# Comments from the Swedish Society for Nature Conservation, SSNC, and the Swedish NGO office for Nuclear Waste Review, MKG, on the industry's, SKB, research programme Fud-07

June 2009

MKG Report 4

mkg
Miljöorganisationernas kärnavfallsgranskning

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## About the Swedish NGO Office of Nuclear Waste Review (MKG)

The Swedish NGO Office of Nuclear Waste Review (Miljöorganisationernas kärnavfallsgranskning in Swedish), MKG, is a Swedish non-governmental environmental organization dedicated to the environmental aspects of nuclear waste management. MKG was founded in the autumn of 2004. Member organizations are the Swedish Society for Nature Conservation SSNC (SNF), Oss - a Public Opinion Group Dedicated to Safe Final Diposal of Radioactive Waste in Östhammar community, Nature and Youth Sweden (Fältbiologerna), the Swedish Society for Nature Conservation in the Uppsala county administrative province and the Swedish Society for Nature Conservation in the Kalmar county administrative province.

The work of the organisation is financed out of the Swedish Nuclear Waste Fund. MKG takes an active part in the ongoing public consultations related to the plans of the nuclear industry to construct a final repository for high-level nuclear waste. The objective of MKG is to promote the best long-term environmentally option for the management of the radioactive waste from the Swedish nuclear reactors.

Comments from the Swedish Society for Nature Conservation, SSNC, and the Swedish NGO office for Nuclear Waste Review, MKG, on the industry's, SKB, research programme Fud-07,
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Digital copies of the reports are available at www.mkg.se.

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## Preface

Every third year the Swedish Government has to approve the nuclear power industry's research program for handling of nuclear waste, the so-called Fud-decision. This decision is part of the legal control of the industry's work according to the Law of nuclear technology. The intention with the Fud-procedure is to provide opportunity for the Government to follow and direct the development in the field of nuclear waste disposal. The Government can in its decision formulate conditions for future work.

The nuclear power industry's company for management of nuclear waste, SKB, submitted its most recent plan for research (Fud-07) to the Swedish Nuclear Power Inspectorate (SKI) in the autumn of 2007. SKI was at that time the authority charged by the government with the responsibility to look after the society's interests in the field of nuclear waste*. SKI sent out Fud-07 programme for a broad review. The present document contains the common review by the Swedish Society's for Nature Conservation [Swedish: Naturskyddsföreningen] and the Swedish NGO Office's for Nuclear Waste Review [Swedish: Miljöorganisationernas kärnavfallsgranskning, MKG] on the industry's research programme and the official cover letter to SKI. The document also contains remarks made by MKG to the Government in October 2008 as the decision on the program was pending. Finally there is a brief general description of the Fud-procedure at the end of the document.

In their broad analysis of the Swedish nuclear waste programme the Swedish Society's for Nature Conservation and the Swedish NGO Office's for Nuclear Waste Review raise several problematic issues. The organisations argue for a major reform of the Swedish system for managing nuclear waste.

In November 2008 the government took its decision on the FUD-07 research programme. The decision was to approve the research programme under certain conditions. One of the conditions was that the nuclear waste company, SKB, had to send in more complete descriptions of alternative methods, including the use of very deep boreholes.

Linda Birkedal
Chairperson for MKGs board

Johan Swahn
Director of MKG

* In the summer of 2008 the SKI and SSI were merged into a new authority, the Swedish Radiation Safety Authority, SSM.

**Index**:

**Part A:**

Missive accompanying “Comments from the SNF and MKG on the industry’s (SKB) research programme Fud-07” available in Part B in this report.
2008-03-25

(2 pages)

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**Submission of the review by the Swedish Society for Nature Conservation and the Swedish NGO Office for Nuclear Waste Review of the Swedish nuclear power industry's nuclear waste company SKB's program for research and development ''Fud-program 2007''**

The Swedish Society for Nature Conservation (SSNC) [Swedish: Naturskyddsföreningen] and the Swedish NGO Office for Nuclear Waste Review (MKG) [Swedish: Miljöorganisationernas kärnavfallsgranskning] hereby present our review of the Swedish nuclear power industry's nuclear waste company SKB's program for research and development, "Fud-program 2007".

