

The assessment of post-closure safety, SR-Site, is one of the central documents in the licensing process and forms part of the application documentation under both the Environmental Code and the Nuclear Activities Act. Both of these applications will be circulated for consideration by the environmental court and SSM, providing ample opportunity for review and comments on content, calculations and conclusions in the assessment. See also SKB's general replies A and B ("Conclusion of the consultations" and "The role of the safety assessment in the EIS").

3.80 Peer review – One thing we have noticed during the consultation process is that virtually all scientific reports that underlie SKB's proposal have been written by SKB's own personnel, either their own employees (e.g. Posiva) or paid consultants. This is understandable given the financing structure for disposing of nuclear waste in Sweden, but very worrying from a scientific viewpoint. (ÅNOM)

SKB takes a positive view of the fact that the results obtained in connection with the development of the KBS-3 method are published scientifically and undergo peer review. The reason most of the reports SKB refers to have been written by SKB or Posiva (Finland) is because these countries have come farthest with regard to a method and site for the final disposal of spent nuclear fuel. The main scientific reports, SR-Site and its background reports, that are included in the applications have been reviewed by international experts.

Other countries are also focused on geological disposal, but in other geological environments such as salt, clay, volcanic rock, etc. This means that the underlying scientific information is not always directly applicable to the conditions that prevail in Sweden, or in Finland.

3.81 In our opinion, the account of the no action alternative should contain more information on the probable consequences of a decision not to build the final repository; for example, calculations or estimates of the effects of a no action alternative on the total quantity of spent nuclear fuel that has to be disposed of. (ÅNOM)

(SKB) The no action alternative entails that final disposal is not realized, which entails continued storage in Clab of the spent nuclear fuel. See also SKB's general reply C ("The no action alternative – scope and main features").

3.82 Nearness to reactors

We are concerned about the fact that Clab, Clink and the final repository are planned to be located only a few hundred metres from operational nuclear power plants (Clab is already located next to existing reactors). Important questions arise here that are not addressed at all in the EIS:

1. If a serious accident occurs at the reactors in Forsmark or Oskarshamn, so serious that the area has to be evacuated (possibly for a long time), how will the waste be managed then?

2. What impact does the presence of a waste facility like the one at Forsmark or Clab/Clink in Oskarshamn have on the consequences of an accident at the power plants? (ÅNOM)

(SKB) There are no really rapid processes going on in Clab, the encapsulation plant or the final repository. Both the encapsulation process and the activity in the final repository can come to a halt without having any consequences for safety. See also SKB's general reply D ("Consequences of interruption in the work").

3.83 Alternative methods

We do not consider the account of alternative methods in the EIS to be sufficient. The account of alternative methods given there is rather short and is based entirely on present-day knowledge. It must be remembered that SKB's timetable is based solely on SKB's commercial interests and has no more overall significance. If more research is needed to allow alternative methods to mature (or be dismissed), that time should be allowed. We are also surprised at how little SKB has chosen to describe other countries' methods in this chapter. All nuclear power countries are involved in similar projects at this time, and we had expected an account of these methods as well. (ÅNOM)

(SKB) The EIS describes the assessed environmental impact of the applied-for activity, i.e. the KBS-3 method. The EIS contains an overview of other methods for disposal of the spent nuclear fuel, as well as SKB's view of these methods. A more detailed description is included in another appendix to the applications, SKB R-10-25, "Metodval – utvärdering av strategier och system för att ta hand om använt kärnbränsle" ("Choice of method – evaluation of strategies and systems for disposal of spent nuclear fuel", in Swedish only). This is based on the report SKB R-10-12: "Principer, strategier och system för slutligt omhändertagande av använt kärnbränsle" ("Principles, strategies and systems for final disposal of spent nuclear fuel", in Swedish only), which contains an overview of the management of spent nuclear fuel and high-level waste in twelve countries. See also SKB's general reply F ("Site selection and choice of method").

3.84 Transport

We demand a much more detailed account of risks and possible consequences of the sea transport plus a comparison with a land-based alternative. In view of the state of health of the Baltic Sea, we question whether it is wise or responsible to allow shipments of this type on the Baltic Sea. (ÅNOM)

SKB's ship m/s Sigyn has transported unencapsulated spent nuclear fuel from the nuclear power plants to interim storage in Clab for more than 25 years. Transport of encapsulated spent nuclear fuel from the encapsulation plant to the final repository will take place in the same way, except that the fuel will not be contained in copper canisters in the transport casks. The number of shipments of spent nuclear fuel from the encapsulation plant on the Simpevarp Peninsula to the final repository in Forsmark will be about 15 per year. This entails a marginal increase in the total number of sea shipments in the area.

3.85 ECRR considers the modelling of the spread of radioactivity and exposure for humans and ecosystems to radioactivity from the final repository to be deficient. SKB uses the ICRP model from the International Commission on Radiological Protection (ICRP), which ECRR contends is obsolete and inaccurate. ECRR contends that the ICRP model, which predicted no damage from the Chernobyl accident and no problems with living close to nuclear facilities, has now been

disproved by experimental and epidemiological results presented in the appended report. [Note: The report is in Appendix A32.] **ECRR recommends that SKB use the risk model that was developed by ECRR in 2003 and updated in 2010. (ECRR)**

The risk model used by SKB is the one that is specified in SSM's regulations and that SKB must use. It is the International Commission on Radiological Protection's (ICRP) risk model, which is based on the relationship between radiation dose and cancer risk. Conversion from dose to risk is regulated in SSM's regulation. ICRP stipulates how this is to be done.

3.86 "In the inner operations area the nuclear activities are conducted on the surface…" What type of nuclear activity will be conducted?? (EK Miljökonsult AB)

The only nuclear activity that will be conducted on the ground surface is transport and transloading of canisters with encapsulated spent nuclear fuel. They will carried by m/s Sigyn, or an equivalent ship, from the encapsulation plant to the Port of Forsmark in Simpevarp and then be taken by special vehicles to the terminal building located in the final repository's inner operations area. The canisters will be transported down to the transloading hall at repository level via the ramp. This transport will also be done by special vehicles.

3.87 The inner emergency zone for the nuclear power plant in Forsmark is 12–15 km and includes Öregrund and Gräsö. A smaller area has been studied in the EIS. How can you justify this? Shouldn't the inner emergency zone be the smallest area that is studied? What is the largest area that could be affected? (EK Miljökonsult AB)

(SKB) The study area in a given study has been chosen based on what has been judged to be appropriate with respect to the nature of the impact, nearby residents, the environment etc., and has nothing to do with the nuclear power plant's emergency zone. See also reply to question 2.176, page 231.

3.88 Regarding the no action alternative – there is not enough information on positive effects. Postponing a final repository allows more time for research that can improve the chances of a good final repository. Examples of research topics:

- **methods that can make the nuclear waste less hazardous,**
- **methods that can utilize more energy in the nuclear fuel,**
- **long-term effects and consequences of a final repository with e.g. copper canisters or deep boreholes.**

(EK Miljökonsult AB)

SKB's mission is to dispose of the spent nuclear fuel so that human health and the environment are protected in the short and long term. Society's requirements on how disposal should take place are embodied in laws, regulations and international agreements. If the spent nuclear fuel will not be reprocessed (as is the case for the fuel covered by SKB's applications), the Nuclear Activities Act requires final disposal.

As far as the account of the no action alternative is concerned, it should describe what happens if the applied-for activity is not implemented. We contend that continued storage in Clab is possible, but do not speculate about what future technical developments could entail.

See also SKB's general reply C ("The no action alternative – scope and main features").

3.89 To how great an extent can wind turbines reduce the quantity of nuclear waste? (EK Miljökonsult AB)

(SKB) The design and planning of the final repository for spent nuclear fuel is based on the quantity of spent nuclear fuel that arises from 50 years of operation of the reactors in Forsmark and Ringhals and 60 years of operation of the reactors in Oskarshamn, plus the amount generated by the operation of Barsebäck. Additional wind power capacity (reducing the need for nuclear power) has no impact on the quantity of spent nuclear fuel to be disposed of now.

3.90 Table 12-2. Shouldn't alternative 1 entail fewer shipments of nuclear waste by Sigyn than the applied-for alternative and alternative 2? If so, this is not evident. (EK Miljökonsult AB)

(SKB) That is correct. That means that atmospheric emissions are lower for this alternative. However, atmospheric emissions have not been included in the table, since the impact will be very small regardless of which alternative is chosen.

3.91 There is no information on assessment of the parameters of the waste: How radioactive is the waste? Does this vary today? Could it change in the future? How accurate is the assessment that the nuclear waste will be harmless after 100,000 years? (EK Miljökonsult AB)

(SKB) The information can be found in the EIS, sections 3.3 and 3.4. The spent nuclear fuel is highly radioactive. Its radioactivity declines with time. After about 40 years of interim storage in Clab, only a few percent of the radioactivity present in the fuel when it is taken out of the reactor remains. SKB does not claim that the spent nuclear fuel is completely harmless after 100,000 years. After about 100,000 years, the radioactivity has declined to the same level as in the quantity of natural uranium from which the fuel was made.

The properties of the spent nuclear fuel are described in the background material to the assessment of post-closure safety, SR-Site.

3.92 We look forward to a risk analysis that shows the waste's radiotoxicity, exposure risks and effects in relation to exposure distance as well as a justified risk and protection area. (EK Miljökonsult AB)

(SKB) The properties of the spent nuclear fuel are described in general terms in the EIS. More detailed descriptions are provided in background material to the assessment of post-closure safety, SKB TR-10-13: "Spent nuclear fuel for disposal in the KBS-3 repository".

The risks associated with spent nuclear fuel can be described in terms of radiotoxicity and accessibility. Radiotoxicity describes the harm which the radiation from the radioactive substances can cause if people are exposed to it. Accessibility describes the degree to which a person can be exposed to radiation in different situations, for example during transport, interim storage ore final disposal.

Spent fuel emits a high level of radiation after it is removed from the reactor. A person who stands unprotected near the fuel will receive a lethal radiation dose in a short time. Accessibility is restricted in all fuel handling steps: during transport by special casks and during the storage periods by keeping the fuel in water pools. The transport casks and the water in the storage pools cool the fuel and shield off the radiation it emits.

The facility itself and the activity pursued there are designed to protect the personnel. The copper canister is designed to withstand normal operation, disturbances and mishaps without being damaged. However, the canister does emit gamma and neutron radiation and will therefore be handled with radiation shielding to protect the personnel. The radiation emitted by the canister does not reach outside of the final repository. There are no events that justify establishing risk or protection areas for the general public.

3.93 What is the weakest link in each handling step? Can the risks within each step be reduced? (EK Miljökonsult AB)

(SKB) We go through all possible disturbances and mishaps that could conceivably occur in the handling of the spent nuclear fuel and adapt the design of the facilities and the activities to avoid dangerous mishaps. For example, the copper canister can withstand being dropped from a given height. The facility is therefore designed so that the canister never has to be lifted above that height. Going through various scenarios of possible disturbances and mishaps in handling is one of the key activities in designing a facility. This is a prerequisite for ensuring that we use the best available technology and knowledge.

3.94 An alternative is lacking that permits recycling of the spent nuclear fuel. (EK Miljökonsult AB)

(SKB) Recycling is not an alternative for SKB. SKB's mission is to dispose of spent nuclear fuel and radioactive waste from the Swedish nuclear power plants so that human health and the environment are protected in both the short and long term. This includes construction, operation and closure of a final repository for spent nuclear fuel with a focus on safety, radiation protection and environmental consideration. The scope and implications of the mission are determined by the Government via the Swedish Radiation Safety Authority.

3.95 If the final repository and the encapsulation plant are located on the same site, this would reduce transport and transloading of the waste. (EK Miljökonsult AB)

SKB's alternatives for location of the encapsulation plant were either adjacent to the interim storage facility Clab outside Oskarshamn or in Forsmark, but only provided that the Spent Fuel Repository was located there. The rock in Forsmark is better than the rock in Laxemar, which is why SKB will apply for a licence to locate the Nuclear Fuel Repository in Forsmark. There are great administrative and functional advantages to having the encapsulation plant adjacent to Clab, which is why SKB will apply for a licence to locate it there.

3.96 If each nuclear power site has its own encapsulation plant, this will reduce the need for transloading of the waste as well as the risk of exposure. (EK Miljökonsult AB)

(SKB) All spent nuclear fuel from the nuclear power plants in Sweden is transported to Clab, outside Oskarshamn, for interim storage. It is therefore practical to have a joint encapsulation plant adjacent to Clab. Furthermore, an encapsulation plant is a rather complex nuclear facility.

During transport the fuel is well protected in transport casks. We have more than 25 years of experience of transporting unencapsulated spent nuclear fuel (in

transport casks) from the power plants to Clab on the ship m/s Sigyn. It is during the actual encapsulation step, when the spent nuclear fuel is unprotected, that there may be a risk of exposure.

3.97 Will fuels be kept within the applied-for areas? (EK Miljökonsult AB)

(SKB) Fuels will be stored on the area. There are collection pads around the stationary fuel tanks, and the law requires the whole fuel volume to be dyked-in in case there should be a leak.

3.98 In today's debate regarding the country's future energy supply, many stakeholders (incl. political parties) have begun to advocate reprocessing of spent nuclear fuel as an alternative to uranium mining.

If the Riksdag decides in favour of reprocessing, won't it affect SKB's activity significantly, incl. both goals and activities?

Could I have some more information about this? (Leif Wahlberg)

SKB's position is that we who have derived benefit from nuclear power should take responsibility for the waste we have created using the best method we know today.

In its planning, SKB assumes that the reactors in Forsmark and Ringhals will be operated for 50 years and the reactors in Oskarshamn for 60 years. The Swedish reactors will then give rise to a total of 12,000 tonnes of spent nuclear fuel, equivalent to 6,000 canisters, including the spent nuclear fuel from the reactors in Barsebäck.

SKB will work according to these assumptions until such time as new directives are issued. If reprocessing should become reality in the future, we will have to look at how the new needs are to be met at that time.

We already have a good solution today that is ready for licensing, and the method permits the fuel to be retrieved if better methods are found in the future or the energy content in the fuel is to be recovered. Naturally, SKB is following research and development in the waste field.

Further information is provided in the preliminary EIS. For example, Chapter 13 deals with how SKB handles any uncertainties.

Meeting with Swedish Radiation Safety Authority

Date	18 February 2010
Time	9:00–11:30 hrs
Place	SKB's offices in Stockholm.
Target group	Swedish Radiation Safety Authority (SSM).
Invitation	The meeting was initiated by SSM.
Background material	Preliminary environmental impact statement (EIS), which deals with environmental aspects associated with construction, operation and decommissioning of the encapsulation plant and the final repository and transport to and from these facilities. The EIS contains descriptions of the impact, effects and consequences expected to occur. Measures planned to mitigate the consequences are also described. The material was prepared in the autumn of 2009 and reflects the state of knowledge at that time. The purpose of the preliminary EIS is to provide some idea of the overall environmental consequences and to allow viewpoints to be expressed on its arrangement, scope, contents and conclusions. The material was posted on SKB's website on 21 December 2009.
Purpose	SSM requested a presentation of issues having to do with radiation and safety and where in the preliminary EIS these subjects are covered.
Present	SSM: *Bengt Hedberg, Virpi Lindfors, Tomas Löfgren, Peter Merck, Josefin Päiviö Jonsson* och *Bo Strömberg*. SKB: *Kerstin Blix, Saida Laârouchi Engström, Olle Olsson, Pia Ottosson, Erik Setzman, Magnus Westerlind* and others.

1 Interim storage facility and encapsulation plant

1.1 What does the no action alternative entail? Continued storage in Clab?

(SKB) Yes.

1.2 Has a study been made of how long it is possible to continue interim storage in Clab?

(SKB) Yes, we have studied that. The conclusions are that it is possible to extend interim storage by about 100 years without any great problems, and that extension by up to 200 years is possible but requires greater resources.

1.3 I read in an American report that "refurbishing" of the fuel is planned. Is that some kind of "reconditioning"? How long can the fuel remain in Clab before it has to be refurbished?

(SKB) There is no experience anywhere in the world of spent nuclear fuel that has been kept for over 100 years. We have experience from Clab going back to 1985, and in the world there may be experience of maybe 10 years' more storage. This is one of the reasons why monitoring and maintenance systems are required.

1.4 What would it cost to choose the no action alternative – continued storage in Clab?

(SKB) Different types of costs are involved: technical, safety-related, societal and financial. Operation itself costs a lot. Refurbishing the fuel would probably not entail any great cost compared to operation for 100 years or so.

What is important is long-term safety, where uncertainty regarding the evolution of society is the weakest link. We cannot rely on a solution that is based on assuming that monitoring and maintenance will work for 100,000 years.

Continued storage in Clab is not a viable option. If the applications are not approved, we can continue to store the fuel in Clab for a certain length of time while we look for something better. However, it is worth noting that Oskarshamn Municipality demands a final solution. They don't accept continued storage in Clab as a final disposal option.

1.5 The point of departure for the design of the final repository is to dispose of spent nuclear fuel from the operation of today's nuclear power plants for 50–60 years. This yields about 12,000 tonnes of spent nuclear fuel. Clab is licensed for 8,000 tonnes. Interim storage of 12,000 tonnes requires relicensing. What does the municipality say about an extension of Clab, Clab 3? Clab does not have a licence under the Environmental Code today, how can you then regard it as a no action alternative?

(SKB) The licences Clab has under the old environmental legislation are sufficient for continued operation.

1.6 If Clab needs to be extended, Clab 3, this will require a new licence.

Yes, SKB is aware of that.

1.7 What will happen if the applications are rejected and it is not possible to extend Clab?

(SKB) Clab's current capacity will suffice until about 2030. Furthermore, small quantities of spent nuclear fuel can be stored at the nuclear power plants. However, the law requires final disposal of the spent nuclear fuel, which is our point of departure. We take note of the viewpoint and will see if the description of the no action alternative can be elaborated.

1.8 Will the results of the study of the possibilities of reducing the releases from Clink be presented in the EIS?

(SKB) No, they will be included in the safety analysis report for Clink. However, we can explain and describe what the EIS will contain more clearly than we have done.

1.9 At the consultation meeting in Oskarshamn on 9 February, the County Administrative Board in Kalmar County pointed out that SKB has to begin planning in good time if they intend to continue the operation of Clab.

SKB will make a note of this.

1.10 The EIS should contain a description of the safety-related advantages of an alternative design of the encapsulation plant in Oskarshamn where blasting in the rock is not necessary. If the encapsulation plant were located in Forsmark, the fuel would be handled dry. What would dry handling in Oskarshamn entail? It may not be necessary to describe this, but think about it.

SKB did not answer the question.

1.11 What are the BAT arguments for the chosen welding method? Posiva (Finland) has a similar repository concept, but has made a different assessment than SKB as far as welding is concerned.

SKB has made its own assessment of BAT for welding which includes many aspects, cost being one.

SSM concluded that the question of BAT for welding will be best handled in the future within the framework of the expert meetings.

2 Final repository

2.1 How many pages in the EIS will deal with long-term safety, in other words SR-Site?

SKB's estimates that there will be more than ten pages.

2.2 Will an "SR-Site light" version be produced?

SKB has not planned to produce such a document for the applications, but we do plan to produce some kind of information material about the applications, and in this context the SR-Site safety assessment will also be described.

The main scenarios included in SR-Site will be described in the EIS, but there will not be any explanation of how the conclusions in the assessments were reached. This is done in SR-Site. We don't want to confuse the EIS with the safety analysis report, since these documents have quite different purposes. The results and conclusions of the safety analysis report comprise premises for the environmental impact statement.

2.3 How does the description of choice of method in the appendix "The activity and the general rules of consideration" differ from the description in the appendix "Choice of method"?

(SKB) It is above all the scope of the descriptions that will differ. Showing that the applied-for activity can be conducted in compliance with the general rules of consideration is a requirement under the Environmental Code. SKB has chosen to do this in a appendix to the applications. The appendix describes, among other things, how the method for final disposal of spent nuclear fuel for which SKB is applying for a licence complies with the requirements in the Environmental Code's general rules of consideration.

The appendix "Choice of method" provides a more complete, more detailed and more technical description of SKB's choice of method.