SSNC is a non-profit and party-politically independent organisation. The society is the largest environmental organisation in Sweden with its 178,000 members and its local and regional branches over the whole country.

MKG is a joint organisation for the Swedish Society for Nature Conservation, its regional branches in the counties of Kalmar and Uppsala, its youth section Fältbiologerna, and Opinionsgruppen för säker slutförvaring i Östhammar, Oss. MKG receives funding from the Swedish Nuclear Waste Fund for its work with reviewing the nuclear power industry's process to find a method and a place for final disposal of nuclear waste. More information about MKG's work can be found on the homepage http://www.mkg.se.

The present review is supported by the regional branches of The Swedish Society for Nature Conservation in Uppsala and Kalmar counties, its youth section Fältbiologerna, and Opinionsgruppen för säker slutförvaring i Östhammar (Oss), although Oss has in addition submitted its own report on FUD-07.

Kind regards,

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**Part B:**

Comments from the SNF and MKG on the industry's (SKB) research programme Fud-07
2008-03-25

(60 pages)

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# Comments from the Swedish Society for Nature Conservation and the Swedish NGO Office for Nuclear Waste Review on the industry's research programme Fud-07: Program for research, development and demonstration of methods for handling and final deposition of nuclear waste

In this document the Swedish Society for Nature Conservation (SSNC) [Swedish: Naturskyddsföreningen] and the Swedish NGO Office for Nuclear Waste Review (MKG) [Swedish: Miljöorganisationernas kärnavfallsgranskning] present common comments concerning the nuclear industry's nuclear waste company SKB's research and development programme, Fud-07.

## Summary

The Swedish Society for Nature Conservation and the Swedish NGO Office for Nuclear Waste Review recommends in response to Fud-07 that:

- The Government must in its forthcoming decision regarding the industry's 2007 research and development program set out requirements that are needed to bring order to the ongoing work on nuclear waste disposition
- The Government must assure an effective quality control of the industry's work
- The Government needs to review the industry's use of resources from the Swedish Nuclear Waste Fund and empower the Radiation Safety Authority to ensure their proper use

- The Government must make it clear that a permit to establish a final repository for high-level waste will not be given until sufficient evidence is available that supports the chosen method and chosen location, and that provide for guaranteed long-term safety
- The Government must instruct the Radiation Safety Authority to develop its own full and independent assessment tools and knowledge base to be able to review the industry's research and development work, with particular emphasis on weaker aspects of the industry's work
- The Government must expand the budget of the Radiation Safety Authority to enable the Authority to perform a thorough examination of the industry's forthcoming application to construct a repository
- The Government must ensure that currently outstanding issues and unsolved problems in the industry's research and development project are thoroughly investigated, and solutions arrived at, before permission to begin construction can be given
- The Government must see to it that work commences on drafting public policy that sets out the objectives and functions that a final repository shall fulfil
- The Government must make it clear that it will not be possible for the industry to neglect or avoid giving alternative methods serious consideration in its environmental impact statement (EIS).
- The Government should instruct the Radiation Safety Authority to develop its own independent assessment tools and knowledge base for its assessment of the industry's presentation, in the forthcoming application documents, of alternative methods for storing high-level nuclear waste
- The Government needs to make it clear that both long-term environmental safety and the security risks that are imposed by possible deliberate or speculative violation of the repository poses weigh heavily in any evaluation of the various alternative methods for storage of high-level nuclear waste
- The Government must ensure that the Radiation Safety Authority continues to develop its own independent assessment tools and knowledge base for its evaluation of an inland location of the repository with respect to long-term environmental safety
- The Government should alert the Radiation Safety Authority to the need to make sure that both collective radiation doses from diffuse sources and the impact of radiation on the entire eco-system are included in safety analyses
- The Government should make it clear to the industry, to local government and to other actors that long-term environmental safety is an overriding criterion that may not be compromised by hastening to a decision to establish a repository
- The Government should review and revise legislation in the area of radiation safety

- The Government should review and reorganize the administrative structure of social science research relating to nuclear waste management
- The Government should take measures to ensure that environmental organizations can receive funds out of the Swedish Nuclear Waste Fund also after 2008

## Table of Contents

## 1. Background

The nuclear power industry's company for management of nuclear waste, SKB, must every third year present a report of their ongoing research and development activities to the Nuclear Power Inspectorate, SKI. The most recent report in this series is "Fud-program 2007: Program for research, development and demonstration of methods for management and final storage of nuclear waste", commonly referred to as Fud-07. The document (dnr SKI 2007/1218) was submitted to SKI on 28 August 2007. SKI has circulated the document and solicited comments from a broad range of organizations and public authorities. After all the comments have been received, including those from the Swedish Radiation Protection Authority, SSI, the SKI will, in the summer of 2008, submit its evaluation of Fud-07 to the Government. The National Council for Nuclear Waste provide separate comments. A decision by the Government on Fud-07 is expected in December 2008 at the earliest.

This procedure is part of the legal control of the industry's work according to the Nuclear Technology Act (1983:4, 12§). After evaluation and circulation for comment the program shall be approved by the Government, which is a prerequisite for continued operation of Swedish nuclear power plants. This provision of the Act replaces a more stringent requirement under the so-called Stipulation Law (1977:140), whereby the industry was required to show how and where a totally safe final repository for irradiated nuclear fuel, or 'high-level waste', might be established. It should be noted that ever since the first Fud-report was submitted in 1986, they have always been approved by the Government.

Paragraph 12 of the Nuclear Technology Act contains the following provision:

> "In conjunction with the examination and evaluation [of the Fud-programs] such conditions as are deemed necessary with regard to the future progress of the research and development program may be set."

This provision is important because it is in principle the only legal possibility for the Government to intervene in the development of the nuclear waste storage program. Thus, the Government has an opportunity every third year to make demands of SKB regarding the conduct of the research and development program.

The Swedish Government has not made much use of the provision over the years. No conditions were imposed on the latest two programs, Fud-01 and Fud-04 (Ministry of the Environment, 2002-12-12, M2002/1287/Mk and M2002/2317/Mk, and Ministry of the Environment and Infrastructure 2005-12-01, M2005/3965/Mk). The most recent instance of Government 'steering' occurred in the decision on Fud-98 (Ministry of the Environment, 2000-01-24,

M1999/2152/Mk and M1999/3040/Mk), which set out the following conditions (our un-official translation):

> "The Swedish Nuclear Fuel and Waste Management Co (SKB) shall:
>
> • Expand its analysis of alternative system designs. Most importantly, the implications of a null alternative (a description of what would follow from the non-implementation of the planned measures) should be discussed. Furthermore, the alternative of deep boreholes (storage in boreholes several kilometres deep) should be discussed with special attention to the amount and content of research and development required to permit an assessment of the alternative on a par with the so-called KBS-3 method.
>
> • Disclose a complete assessment of the preliminary studies completed to date and other data and information pertinent to the selection of the sites for further investigation.
>
> • Disclose an explicit and specific program for the site investigations.
>
> The Swedish Nuclear Fuel and Waste Management Co shall produce the above-mentioned reports in consultation with concerned municipalities, county administrations and other authorities. These consultations shall be documented and reported [to the Government]."

It should be noted that these conditions were addressed solely to the industry. None of the conditions relates to other actors' roles in the work to draft a plan for environmentally acceptable management of Swedish nuclear waste, including those of regulatory authorities, primarily SSI and SKI. The conditions the Government set out in its decision on Fud-98 elicited a separate report from the industry, "Comprehensive report of the method, site selection and program for the site exploration phase," commonly referred to as 'Fud-K'. SKB also produced several reports, including one on the deep borehole alternative (SKB R-00-28) and a comparative system's analysis of different methods (SKB R-00-32).

On the basis of the industry's reports alone, the Nuclear Power Inspectorate, SKI, solicited comment, following which the SKI recommended (SKI rapport 01:20) that the Government, in its approval of Fud-K, make the following determination (our un-official translation):

> • SKB has described its selection of method considerably better than in Fud-98. This applies also to the null alternative in the form of continued intermediate storage in CLAB. Whereas the

discussion of the choice of method suffices to permit the start of site investigations, it will need to be updated in advance of future decisions.