Figure 13 – Appendix: Siting process

2.4 Point 7 in the figure is "Comparative evaluation and choice". What is being compared? Is it only the sites, Forsmark and Laxemar, that are being compared? In that case, assume that both sites are poor; that would mean that the least poor site of these two will be selected. Is a comparison made with more sites? SKB has data from many sites. (SSM)

(SKB) More sites are compared in Chapter 8 of the Siting appendix, see point 8 in the figure. Chapter 7 is a comparison of Forsmark and Laxemar.

2.5 Will the comparison also consider siting in recharge versus discharge areas?

(SKB) Yes, that comparison will be included in Chapter 8 of the appendix "Siting process", with references to modelling work done.

2.6 It is a pedagogical challenge to describe the method selection and siting processes. This description is of great interest to the general public.

SKB is aware of the challenge. It is one of the reasons we have included the two appendices: "Choice of method" and "Siting process".

Figure 14 – Appendix: Alternatives report in EIS 1 (2)

2.7 Somewhere in the EIS it says that "Other methods are not included in the alternatives report." What is the difference between "other methods" and "alternative methods"?

SKB has chosen to call the methods which we have judged not to be available or not to serve the purpose of final disposal "other methods", since they are then not alternatives in the legal sense.

2.8 Point 4.1 is "Applied-for activity – incl. KBS-3H". So you are also applying for a licence for horizontal deposition?

SKB's applications will be for the KBS-3 method, and we wish to keep the option of switching to horizontal deposition open for the future.

2.9 You use many terms in the EIS: other and alternative methods, design, variant... You have to provide a better explanation of what these terms mean.

(SKB) We take note of the viewpoint and will review this. We have ourselves noticed that the terms are not used consistently in Chapter 4.

2.10 Is KBS-3H an alternative design according to the Environmental Code?

(SKB) Yes, that's how we see it.

2.11 If KBS-3H is not an alternative, why is the text about KBS-3H in section 4.1?

(SKB) We will apply for a licence for KBS-3, but focus on KBS-3V. The text about KBS-3H could be in section 4.2, as an alternative design. We are taking note of the questions and the viewpoints considering this and will think about it.

2.12 What do you mean by the term "variant"?

(SKB) An example is the construction of the City Tunnel in Malmö. There were two alternative designs of the central station, both of which were possible. The environmental court's decision was to give the applicant the option of choosing the design that turns out to be best in the continued design work. This is comparable to KBS-3V and -H, where we want to have the option of choosing. However, one difference is that we cannot say today whether KBS-3H is feasible. No safety assessment has been done for KBS-3H under Swedish conditions. When we have more material we can always go back to SSM, but this is not possible with the environmental court.

Figure 21 – Chapter 10 – Final repository for spent nuclear fuel

2.13 What types of disturbances are we talking about?

(SKB) Examples of disturbances are dropped canister, rock breakout ("missiles") and fire.

2.14 In earlier consultations, SKB has promised to describe the environmental consequences of retrieval of deposited canisters.

(SKB) In the EIS we describe how a retrieval can be done in general terms, but it isn't something for which we are applying for a licence. We haven't taken a closer look at the environmental impact of post-closure retrieval. It is impossible to "reverse" the process during operation, which is described in the safety analysis report.

2.15 In earlier consultations, SKB has promised to make a safety-related comparison – barrier by barrier – between the KBS-3 method and disposal in deep boreholes. Will this comparison be made?

(SKB) Yes, the comparison, as far as one is possible, will be made in the appendix on choice of method.

2.16 In earlier consultations, SSI (the Swedish Radiation Protection Authority) has requested an account of the advantages and disadvantages of locating a repository in a recharge area versus in a discharge area as a function of time and taking into account future climate change. Will this comparison be made?

(SKB) It is made in the appendix on the siting process.

2.17 SSM has noted that viewpoints have been expressed concerning the fact that the issue of long-term safety has been left outside of the consultations. SSM respects SKB's position, but thinks that SKB could have consulted on what should be included in the EIS with regard to long-term safety. (SSM)

SKB notes the viewpoints expressed. Many people wish that all material were ready for the consultations, but the consultations are not supposed to deal with finished documents that cannot be influenced. A distinction should be made between consultation and review.

2.18 The consultations will be concluded on 5 March and the applications will be submitted at the end of the year. There is plenty of time to consult about long-term safety.

(SKB) We have consulted for a long time, including about the SR-Can safety analysis report. SR-Can can be said to be a preliminary version of SR-Site. The discussion concerning SR-Can has yielded viewpoints of value for the work with both the EIS and SR-Site.

2.19 Will the account concerning chemical toxicity in the EIS be expanded? Have any other countries done anything about this?

(SKB) The study of chemical toxicity was recently concluded and is currently being reviewed. The account in the final version of the EIS will be more detailed. Besides Sweden, Canada has also done some work on chemical toxicity.

3 Common issues

3.1 The main heading of Chapter 4 is "Applied-for activity and alternatives". Then it says "design" in the subheadings. What do you mean by "alternative" and "design" in the relevant sections?

(SKB) For each activity, different designs are presented, for example how the facility is positioned in the bedrock and adjustments that can be made in the continued design process. Another example is choice of welding method. At first we regarded the welding methods as alternative designs, but have arrived at the conclusion that it is a question of choice of technology.

This distinction is not easy to make, since the EIS will accompany applications under two different kinds of laws. The decision we get under the Environmental Code cannot be changed, which is why we want a licence with broad compass. We would like to obtain a licence for the KBS-3 method and have the freedom to choose vertical or horizontal deposition when we have a technical basis for comparison.

As far as the Nuclear Activities Act is concerned, we can always come back to SSM, present new material and propose changes, if they entail improvements in the safety of the method. It may therefore be difficult to make a strict distinction between what is a design alternative and what is a different technical solution.

(SSM) SSM understands the dilemma and believes that these types of questions are best dealt with at the expert meetings. A meeting about the applications is planned for May.

Figure 17 – Contents

3.2 The figure, showing where in the EIS safety and radiation protection matters are described, was shown at the meeting in October. Is it still valid?

(SKB) The figure is a rough indication. Safety and radiation protection matters are dealt with in more sections than the figure shows. SKB can go through the figure and send an updated version to SSM.

3.3 You use many terms: other and alternative methods, design, variant... You have to describe and explain what they mean in a better way.

SKB will make a note of this.

3.4 SSM informed SKB that the Authority will not submit viewpoints until 12 March, since they first wanted to hold a planned meeting with the municipalities and the county administrative boards on 10 March. The Authority said that they are aware that SKB will conclude the consultations on 5 March, but thought it would nevertheless be good if the viewpoints were included in the consultation report.

(SKB) SSM's viewpoints will be included in the consultation report.

3.5 It says on page 41 in the EIS that "The KBS-3 method was formally examined by the regulatory authorities and the Government in the early 1980s and comprised the basis for the permits to fuel the nuclear power reactors Oskarshamn 3 and Forsmark 3." What is meant by this? Clarification is needed. (SSM)

(SKB) We will look at the formulation.

Public meeting in Östhammar Municipality	
Date	3 May 2010
Time	18:00–21:00 hrs
Place	The Storbrunn cinema, Klockstapelsgatan 2, Östhammar.
Target group	Private citizens, organizations, government agencies.
Invitation	The meeting was advertised locally in Upsala Nya Tidning (10 and 30 April), Östhammars Nyheter (10 and 30 April), Annonsbladet (14 and 28 April) and Upplands Nyheter (9 and 30 April). A written invitation went to the organizations that receive funding from the Nuclear Waste Fund to follow the consultations, Östhammar Municipality, the County Administrative Board in Uppsala County and to all government agencies.
Background material	No new background material was compiled for the meeting. Viewpoints and questions received from the consultations in February could be downloaded on SKB's website.
Presentations	The meeting began with presentations by Erik Setzman, who explained how long-term safety has been dealt with in the consultations and the environmental impact statement, EIS, and the place of the safety assessment and the EIS in the applications under the Environmental Code and the Nuclear Activities Act. Allan Hedin described the background and purpose of the assessment of post-closure safety, SR-Site, and some preliminary results.
Present	About 70 persons. Private citizens/nearby residents: Five persons. Representatives from: *SSM, Östhammar Municipality, Oskarshamn Municipality, the Swedish National Council for Nuclear Waste, Forsmarks Kraftgrupp AB (FKA), the Regional Council in Kalmar County, MKG, Milkas, SERO* and *Åland's National Association for Nature and Environment (ÅNOM).* SKB: *Saida Laârouchi Engström, Mikael Gontier, Allan Hedin, Inger Nordholm, Olle Olsson, Erik Setzman, Magnus Westerlind* and others.
Moderator	*Ulf Henricsson.*
Minutes checkers	*Marie Berggren* and *Hans Jivander.*

Questions and answers from the consultation meeting are given below. A compilation of written questions and viewpoints received within the framework of this meeting is presented separately: "Compilation of written questions and viewpoints and SKB's replies", page 281.

1 Interim storage facility and encapsulation plant

1.1 I have spoken with Oddbjörn Sandevåg at SSM, who says that if new fuel assemblies are developed and burnup is increased, the risk of accidents will increase.

I would like to reiterate that increasing the power level will increase the risks associated with storage in Clab. How long will it take to obtain standby pumps? How will you manage an accident at the nuclear power plant in view of the fact that Clab is located only about 700 metres from the reactors? The union won't allow you to send people into contaminated areas.

(SKB) Clab's plant manager said at the most recent consultation meeting in Oskarshamn (9 February 2010) that Clab can withstand a power outage lasting eight weeks. This is also evident from the operational safety report for Clab.

Fuel placed in a canister must have a limited decay heat. The planned power increases are included in our calculations.

2 Final repository

2.1 Will SR-Site be submitted to the environmental court as well?

(SKB) Yes, the safety analysis report, including SR-Site and its main document, will be submitted to the environmental court in the licensing review under the Environmental Code. If the environmental court needs to see additional documents, they will be available, and we will give them whatever information they need.

2.2 Will the sub-appendices to the safety analysis report only be submitted with the KTL application (the application under the Nuclear Activities Act)?

(SKB) Yes, the complete safety analysis report will be submitted with the KTL application, but the important parts will also be submitted to the environmental court with the application under the Environmental Code.

2.3 It would be good to have a summary of which parts of the safety analysis report are already finished and which parts are not.

(SKB) Allan Hedin will cover this in his presentation.

2.4 It says BP on the map figure (Figure 6). What does that mean?

(SKB) Before Present.

2.5 Do the conclusions in SR-Can regarding ice ages apply to both Forsmark and Laxemar (Figure 14)?

(SKB) Yes.

2.6 You say that meltwater can penetrate down to the repository, but not oxygen. Will microbes consume the oxygen?

(SKB) The oxygen is mainly consumed by reactions with minerals in the bedrock.

2.7 You say that the water does not contain oxygen. Isn't water composed of oxygen?

(SKB) The molecular formula of water is H_2O (two hydrogen atoms and one oxygen atom), but we are referring to molecular oxygen (O_2) that is dissolved in water. The amount of oxygen dissolved in water is determined by the equilibrium between air and the water.

2.8 What nuclides are we talking about: uranium, plutonium? Where do they come from? (Figure 15).

(SKB) There are very many different nuclides, most of which have short half-lives. The harmful nuclides have half-lives of tens of thousands to hundreds of thousands of years.

Nuclides with long half-lives include iodine-129, which is created by uranium fission and has a half-life of 15 million years. There are also nuclides which we virtually never get rid of, for example uranium-238, which has a half-life of 4.5 billion

years. Uranium-238 decays in 14 steps to stable lead-206. One of the intermediate products in this decay chain is radium-226. Radium has such properties that it slips through the barriers fairly easily.

2.9 The decay chain includes plutonium, which has a short half-life, as well as plutonium, americium and curium. Will they move down there?

(SKB) Americium and curium will exist to begin with, but will disappear fairly quickly. Plutonium-239 has a half-life of 24,000 years and won't disappear so quickly.

2.10 How much plutonium does the waste contain? A few percent?

(SKB) Roughly, it depends on how the reactor has been operated.

2.11 What is the timetable for application for an operating licence (Figure 20)?

(SKB) According to current plans, an application for a licence for trial operation will be submitted to the Swedish Radiation Safety Authority in around 2023, after which a licence is required for routine operation.

2.12 What do the Finns say about SKB's conclusions concerning long-term safety (Figures 22–24)? Do they make other assessments than SKB?

(SKB) Finland is wrestling with the same issues as we are at SKB. They have not carried out a safety assessment equivalent to SR-Site in recent years. They are considering a variant of the KBS-3 method with horizontally deposited canisters, instead of vertically deposited canisters as in SKB's main alternative. Their assessments, for example regarding buffer erosion, are based in part on different data. However, they have complete access to our data and I imagine they will arrive at the same results as we.

2.13 You talk about the biggest earthquakes that might occur in Forsmark. How powerful are they (Figure 24)?

(SKB) They have a magnitude of between 5 and 6.

2.14 Is the risk criterion the same in Finland as in Sweden, i.e. one in a million?

(SKB) Finland has different legislation, which sets a limit for releases. They thus have a different type of criterion, but it is set in such a way that it is roughly equivalent to ours. The Finnish legislation is currently being updated in this regard.

2.15 I have a question concerning the radioactivity in the sediments in the marine area offshore of Forsmark. The EIS says that you will take about 50,000 cubic metres of shot rock at the pier. Via water drainage and runoff, radionuclides will be leached from excavation activities and excavation spoil will to the offshore marine area, which is already radioactively contaminated. Cesium, cobalt, strontium and other radionuclides will be released. Radionuclides will also be released by rock crushing and leaching from the rock heap. How have you planned to handle this? Have enquiries been made after Chernobyl?

(SKB) The EIS contains information and clear descriptions of how we will handle the spoil and any problems that can be anticipated. We judge that we can handle this material without problems, and the handling of radon in the final repository is an occupational health matter, but is nevertheless described in the EIS.

2.16 This consultation meeting is another opportunity to discuss the safety assessment, after which viewpoints may be submitted up until 17 May. Has any new information or new questions emerged besides what is presented in SR-Can?

(SKB) The safety assessment and the EIS are interlinked, as Erik Setzman has just described. We have had consultation meetings with the preliminary safety assessment (SR-Can, 2007) and the preliminary EIS (February 2010) as background material. The conclusions from SR-Site will be incorporated in the final EIS. No additional questions have come up beyond those that have already been dealt with and illuminated.

2.17 SKB (Erik Setzman) previously stated that the question of long-term safety has been an important part of the consultations. The environmental movement thinks that it should have been given more attention. We have had quite different pictures of how this question has been handled in the consultations. We have quite a few remaining viewpoints and questions regarding long-term safety.

(SKB) It is clear from previous consultation minutes that we have consulted about long-term safety and brought up this matter at the consultation meetings. We have received many viewpoints and questions through the years, for which we are very grateful, and we believe we have consulted and had a very fruitful dialogue on this matter. Safety and radiation protection was the theme of a consultation meeting in 2007.

I interpret your question now as: Are there and have there been opportunities to submit viewpoints and questions concerning the assessments of long-term safety? My answer is yes, there have been and there are. The preliminary results are reported in SR-Can, which regulatory authorities, concerned municipalities, environmental organizations and other actors have had an opportunity to comment on. The results of the regulatory authorities' (SKI and SSI) review of SR-Can have been reported.

2.18 It has been said several times that long-term safety is the most important issue for the environmental licensing review. My view is that we should consult about all aspects of long-term safety. Since you don't want to have further consultations on long-term safety, it is important to have this dialogue here and now. Isn't it important for you to avoid a discussion of SR-Site in the review of the applications? It is urgent both for the Authority and for us. I have, for example, not yet seen how SKB handles copper corrosion.

(SKB) SKB is responsible for choosing themes for consultations in cooperation with concerned parties and actors. We have presented proposals for different themes in good time to enable all concerned parties to express their viewpoints. SKB has not in any way tried to avoid certain aspects. Allan Hedin's presentation today demonstrates this. Anyone with viewpoints has an opportunity to express them. That's how it has been during all the years the consultations have been held. All viewpoints and questions have been dealt with and are included in the minutes. We are very grateful for all your viewpoints and comments.

2.19 We have offered many viewpoints and SKB has just referred to SR-Can. We have posed many new questions and expressed many viewpoints since 2007, when SR-Can was published. How have they been dealt with? Isn't it possible to obtain a preliminary version of SR-Site? To consult about it? As I see it, it would benefit the process if we could see it before the applications are submitted. Otherwise there is a risk that the licensing review process will be delayed.

(SKB) I share your opinion that it is good to get viewpoints, and we have. We have had many meetings with concerned regulatory authorities and municipalities within the framework of the Oskarshamn EIA Forum and the Forsmark Consultation and EIA Group. Most of them have been open to the general public. We have presented a preliminary EIS and consulted about it, and will incorporate the comments and viewpoints that we have received in the final version and then submit it with the applications. We will not consult about the final version. The same applies to the assessment of long-term safety. We have presented a preliminary version, SR-Can, which served as a basis for consultations, incorporated the viewpoints we have received in the final version and will submit it with the applications. We value the viewpoints we have received from different actors and want the licensing review to go smoothly.

2.20 I have many questions, but my main point is that I concur with MKG that it would be better for all of us if we had an opportunity to express viewpoints on SR-Site. It would be good if more information could be made available quickly, for example by posting the presentations that have been shown and the video on SKB's website.

(SKB) The presentation is a part of the minutes from the consultation meeting and will be posted on the website. You can also submit viewpoints and questions in writing up until 17 May, and they will be included in the minutes from the consultation meeting.

(ÅNOM) It is difficult to express viewpoints on something I haven't read.

2.21 If you run into problems in Forsmark, will you have to redo the SR-Site safety assessment for Laxemar?

(SKB) The body of data isn't sufficient, since SR-Site only covers Forsmark, which means that new assessments would have to be done for Laxemar.

2.22 I have got the impression from the EIS that Laxemar is an alternative.

(SKB) We have selected Forsmark and will argue for Forsmark in the applications. The environmental court can say no to Forsmark, but cannot require us to site the repository in Laxemar.

2.23 SSM's risk criterion of one in a million is converted to dose. Research is currently being conducted on the consequences of low-dose radiation. How will the new knowledge be handled during the operating phase? What will you do if the criterion is changed due to new research results?

(SKB) The conversion from dose to risk is regulated in SSM's regulation. ICRP stipulates how this is to be done.

2.24 Hasn't SKB done their own analysis? (ÅNOM)

(SKB) No, SSM stipulates how the conversion from dose to risk is to be done. In order to provide some perspective on this, it is worth noting that we are all constantly exposed to natural background radiation and that dose and risk limits are set in relation to this. All dose limits are set well below the dose from the natural background radiation.

2.25 I am returning to the same question: Do you have a plan for what to do if ICRP lowers the dose limit or if SSM changes the regulation? Would this require a new licence?

(SKB) If the regulatory authorities change the regulations, we will naturally have to adapt to this. If we already have a licence, the legislation has to stipulate how to proceed with a new limit, if it has been changed. This is a legal question.

2.26 What is the timetable for the fuel line report and the references for SR-Site? Do plans exist to present any of the ongoing studies before the applications are submitted?

(SKB) The fuel line report is in preparation. Some of the references have been published, for example the site descriptive model for Forsmark, which was published in conjunction with the site selection. Most of the references will be published when the applications are submitted.

2.27 Allan Hedin says we should read the reports in the application documentation. That is the problem for us who are working with this. The reports are not available. Is this reasonable? Long-term safety is the most important question, but it is poorly treated in the EIS. As a party in the consultations, it feels as if we are being left out when this is the way the dialogue is handled.

(SKB) We have received many good viewpoints, comments and review questions regarding the assessment of long-term safety, over a long period of time, from the regulatory authorities, the environmental organizations, the municipalities and others. We have been working with several years of viewpoints received. All review questions from SR-Can will be answered. Those that remain have been taken into consideration in our work. We are not supposed to consult about the finished product. We consult about work in progress. The consultations are intended to lead to a finished product, which will be reviewed.

2.28 It doesn't feel as if we have had an opportunity to submit all the viewpoints we want, since we haven't been able to examine all the documents. This means that there will be many viewpoints during the licensing review. We do not want to consult about the final application, we want to consult about a preliminary SR-Site. If you had a final consultation about the preliminary version of the documents that will be included with the applications, we would avoid this. How can the Espoo consultations be based on final products – EIS and SR-Site?

(MKG) I concur.

(SKB) The scope of the Espoo consultations is not close to that of the review that will take place in Sweden.

We want viewpoints and are grateful for those we get. We want to submit an application we feel can gain the acceptance of society. We do not share your viewpoint that we have not had complete consultations.