- SKB has presented a good survey of possible approaches and the difficulties associated with deep boreholes, but deep boreholes are not a realistic alternative.

- SKB has presented an adequate basis for the selection of sites for a final waste repository.

- SKB should not exclude Hultsfred as a site alternative until issues concerning inflow/outflow [of groundwater] and the depth of saline groundwater has been further investigated.

That the Nuclear Power Inspectorate, SKI, reported to the Government without having made any independent analysis of its own means that it's recommendation to the Government may be called into question. SKI recommended that the Government should write off very deep boreholes as an alternative and approve the industry's plans for site investigations. This was done at a juncture when the Government had set conditions because of a concern that the industry had not shown due diligence with respect to long-term environmental safety in its work relating to both method and siting. This was not the first time that SKI sided so uncritically with the industry, a pattern that has continued to this day.

SKI is not the only authority to comment on the industry's research and development program. According to established procedure, the authority responsible for long-term radiological safety, the Swedish Radiation Protection Authority, SSI, submits comments to SKI before SKI submits its comments to the Government. In its comments to SKI regarding Fud-K (SSI 2001:12), SSI expressed a number of significant concerns that SKI chose not to pass on to the Government. They included the following points (our un-official translation):

- […] SSI sees no principal advantages in any of the various alternatives to KBS-3, with the exception of deep boreholes, which in SSI's view would appear to have potential as an alternative approach in accordance with the requirements of the Environmental Code.

- Therefore, the deep borehole alternative must, no later than when SKB applies for a permit to construct a repository, be supplemented with an analysis of the long-term safety and radiation protection aspects of the method.

- SSI has no objection to SKB's plans to include sites adjacent to nuclear power installations among the potential sites. At the same time, it remains unclear to SSI, how the industrial and

societal advantages of such a location have been weighed against the requirements of radiation protection in the short and long-term.

- In SSI's view, the assessed ability of a site to provide long-term protection should take priority in the site selection process. SSI should like to point out that SKB's safety report, "SR 97" documents major differences between sites in this regard, and in our view SKB cannot ignore such differences in the company's selection process.

- In SSI's view, if several localities present acceptable alternatives overall, the place that appears best equipped to fulfil the criteria for long-term safety should be included among the selected sites, even if it may not be as suitable in other respects (industrial localizations, societal advantages, etc.). It is not clear to the SSI whether this location is included among those that SKB has chosen for further site investigation.

- SSI notes that the role of factors in the biosphere for long-term safety has been given lower priority for the choice of site, and that this deviates from what SKB stated before starting the preliminary studies.

- SSI advises SKI to take note of the weaknesses in the argumentation supporting the selection of sites when evaluating the entire material, including the solicited comment, before SKI reaches a conclusion as to whether 'FUD-K' is ready to be presented to the Government for a decision. SSI does not rule out the possibility that SKB may need to give cause for, and possibly revise, its selection of sites.

SSI is clearly concerned that the industry is not sensitive enough to the requirements of long-term safety in its choice of method and site. However, SKI's report to the Government contains no mention of SSI's concerns.

SKI's blanket approval of the industry's reports, without having made any effort to examine the material with respect to alternative methods or sites, meant that the material on which the Government took its decision regarding Fud-K was not satisfactory. The decision by the Government followed SKI's recommendations concerning the site selection process; no account was taken of SSI's concerns about long-term safety. The Government did not, however, fully accept SKI's recommendations concerning the choice of method. Unlike the SKI, the Government had the requirements of Sweden's then-new Environmental Code (2000:61) in mind. The Governments decision (dnr M2001/2840/Mk, M2001/2750/Mk and M2001/1469/Mk) contains the following observations (our un-official translation):

> "The Government shares the Nuclear Power Inspectorate's view that the account of the method selection process has improved substantially compared to the account offered in FUD-program 98. The discussion lends further support to the Government's judgment (cf. Government decision of 24 January 2000) that some form of repository in bedrock is the most appropriate strategy for final storage of nuclear fuel [waste]."
>
> "The Government calls attention to earlier observations, most recently in the Government decision of 24 January 2000, that the company should, within the framework of the Fud-programs, continue to monitor technological developments concerning alternatives for the management of nuclear waste. Furthermore, the Government calls attention to the requirements concerning a discussion of alternatives in conjunction with environmental impact statements, as set out in Ch 6, para 7:4 of the Environmental Code. According to Ch 6, para 5 of the Code, the applicant shall consult the county administration and other government authorities, the municipalities, the citizens and organizations that are likely to be affected. The Government presumes that the question of which alternatives should be included in the environmental impact statement will be discussed in detail in conjunction with the prescribed consultations."