2.29 We would like the consultations to be a dialogue concerning the material to be included in the applications. We regard this meeting as an information meeting. If we are to have a discussion, we have to have access to the background material.

It is difficult to understand what has already been done and what remains to be done. You have said that a repository at Forsmark satisfies the risk criterion. Does this mean that the assessments are finished?

(SKB) The assessments are not finished, they are still in progress. I have given a status report and presented preliminary conclusions.

2.30 When will we find out how you arrived at these conclusions?

(SKB) This will be explained in the application.

2.31 So it isn't something you will consult about?

(SKB) No. It is the same reply as before: We aren't consulting about a final product. The consultations are intended to lead to a finished product, which will then be reviewed.

I encourage all of you to pose questions to our expert on safety assessment, who is here today. You have asked for this extra consultation meeting, so take the chance to ask all your questions.

2.32 As I understand it, there will be more safety assessments after SR-Site. For example prior to an application for an operating licence, when more is known about the rock. This can be compared with the process in Finland, where they first go down into the rock and then get a licence. What do you think about how it's done in Finland? Has this been discussed?

(SKB) Historically, the intention was to do it the same way in Sweden: start with a hard rock laboratory and then apply for a licence to deposit canisters of spent nuclear fuel. But the Swedish legislation was amended, so now you need a licence before you can go down into the rock. Once you've started going down into the bedrock you tie up a lot of money. So it would be costly to go down into the bedrock, conduct investigations and then risk not getting a licence to site the final repository there. Swedish and Finnish legislation differ.

2.33 I would like to get back to the subject of long-term safety. The first 1,000 years are particularly important. Then the canisters are hot and highly radioactive, which could have serious consequences if something should happen. Do you have a "worst case" for the first 1,000 years, if something should go wrong?

It would be valuable if you would share your thoughts in advance, for example about what might happen during the first 1,000 years, so we could give you some feedback before the licensing process starts. An example is what the KTH researchers have said about copper corrosion. They say that the canisters could corrode apart within 1,000 years in oxygen-free water. How can you, with all you have learned from the LOT tests, claim that no canisters will fail during the first 1,000 years? How do you publicize the results from the LOT tests so that everyone can learn from them? What do you think about the KTH researchers' results? I would like to be able to give feedback to the KTH researchers.

(SKB) There are "what if" analyses for the first 1,000 years. A possible scenario was analyzed already in SR-Can: What happens if a canister is leaky at deposition? But we will argue that there will not be any such canisters.

What do we do about the claims of copper corrosion? We have done a "what if" analysis based on the claims of the KTH researchers. But there is a limit to the corrosion process, if it occurs, that is determined by how rapidly the hydrogen gas that is formed can be transported away. During the first 1,000 years, the volume in which hydrogen gas can accumulate is limited and can be estimated. In this way the quantity of copper that can corrode can be calculated. The results show that only a fraction of the canister can corrode away. This is the main approach.

The KTH researchers base their claims on laboratory tests, where the corrosion process is not limited by how rapidly hydrogen gas is transported away. In other words, the conditions at repository level have not been taken into account. We have

taken into account the fact that the capacity of the rock to transport hydrogen gas is limited under actual conditions in a repository.

2.34 What is it that limits the volume in which hydrogen gas can accumulate?

(SKB) There are water-saturated conditions a bit out into the rock, that's where the limit is.

2.35 Isn't hydrogen soluble in water?

(SKB) Yes, but the transport properties are limited.

2.36 So you mean this argument will be presented in SR-Site. I will try to tell the KTH researchers about this.

(SKB) SKB has also had meetings with the KTH researchers to discuss this.

2.37 Could the repository pose a risk to nearby residents? How are nearby residents defined? In other words, where does the limit go for being counted as a nearby resident? One of the figures (Figure 15) showed that the method for calculating the dispersal of radionuclides in the biosphere was not fully developed in SR-Can. Is it now?

(SKB) The definition of "nearby residents" is determined by how radionuclides are spread in the biosphere. There is no physical boundary; we look at the dispersal pattern to find the areas where the concentration will reach a maximum.

The other question concerned the biosphere model. Do we have enough knowledge? Yes, we believe we do. Compilation of material is under way. We look forward to presenting the results and subjecting them to examination.

2.38 Is it possible to examine the model itself?

(SKB) The documentation of the development of the model that has taken place since SR-Can will not be finished until the applications are submitted. It will be possible to examine the model during the licensing review process.

2.39 I have thought about the description of how hydrogen gas is transported. You have experiments under way in Äspö, the LOT project. You retrieved a parcel in early 2006. When will you retrieve the second parcel, LOT-S2? It may provide knowledge on copper corrosion and how hydrogen gas is transported.

(SKB) The LOT test is not designed for measuring copper corrosion or the evolution of hydrogen. From laboratory tests, for example those done at KTH, we know that very small quantities of hydrogen are formed, such small quantities that they could not be traced in the LOT tests.

2.40 SKB says that the corrosion that occurs is mainly caused by sulphides. Have you demonstrated this in laboratory tests or in Äspö? How do you know this is true?

(SKB) This cannot be studied by means of the LOT tests. We have, however, done this in the "wire tests", experiments with thin copper wire in oxygenated water. After the oxygen had been consumed, the corrosion stopped.

2.41 Has this been reported? If so I would very much like to have the reports.

(SKB) I think you already have them, since they were included in the background material for the seminar on copper corrosion arranged by the Swedish National Council for Nuclear Waste in November 2009. I will send the reports to you

anyway. (Clarification added after the meeting. Allan Hedin sent two articles to Johan Swahn at MKG:

- Betova et al. **Application of an On-line Probe and a Reference Electrode for Copper Corrosion Studies in Repository Conditions.** Mat. Res. Soc. Symp. Proc. Vol. 807 © 2004 Materials Research Society
- Bojinov et al. **Corrosion of copper in 1 m NaCl under strictly anoxic conditions.** Mat. Res. Soc. Symp. Proc. Vol. 807 © 2004 Materials Research Society)

(SKB) In the experiment, the corrosion rate decreased as the oxygen was consumed. However, the results of the experiment cannot be used to argue convincingly against the KTH researchers, nor was this the purpose of the experiment. We are nevertheless continuing our studies, as other experts are also doing. Based on the evidence we have seen so far, however, we don't think there is any reason to assume that the process occurs.

(MKG) It must be a closed system.

2.42 Karsten Pedersen is doing research on cyanobacteria, of which there are more than 200 species.

Cyanobacteria, which are also present at great depth in the bedrock, produce hydrogen.

(SKB) It's very good if the bacteria form hydrogen, since this inhibits the corrosion process. In our analysis we assume that there is no hydrogen in the rock. If there is, this is favourable.

2.43 In the calculations of copper corrosion, you assume there is only a certain amount of volume for hydrogen gas, which means that only a certain quantity of copper can corrode. Have you assumed an average figure for all copper canisters? Or that only certain canisters produce hydrogen?

(SKB) We have been very careful in our analysis. We have not spread out the volume among all canisters, nor have we assumed that one canister gets all the volume.

2.44 There is a risk that future generations will intrude into the repository, destroying the barriers.

(SKB) In SR-Can there is a scenario that deals with inadvertent intrusion. We have looked at the consequences for the barriers and for the intruders themselves. This is included in the safety assessment, as required by SSM's regulation.

2.45 When will LOT-S2 be retrieved? Before or after the application?

(SKB) There are no immediate plans to retrieve it, so it will be after the application. After that it will take several years to make analyses and report the results of the test.

3 Common issues

3.1 I suggest you find a better way to document the meeting. I hereby submit a Milkas report from the previous meeting. It describes the meeting in a different way than is reflected in SKB's minutes, for example you can see who said what. Since SKB has its own cameras here this evening, I propose you record the meeting. (Milkas handed over Kärnavfallsnytt no. 1/2010 to the secretariat, see Appendix D in the minutes of the meeting.)

SKB has no intention of recording the whole meeting. Only Allan Hedin's appearance will be recorded, to be used in SKB's internal work. It's always possible to submit viewpoints on SKB's minutes, and the meeting has appointed persons to verify and sign the minutes.

3.2 We are currently increasing the power capacity of our nuclear power plants by 20–30 percent, and no one knows how the reactors will react. What we do know is that we cannot increase the pressure or the temperature, but that the power increase must be effected by increasing the steam flow. The fuel will then be subjected to heavier vibrations, resulting in more damaged fuel to be dealt with. It also means that the fuel will contain more water than the 600 millilitres mentioned in the EIS.

I learned when I was in school to "never hammer an iron nail in copper". Here copper will be handled along with steel and in the presence of both radiolysis and heat. This leads to the creation of gap gases. There is a German patent that solves the problem with gap gases, as I reported in the documents handed over at the last meeting (6 February 2010).

Szakálos (KTH) has studied the question of chemical reactions inside the canister.

What will the impact be when it comes to helium/hydrogen? Has this been addressed?

The power increase means that we will get a fuel with higher decay heat that must be interim-stored for a longer time in Clab. You say you will use compact storage canisters, which cannot be the right way to go. The spacing between the fuel assemblies should instead be increased.

According to SSM, boron shielding will be used in Clab, is that right?

(SKB) I recommend you read the "Fuel line report" when it becomes available. It describes the fate and adventures of the fuel before it is placed in the copper canisters. There you can find out what types of fuel we are applying for. We have also included and explained the consequences of the power increases. The increased helium production is also included in the premises. I would like to clarify that we do not take credit for the fuel's cladding tubes as a barrier.

It is true that fuel that has been operated at higher power produces more heat, but we set a limit on how much decay heat the canister may contain. The fuel will be dried, and the amount of water in the fuel is checked. As you mentioned, 600 millilitres is the upper limit.

(FKA) A power increase does not mean that the power level in individual fuel assemblies is raised, but that the power over the core is raised. There will thus be no change in the current set of requirements for handling spent nuclear fuel. Changes in the burnup of the fuel are made in consensus with SKB. There is nothing to indicate that the power increase will lead to an increase in the incidence of fuel damage. Even now fuel damage is rare, and constant efforts are made to further reduce its occurrence.

3.3 Are there different kinds of consultations? In the form of this meeting, and in the form of another dialogue?

(SKB) There are consultations according to Chapter 6 of the Environmental Code, such as today's meeting. We send out invitations to these meetings via, for example, advertisements in newspapers in concerned municipalities. Then SKB and SSM hold consultations according to a Government decision, and finally we have – through the Swedish Environmental Protection Agency – consultations with countries around the Baltic Sea according to the Espoo Convention.

3.4 Do you take into account the fact that alpha particles can get into the body? The body is covered by sweat pores, where it is very easy for these particles to get into the body and cause cancer.

(SKB) We calculate the consequence of radiation doses based on ICRP's rules and SSM's regulations.

3.5 How do you calculate the background radiation?

(SKB) We don't calculate it; we use an approximate value of one millisievert per year, which is average in Sweden.

3.6 Radioactive substances are released during normal operation of the nuclear power plants. Do you take this into account when you calculate the background radiation? One millisievert per year is an average then? Is that realistic?

(SKB) The background radiation assumed by us is realistic. There is no measurable enhanced background radiation around the nuclear power plants.

(FKA) The activity at the nuclear power plants is subject to existing legislation and the rules established by SSM. The releases are well below established limit values for dose to critical group. There is no way they would have any measurable effect on the background radiation.

(Milkas) I don't believe that!

(SKB) We comply with the law of the land. Present your case to the regulatory authority.

3.7 ICRP does not take into account which isotope reaches which part of the body.

(SKB) Yes, that is exactly what we do in our analyses. We take into account where the isotopes are accumulated in the body. When, for example, we analyze canister damage, we consider specific isotopes that occur at sites of canister damage, how they are transported up to the surface, into the body and to which parts of the body.

3.8 Can I have access to this information? Is it on your website?

(SKB) The same information is in SR-Can. We have researched, developed and analyzed around the KBS-3 method for a couple of decades now. It is impossible for us to refer to all the material that has been produced, but we have the information.

(Milkas) SKB could refer to what information can be found where on their website.

It is important to take the time to see what independent researchers have arrived at. I have a book, "A Primer in the Art of Deception", which I think you should read. (The information on the book was handed over, see Appendix D in the minutes of the meeting.)

3.9 Have you had contact with Local Authorities International Environmental Organisation – KIMO? Have you solicited their viewpoints on shipments of spent nuclear fuel on the Baltic Sea?

No, but SKB is already transporting spent nuclear fuel on m/s Sigyn. The shipments comply with the regulatory authorities' requirements and regulations.

Summary of written questions and viewpoints and SKB's replies from the public consultation meeting in Östhammar Municipality on 3 May 2010

Written invitations to participate at the consultation meeting and/or to submit written viewpoints were sent to the following organizations (which receive funding from the Nuclear Waste Fund to follow the consultations), government agencies and concerned municipalities. The table also shows who replied. No new background material was compiled for the meeting. Viewpoints and questions received from the consultations in February 2010 could be downloaded on SKB's website.

Swedish Work Environment Authority	No reply
National Board of Housing, Building and Planning	Abstains
Döderhult Nature Conservation Society	No reply
Eckerö Municipality, Åland	No reply
Energy for Östhammar	No reply
Swedish Energy Agency	No viewpoints
National Board of Fisheries	No viewpoints
National Institute of Public Health	No reply
Forsmarks Kraftgrupp AB	No reply
Swedish Fortifications Agency	No reply
Swedish Armed Forces	No viewpoints
Swedish Board of Agriculture	No viewpoints
Legal, Financial and Administrative Services Agency	No reply
Swedish Chemicals Agency	No reply
Swedish Coast Guard	No reply
Swedish Civil Contingencies Agency	Abstains
Swedish National Council for Nuclear Waste	No reply
County Administrative Board in Kalmar County	No reply
County Administrative Board in Uppsala County	No reply
Swedish NGO Office for Nuclear Waste Review (MKG)	Viewpoints expressed
Swedish Environmental Movement's Nuclear Waste Secretariat (Milkas)	Viewpoints expressed
Swedish Society for Nature Conservation, Uppsala County	No reply
OKG AB	No reply
Opinion Group for Safe Final Disposal (Oss)	No reply
Oskarshamn Municipality	No reply
Swedish Environmental Protection Agency	No reply
Regional Council in Uppsala County	No reply
Regional Council in Kalmar County	No reply
National Heritage Board	No reply
National Police Board	No reply
Geological Survey of Sweden (SGU)	No viewpoints
Swedish Maritime Administration	No reply
National Board of Forestry	No reply
National Board of Health and Welfare	No reply
Swedish Radiation Safety Authority	No reply
Swedish National Grid	No reply
Swedish Renewable Energies Association (SERO)	No reply

Swedish Agency for Growth Policy Analysis	No reply
Swedish Agency for Economic and Regional Growth	No viewpoints
Vattenfall Vindkraft	No reply
Vattenfall Eldistribution AB	No reply
Åland's Provincial Government	No reply
Åland's National Association for Nature and Environment (ÅNOM)	Viewpoints expressed
Östhammar Municipality	Viewpoints expressed

SKB's general replies

Some of the questions and viewpoints that have been received from various bodies raised questions of a similar nature. These questions and viewpoints are commented on collectively below.

A – The role of the safety assessment in the EIS

B – Site selection and choice of method

A – The role of the safety assessment in the EIS

Post-closure safety

Viewpoints have been expressed that the question of the final repository's post-closure safety has not been sufficiently dealt with in the consultations.

Throughout the consultation process, SKB has made it clear that even if a given consultation meeting focuses on a given theme, it has always been possible to pose any question dealing with interim storage, encapsulation and final disposal of spent nuclear fuel, including questions about post-closure safety.

Furthermore, some consultation meetings have focused on post-closure safety. During 2007, consultations were held on the theme "Safety and radiation protection". The background material provided a general description of SKB's work with safety and radiation protection. An appendix contained a summary of the SR-Can safety assessment (Can stands for canister).

During and following the consultation meetings in February 2010, several actors expressed the wish that a closer look be taken at this question in the consultations. For this reason, SKB arranged a concluding consultation meeting in Östhammar on 3 May 2010 on the theme "The role of the safety assessment in the EIS". An account was given at the meeting of SKB's work with safety assessments along with a status report on the ongoing work with the assessment of post-closure safety, SR-Site.

Assessment of post-closure safety

The safety assessment, SR-Site, is comprehensive and is presented in separate documentation included in the applications under both the Environmental Code and the Nuclear Activities Act.

SR-Site is supposed to show that the selected site and method, in combination with the design of the repository itself, are sufficiently good and fulfil the regulatory authority's safety criterion. The regulatory authorities (former SKI and SSI)

have said that the sites where SKB has conducted site investigations must be compared with respect to post-closure safety and that a complete safety assessment for the selected site is sufficient. The safety assessment calculations done for Laxemar are reported in the documentation included in the application under the Nuclear Activities Act.

Post-closure safety in the EIS

SR-Site shows that the activity in the final repository for spent nuclear fuel does not have any significant radiological impact on human health and the environment. This comprises a point of departure for the environmental impact statement and a prerequisite for obtaining a licence for the activity. Since the final repository does not give rise to any significant radiological environmental impact, the EIS only contains a summary of conclusions and important results from SR-Site.

Continued work

Both applications will be circulated for consideration by the environmental court and SSM, which means there will still be ample opportunity for review and comments on the content, calculations and conclusions in the assessment of post-closure safety.

B – Site selection and choice of method

Site selection

A suitable site has been selected

SKB has selected Forsmark as the site for the final repository for spent nuclear fuel. The site selection is the end result of an extensive siting process that began in the early 1990s. The strategy and plan for the work was in turn based on experience from investigations and development work over a period of more than ten years prior to then. In other words, the selection of a site for the final repository is well-founded.

Sites were chosen for site investigations on the basis of an extensive body of material that included general siting studies, feasibility studies etc. The choice was based on a number of factors, foremost among them being the potential suitability of the site with respect to post-closure safety, i.e. the properties of the bedrock. The properties of the bedrock were also the most important aspect in the choice between Laxemar and Forsmark.

The selected site, Forsmark, is very suitable to host a final repository for spent nuclear fuel according to the KBS-3 method. The area around Forsmark has been designated as being of national interest for energy production, as well as for final disposal of nuclear waste. The final repository will be an addition to the existing cluster of nuclear activities in Forsmark.

SKB is submitting applications under the Nuclear Activities Act and the Environmental Code for a licence to build the final repository in Forsmark. The basis for the applications is an assessment of post-closure safety for a siting in Forsmark. The safety assessment calculations done for Laxemar are reported in the documentation included in the application under the Nuclear Activities Act.

It is SKB's choice

As the applicant it is SKB's responsibility to identify a site for the facility in the applications for a final repository for spent nuclear fuel. SKB argues that the site is good enough both in the applications themselves and in an appendix to the applications. The Swedish Radiation Safety Authority, the environmental court and the Government will decide whether the choice is sufficiently well-founded.

The scope of the description in the EIS

The EIS describes the site selection work in general terms with arguments as to why SKB rejected sites. The area in Forsmark is described in detail and compared with the site in Laxemar.

A more detailed account of the site selection process is provided in a special appendix to the applications (SKB R-10-42), which describes the siting work and the selection of a site for the final repository. Furthermore, SKB's supporting material and reasons for the decisions that have been made during the course of the work, and for the site selection decision, are also described.

Choice of method

Development of the KBS-3 method

SKB has developed the KBS-3 method over a long period of time. An account of the development of the method has been submitted to the Government every three years in the RD&D programmes. Over the years, the direction of SKB's work has received the approval of both the Government and the regulatory authorities.

Studies of other methods

SKB has studied and followed other methods than the KBS-3 method for a long time. This work has also been described in the RD&D programmes. On several occasions, SKB has also compared other methods with the KBS-3 method. These comparisons have not shown that any of the other methods are more suitable than the KBS-3 method. On the contrary, none of the other methods satisfy the purpose of the final disposal of the spent nuclear fuel.

Scope of description in the EIS

The EIS describes environmental consequences caused by the applied-for activity, i.e. the use of the KBS-3 method. The EIS contains an overview of other methods for disposal of the spent nuclear fuel, as well as SKB's view of these methods. However, SKB sees no reason to describe the environmental impact of methods that do not fulfil the purpose of the final repository or are not available.