This Government decision neither affirms nor rejects the deep borehole alternative, but instead stresses the requirement that vetting according to the Environmental Code requires an assessment of alternative methods. Another aspect not addressed in the Government decision is how the Environmental Court may be expected to have a basis on which to evaluate the industry's presentation of alternatives, if the Nuclear Power Inspectorate is unwilling to do or to commission its own evaluations of central issues pertaining to choice of method (these include long-term safety, the feasibility of executing the plan safely, long-term physical security, and costs). The Government decision on Fud-01 simply repeats the reminder about the requirements of an environmental impact assessment under the Environmental Code. In its decision on Fud-04, however, the Government expresses a greater degree of concern (our un-official translation):

> " As the Government has pointed out on previous occasions, most recently in the Government decision of 12 December 2002, SKB should, within the framework of the Fud-programs, continue to monitor technological developments with regard to different alternatives for the management of nuclear waste. In their comments, SKI and SSI point out that SKB should expand the discussion of alternative methods before the project is examined [by the Environmental Court] under the

> Environmental Code. A comparison with the KBS-3 method should be made using safety analysis methodology. The Government shares that opinion."

The Government makes no mention of long-term safety in relation to the choice of site in the decisions on SKB's research programs as outlined in Fud-01 and Fud-04. One reason for this may be that SKI has consistently refrained from forwarding SSI's above-noted concerns about the low priority accorded long-term radiological safety in the localization process. This is not to say that the Government has not been concerned about diligence in the choice of site. As stated in the Government decision on Fud-K in 2001:

> "The Government has on repeated occasions stated that applications for permits to establish a final repository for irradiated nuclear fuel and nuclear waste should contain information that allows comparative assessments that show that preliminary studies of 5-10 localities in the country and full-scale inventories of at least two potential sites have been undertaken – and the reasons why these localities were selected. This view was stated first in the Government decision of May 15th, 1995 (dnr M93/1228/5) and was repeated in the Government decisions of December 19th, 1996 (dnr M96/2291/5) and 24 January 2000 (dnr M1999/2152/Mk). That alternative locations should be assessed is also a requirement set out in the section of the Environmental Code that specifies what an environmental impact statement shall contain."

In recent years the question of an inland localization, e.g., in Hultsfred, has once again been raised in recognition of the long-term safety advantages of macro-regional patterns of groundwater mobility further inland. The industry has neglected the alternative, but the authorities, SSI and SKI, have not been content with the industry on this score. At present, however, the authorities have once again remitted the question to the industry, rather than exploring the alternative in studies of their own.

The Swedish Society for Nature Connservation (SSNC) and the Swedish NGO Office for Nuclear Waste Review (MKG) will in the following pages demonstrate that the material regarding alternative methods and sites presented by the industry in a succession of Fud-reports and in consultations up to the present date is lacking in vital respects. Furthermore, we are seriously concerned fear that the information and data the industry is producing in support of the long-term safety of their own method, KBS-3, will be deficient. In view of the fact that the industry is under considerable pressure to obtain a permit to construct a final repository, the risk is eminent that shortcuts will be sought and embarrassing issues avoided. In our view, an important issue that the Government and authorities should consider now, as they review the industry's research and development work, past and planned,

is how the authorities can establish the benchmarks they will need to be able to assess the industry's application. On past occasions the lack of such independently arrived-at standards has impaired the quality of SKI's reports to the Government, so that the Government has not had a full basis for their decisions on Fud. The SSNC and MKG therefore urge the Government to require of the authorities that they, to a greater extent than they have to date, undertake to gather or produce independent assessments and data, including aspects neglected by the industry.