SKB's choice of method is presented in a special appendix to the applications entitled "Utvärdering av strategier och system för att ta hand om använt kärnbränsle" ("Evaluation of strategies for disposal of spent nuclear fuel, in Swedish only"), SKB R-10-25. The report describes the grounds for SKB's choice of the KBS-3 method and the reasons why other methods have been dismissed. Forsmark has been chosen as the site for the final repository based on the KBS-3 method.

1 Interim storage facility and encapsulation plant

No questions or viewpoints were expressed pertaining solely to the interim storage facility or the encapsulation plant for spent nuclear fuel.

2 Final repository

2.1 Consultations on long-term environmental safety must continue and be based on a complete body of consultation material for the safety assessment, i.e. a preliminary version of the SR-Site safety assessment that will be submitted with the application. (MKG)

SKB believes that it is important to distinguish between consultations according to the Environmental Code and the review that is part of the licensing process. The consultations shall, according to the Environmental Code (Chap. 6, Sec. 4), be concerned with the siting, scope, design and environmental impact of the activity and the content and design of the environmental impact statement.

SR-Site is one of the central documents in the licensing process and is included in the appendix "Safety Analysis Report", which is an appendix to both the application under Chapter 9 of the Environmental Code and the application under the Nuclear Activities Act. Both of these applications will be circulated for consideration by the environmental court and SSM, providing ample opportunity for review and comments on content, calculations and conclusions in the assessment. See also SKB's general reply A ("The role of the safety assessment in the EIS").

2.2 The application must include a safety assessment for a siting in Laxemar that is sufficiently detailed to permit a complete comparison with a siting in Forsmark. (MKG)

SKB has discussed this question with SSM, who said that a complete safety assessment only needs to be done for the site to which the applications for the final repository pertain, i.e. Forsmark. A safety-related comparison between Forsmark and Laxemar has been done.

2.3 Consultations on site selection must continue and be based on a complete body of consultation material for site selection, for example a preliminary version of the special document on site selection that will be appended to the application. (MKG)

SKB has selected Forsmark as the site for the final repository for spent nuclear fuel. The site selection is the end result of an extensive siting process that began in the early 1990s. The strategy and plan for the work was in turn based on experience from investigations and development work over a period of more than ten years prior to then. In other words, the process of selecting a site for the final repository has been a thorough one and the choice is well founded. The choice of site has been discussed in the consultations.

SKB believes that it is important to distinguish between consultations according to the Environmental Code and the review that is part of the licensing process. The consultations shall, according to the Environmental Code (Chap. 6, Sec. 4), be concerned with the siting, scope, design and environmental impact of the activity and the content and design of the environmental impact statement.

One of the central documents in the licensing process deals with site selection. See also SKB's general reply B ("Site selection and choice of method").

2.4 Consultations on choice of method must continue and be based on a complete body of consultation material for choice of method, for example a preliminary version of the special document on choice of method that will be appended to the application. (MKG)

SKB has developed the KBS-3 method over a long period of time. An account of the development of the method has been submitted to the Government every three years in the RD&D programmes. The direction of SKB's work has received the approval of both the Government and the regulatory authorities.

SKB has studied and followed other methods than the KBS-3 method for a long time. This work has also been described in the RD&D programmes. On several occasions, SKB has also compared other methods with the KBS-3 method. These comparisons have not shown that any of the other methods are more suitable than the KBS-3 method. On the contrary, none of the other methods fulfils the purpose of final disposal of the spent nuclear fuel. SKB's work with other methods and the reasons why the KBS-3 method has been chosen have been taken up in the consultations.

SKB believes that it is important to distinguish between consultations according to the Environmental Code and the review that is part of the licensing process. The consultations shall, according to the Environmental Code (Chap. 6, Sec. 4), be concerned with the siting, scope, design and environmental impact of the activity and the content and design of the environmental impact statement.

One of the central documents in the licensing process deals with the choice of method. See also SKB's general reply B ("Site selection and choice of method").

2.5 The Swedish NGO Office for Nuclear Waste Review, MKG, is currently participating in a reference group for a research project on copper corrosion being conducted by the activity operator.

The nuclear waste company has so far not shown any interest in long-term tests or a structured feedback of the results of the long-term tests to the final repository. The Swedish NGO Office for Nuclear Waste Review, MKG, will continue to consult on matters relating to copper corrosion within the reference group on copper corrosion formed by the activity operator. (MKG)

(SKB) The consultations prior to applications for interim storage, encapsulation and final disposal of spent nuclear fuel commenced in 2002. They were concluded and closed for viewpoints on 17 May 2010 after a concluding consultation meeting in Östhammar on 3 May. MKG is welcome to offer viewpoints concerning copper corrosion within the framework of the work of the reference group.

2.6 In summary, we would like to say that all the criticism we expressed in our earlier petition after the consultation meeting on 6 February 2010 still applies. We feel that the questions of when the leakage will begin and how much radioactivity leakage there will be are the most central questions when discussing how a final repository for spent nuclear fuel could impact the environment. That is why the long-term safety assessment is such an important part of the EIS that it is not possible to discuss the EIS without it. We do not feel that meaningful consultations on the EIS have taken place, since a vital part is still missing. The consultations that have been held have only dealt with parts of the EIS. In our opinion, SKB should publish a preliminary but largely complete version of SR-Site and then consult about the document and the whole EIS, including those aspects relating to long-term safety. (ÅNOM)

Throughout the consultation process, SKB has been clear on the fact that even if a given consultation occasion focuses on a given theme, it is always possible to ask any question dealing with interim storage, encapsulation and final disposal of spent

nuclear fuel, including the post-closure safety of the repository. Furthermore, some consultation meetings have focused on post-closure safety.

SKB believes that it is important to distinguish between consultations according to the Environmental Code and the review that is part of the licensing process. The consultations shall, according to the Environmental Code (Chap. 6, Sec. 4), be concerned with the siting, scope, design and environmental impact of the activity and the content and design of the environmental impact statement.

SR-Site is one of the central documents in the licensing process and is included in the appendix "Safety Analysis Report", which is an appendix to both the application under Chapter 9 of the Environmental Code and the application under the Nuclear Activities Act. Both of these applications will be circulated for consideration by the environmental court and SSM, providing ample opportunity for review and comments on content, calculations and conclusions in the assessment. See also SKB's general reply A ("The role of the safety assessment in the EIS").

2.7 SKB has stated that "the purpose of the final repository for spent nuclear fuel time is to protect human health and the environment against the harmful effects of ionizing radiation from the spent nuclear fuel for a long time." This has a bearing on how SKB fulfils and describes the compliance of the project with the precautionary principles in the Environmental Code as well as the alternatives report and the no action alternative in the upcoming application with appended EIS. (Östhammar Municipality)

SKB concurs with the municipality's assessment, and the purpose of the final repository is cross-checked against the general rules of consideration in a special appendix to the applications. SKB also wishes to add that a detailed analysis of how man and the environment are protected in a long-term perspective is provided in the assessment of post-closure safety, SR-Site.

2.8 SKB has developed a variety of models for different types of calculations, some of which are of great importance for determining the impact on the environment and human health. Examples of this are MOUSE-SHE and the model for dispersal of radionuclides in the biosphere. It must be possible to examine these models in order to understand SKB's thinking and what parameters are included. The values incorporated by SKB in a particular model will naturally be evaluated when the application has been submitted, along with the conclusions drawn by SKB in using the model. However, with just over six months remaining before the applications are submitted, the basic concept of the models should be evaluated, quality-assured, possibly patented and open to examination. (Östhammar Municipality)

(SKB) Both the EIS and the assessment of post-closure safety (SR-Site) are central documents in the applications under both the Environmental Code and the Nuclear Activities Act. Both applications will be circulated for consideration by the environmental court and SSM, providing ample opportunity for review and comments on content, calculations and conclusions in the documents. SKB will naturally cooperate as requested with information and discussion of the background material for the applications during the licensing process.

2.9 It is urgent that the large number of reports that were not available at the time the preliminary EIS was published should be published as soon as possible so that they can be read and questions can be posed before the application is submitted. (Östhammar Municipality)

SKB believes that it is important to distinguish between consultations according to the Environmental Code and the review that is part of the licensing process. All reports that comprise supporting material to the applications were published when the applications were submitted. Both applications will be circulated for consideration by the environmental court and SSM, providing ample opportunity for review and comments on content, calculations and conclusions in the documents.

3 Common issues

No questions or viewpoints were expressed that were common issues for the interim storage facility, the encapsulation plant and the final repository for spent nuclear fuel.

Meeting with Swedish National Council for Nuclear Waste

Date	12 May 2010
Time	9:00–11:30 hrs
Place	SKB's offices in Stockholm
Target group	Swedish National Council for Nuclear Waste
Invitation	The meeting was initiated by SKB
Background material	Preliminary environmental impact statement (EIS), which deals with environmental aspects associated with construction and operation of the encapsulation plant and the final repository and transport to and from these facilities. The EIS contains descriptions of the impact, effects and consequences expected to occur. Measures planned to mitigate the consequences are also described. The material was prepared in the autumn of 2009 and reflects the state of knowledge at that time. The purpose of the preliminary EIS is to provide some idea of the overall environmental consequences and to allow viewpoints to be expressed on its arrangement, scope, contents and conclusions. The material was posted on SKB's website on 21 December 2010.
Present	Swedish National Council for Nuclear Waste: *Holmfridur Bjarnadottir, Torsten Carlsson, Tuija Hilding Rydevik* and *Eva Simic*. SKB: *Kerstin Blix, Saida Laârouchi Engström, Mikael Gontier, Olle Olsson, Pia Ottosson, Erik Setzman, Magnus Westerlind* and others.

1 Interim storage facility and encapsulation plant

1.1 The description the no action alternative needs to be supplemented with what happens when the pools in Clab and at the nuclear power plants are full. Do the nuclear power plants have to close then? Or what will the consequence be?

(SKB) We don't want to speculate in the EIS, we just report how much time we have.

1.2 What is the capacity of Clab?

(SKB) About 200 tonnes of spent nuclear fuel is brought there each year. In 2025 we will have to switch to compact storage canisters in all of Clab. This will increase its capacity by about 2,000 tonnes, which will be enough until 2035.

2 Final repository

2.1 Since the assessment of long-term safety is not included in the EIS, it is not possible to assess the long-term environmental consequences. The public and the environmental groups are entitled to have that information. The EIS has a democratic role, and the assessment of long-term safety should be included.

(SKB) The section in the EIS that deals with long-term safety will be more detailed in the final version of the EIS.

2.2 We would in particular like more information on the safety aspects of the selected site.

(SKB) The results of the preliminary safety assessment SR-Can indicated that Forsmark is a suitable site for the final repository. The results of SR-Site are expected to confirm this. The conclusions from SR-Can are included in the preliminary EIS. The conclusions from SR-Site will be included in the final EIS.

2.3 Where is the safety-related comparison between Forsmark and Laxemar needed for site selection?

(SKB) SR-Site will show that the site for which the applications apply – Forsmark – satisfies the requirements. In the appendix "Site selection", we argue in favour of this choice, and this appendix has a sub-appendix which contains a large number of safety assessment calculations for Laxemar as well.

2.4 Discussion of the contents of the EIS

(Swedish National Council for Nuclear Waste) It is important that the EIS does what the Environmental Code says it must do: enable an overall assessment to be made of the impact on human health and the environment. Scenarios involving accidents are lacking, and it is not clear what the environmental impact would be. This means that the material is not sufficient to enable an overall assessment to be made.

(SKB) The problem is in part pedagogical. The EIS is supposed to deal with significant environmental consequences. The results of SR-Site will show that accidents that can give rise to significant environmental consequences cannot occur. This is a prerequisite for the impact assessments in the EIS.

The purpose of the EIS is stated in the Environmental Code. There is nothing there about reporting the consequences of accidents or risks. But it is our judgement that risks, as well as long-term safety, should be included in the EIS. It is also a question of scope. How much should be said about long-term safety in view of the fact that it is a prerequisite if SKB is to submit the applications?

(Swedish National Council for Nuclear Waste) This is a question of interpretation.

(SKB) The work with the safety assessment is extremely complex and far-ranging. We cannot describe it in simple terms.

The assessment of long-term safety is important. The conclusions will be presented in the EIS. How can people believe in the conclusions? To do this it is necessary to closely examine the supporting material and the calculations.

The EIS describes "what if" scenarios.

(Swedish National Council for Nuclear Waste) What happened after the power increase in Ringhals is that the environmental court demanded a description of long-term safety.

2.5 The environmental impact of alternative methods should be included in the EIS. In particular the environmental impact of Deep Boreholes. Moreover, there should be a complete safety assessment for both Forsmark and Laxemar in order to explain the choice of site.

SKB has done calculations for both sites as a basis for site selection. SR-Site will show that the selected site is good enough. The regulatory authorities (formerly SKI and SSI) have said that it must be possible to compare the sites with respect to long-term safety, and that a complete safety assessment, SR-Site, for the selected site is sufficient.

Other methods will be described in the appendix "Choice of method". However, there is no reason to describe the environmental impact of methods that do not fulfil the purpose of the final repository or are not available. Nevertheless, there is a thorough description of the methods and reasons why they do not fulfil the purpose.

2.6 Does SR-Site only cover Forsmark? (Swedish National Council for Nuclear Waste)

(SKB) The complete safety assessment – which includes the reference scenario, the "what-if" scenario etc. – is only done for Forsmark. Safety assessment calculations for both Laxemar and Forsmark are presented in one of the sub-appendices to the site selection appendix, "Jasp – Jämförande analys av säkerhetsrelaterade platsegenskaper", ("Comparative assessment of safety-related site characteristics", in Swedish only). The calculations include the reference scenario.

2.7 How is the environmental impact for the two sites compared? It is important that they be compared fairly.

(SKB) The purpose of the safety assessment, including underlying documentation, is to show that the selected site satisfies the requirement on long-term safety, the risk criterion one in a million. In the site selection appendix, the sites are compared with respect to different factors of importance for long-term safety. The impact is compared in the form of risk of injury and by comparison of indicators such as number of damaged canisters.

2.8 How do you handle the risks associated with nearness to the nuclear power plant? What do you do if an accident occurs there. (Swedish National Council for Nuclear Waste)

(SKB) The question will be answered within the framework of SKB's replies to questions from the consultations. An overall description will be included in the EIS. In general it can be said that an accident in the nearby nuclear power plant would not entail any problems in the final repository, since no rapid processes occur there. We can interrupt the activity at the final repository for months or years without jeopardizing safety.

3 Common issues

3.1 Where will SKB report how viewpoints received have been dealt with? (Swedish National Council for Nuclear Waste)

(SKB) This will above all be done in the consultation report, which is a sub-appendix to the EIS. Central and frequent questions are summarized there with an explanation of what we have taken into account, what has not been acted on, and questions where we have changed our opinion.

Ever since the consultations started we have summarized the consultations annually in yearbooks. Questions and viewpoints received are included in them, along with SKB's replies and comments on them. The minutes from the consultation meetings contain all questions posed at the meetings and SKB's replies. The appendices to the minutes contain all questions and viewpoints received in writing, along with SKB's replies and comments.

3.2 It is important to see how a given question has influenced the process, and if it hasn't why not.

(SKB) SKB concurs.

3.3 It is important that all comments received are dealt with seriously. (Swedish National Council for Nuclear Waste)

(SKB) We deal with all questions seriously.

3.4 How do you respond to viewpoints received? You probably get both serious viewpoints and irrelevant questions.

(SKB) We try to answer each individual question and viewpoint.

3.5 Discussion of deposition in MLA

(SKB) Viewpoints were expressed at the consultations regarding deposition of low-level waste in MLA. This is above all OKG's question.

(Swedish National Council for Nuclear Waste) SKB also deposits waste in MLA.

(SKB) That is correct.

3.6 If it is the same people in a limited group that contribute similar viewpoints, the consultations can be regarded as unsuccessful. What have you done to counteract this?

(SKB) You could frame the question like this: Have we received enough viewpoints? Then the answer is yes. We have had many constructive meetings with the municipalities' working groups. The nearby resident meetings, for example in Misterhult, have given a lot. The dialogue with the regulatory authorities has been positive. The public consultation meetings have been dominated by the environmental organizations. This has also been pointed out by the municipalities, which have also asked many questions.

3.7 Can it be a disadvantage that the Government has dictated the direction of the RD&D process? The Government is not in any way bound to what has been said previously.

(SKB) I don't know if it's a disadvantage. Personally I view it as a support. The Riksdag gave us an order which we have executed, and we have had a number of cross-checks along the way.

3.8 The Government has approved the planning premises. They have not given the go-ahead to the solution.

(SKB) We have followed the planning premises. If the solution is good enough we cannot see any reason for not going forward. This way of working has anchored the programme. Whether or not it has been an advantage will be revealed when the Government makes its decision. Furthermore, the Government has done more than just approved the planning premises, they have also "put their foot down". In 1995, for example, they said that the detailed characterization has to undergo licensing because it is a step in the construction of the final repository.

3.9 They have permitted only one party to work with the matter, which could be dubious.

(SKB) That principle applies to all industry in Sweden. Take the pharmaceutical industry, for example. Whoever has a matter requiring approval submits a proposal.

3.10 Has the structure of the applications been changed recently?

(SKB) The change that has been made is that we will submit the entire safety analysis report to the environmental court for the sake of completeness.

3.11 How will the environmental court organize its work?

(SKB) We wonder about that too. We will try to meet the environmental courts to warn them that this application is on the way and ask them how they can handle it. Then we will choose which environmental court we will submit the application to.

3.12 Discussion: The Swedish National Council for Nuclear Waste noted that they are an independent organization with an advisory role to the Government. The Swedish National Council for Nuclear Waste is not bound by the legislation in the formal sense, but is free to express viewpoints.

(SKB) What do you mean when you say you aren't bound by the legislation?

(Swedish National Council for Nuclear Waste) We can have a different opinion than that embodied in the legislation.

We are inspired by the legislation, but we don't interpret it. We are not jurists.

(SKB) SKB has to comply with the law.

3.13 What percentage of the canisters will be defective? (Swedish National Council for Nuclear Waste)

(SKB) No canisters will be defective at deposition. The descriptions and explanations of how we achieve this were included in SR-Can and accepted by SKI and SSI.

3.14 What happens if you discover a canister is leaking during the operating phase? There is nothing about this in the EIS.

(SKB) Only leaktight canisters will be deposited.

3.15 Discussion of the contents of the EIS

(SKB) We cannot report all types of eventualities in the EIS.

(Swedish National Council for Nuclear Waste) Activities that calculate and assess risks are also expected to report risks. Reality may turn out to be different. The reader must feel secure with the material and get an indication of how the calculations have been done. Hearing SKB say they "assume that the repository is safe" doesn't make you feel secure.

(SKB) There is no doubt that we can make leaktight canisters and that they are leaktight when they are deposited. In the safety assessment we calculate what could happen by looking at different "what-if" scenarios, for example the consequences if a canister should fail at an early stage.

(Swedish National Council for Nuclear Waste) It's important that you describe this clearly in the EIS. It would make things easier for all parties.

(SKB) We will think about how we will present scenarios etc. in the EIS. We could possibly expand the section dealing with the safety assessment.

3.16 Descriptions of the environmental impact of decommissioning and dismantling are lacking. It needs to be described now, even if an EIS is required prior to licensing of these activities.

(SKB) What it says in the EIS, that an EIS is required for decommissioning, is a misunderstanding and will be taken out. We want to be able to make use of the technology development that occurs up to decommissioning. The environmental impact of decommissioning and dismantling is described at a general level. Describing the environmental impact in detail at this time is pure speculation.

3.17 You have to include something about the environmental impact of decommissioning and dismantling now.

(SKB) There are general descriptions in the EIS. But we do not want to start speculating about, for example, what types of engines or fuels will be used for

transport and what effects and consequences they will have. Decommissioning and dismantling will not take place for another 70 years.

We have discussed this with SLU and our lawyers and have arrived at the conclusion that our activity in this case is comparable to mining. There are no requirements there to describe the environmental impact of decommissioning in the EIS appended to the applications for operating licences. In these cases we are dealing with an activity that lies about 50 years in the future.

3.18 You have to look at all phases in the EIS, including decommissioning. It doesn't have to be detailed; a theoretical discussion is sufficient to provide credibility and provide a whole picture.

(SKB) There is some discussion of decommissioning in the EIS. Preliminary decommissioning plans for the final repository and Clink are included as appendices to the applications under the Nuclear Activities Act, and we use them to describe the environmental impact of decommissioning and dismantling on a general level.

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