The Nuclear Technology Act (1984:4, paras 10-11) gives the industry total responsibility for the safe management and storage of the nuclear waste produced in its power reactors. The industry is also responsible for the all-round research and experimentation required to achieve this. But the law says nothing about what to do, should the industry shirk its responsibilities or limit the scope of the research and development effort. This lacuna has left the authorities without legal grounds to intervene when they see shortcomings other than to ask the industry to try to do better. When this has proven futile, the authorities have had no legal authority to do anything until the industry applies for a permit to construct a final repository.

In our view, the authorities should have an overall responsibility to see to it that the management of nuclear waste is not left exclusively in the hands of the industry. Using funds from the Nuclear Waste Fund, the authorities should reasonably be able to do much more than examine the industry's reports. The authorities need to develop their own knowledge so as to be able to evaluate the application and accompanying EIS, even in areas that the industry has neglected to follow up in the research and development program. The industry has so much at stake that it is not reasonable to assume that SKB would go out of its way to raise issues and investigate areas that might threaten the industry's interests. This also applies to issues crucial to the long-term safety of a final repository for irradiated nuclear fuel. The law allows the authorities to use funds from the Nuclear Waste Fund for this purpose; the Nuclear Waste Financing Act (2006:647, 4§) provides for payments out of the Fund to cover such research and development as government agencies may need to do or commission so as to be able to examine the nuclear industry's efforts regarding management and storage of nuclear waste. The SSNC and MKG see no constraints in the law as to what the authorities may choose to study or the resources they may need for that purpose. It is not a question of assuming the industry's responsibility, but rather a question of ensuring that the industry actually shoulders its responsibility and fully complies with the law. Experiences of the present process indicates that it is very important that the Government make it clear to the authorities that the scope of their responsibility is greater than merely reacting to what the industry does.

The SSNC and MKG will in the following pages show that the Swedish undertaking to manage and store nuclear waste has serious flaws. In our view, the nuclear industry has not fulfilled all the requirements concerning measures

and all-round research and development activity required by the law. It is therefore important that the Government attaches conditions to its decision on the Fud-07 program. It is important, moreover, that these conditions do not focus to the work of the industry alone, but also clarify the roles and responsibilities of the new Swedish Radiation Safety Authority, the National Council for Nuclear Waste, and possibly other actors, as well. In our view, the situation demands forceful remedial measures on the part of the Government. Otherwise, there is overhanging risk that the Swedish program to manage nuclear waste will not be safe.

Few of the issues that the SSNC and MKG highlight in this document are new. They have been raised by the environmental movement, by other organizations that have filed solicited comment and, to some extent by governmental authorities. The Government has had access to this material, but neither the Nuclear Power Inspectorate (SKI) nor the National Council for Nuclear Waste (previously KASAM) has taken it upon themselves to call the Government's attention to them. Having done so would have facilitated the Government's statement of the requirements needed to bring the Swedish nuclear waste management program to an acceptable level according to the goals of the Environmental Code. We urge SKI and the National Council for Nuclear Waste, insofar as they agree with the points made in these pages, wholly or in part, disclose them to the Government into their own comments. It would help the Government to formulate its requirements for a decision on Fud-07.

SSI files comments on the research and development program with SKI. The SSNC and MKG urge SSI and SKI to coordinate their examinations of the Fud-07 report so that the new Radiation Safety Authority, as of its inauguration on 1 July 2008, will be well-equipped to inform the Governments decision on the research and development program.

The new Radiation Safety Authority has good prospects of correcting the situation. It is vital that the Government enable the Authority to start its work to remedy the shortcomings in the Swedish waste management system. Only then can future research and development efforts succeed in producing a system that affords the best possible nuclear waste management with respect to the environment and public health.

Miljöorganisationernas kärnavfallsgranskning, MKG, a non-profit organization of which the Swedish Society for Nature Conservation, SSNC, is the largest member, was created in 2004. When in 2005 civil society organizations were able to apply for funding from the Nuclear Waste Fund, MKG applied and has received support since then. One of the first projects MKG undertook was to comment on the preceding research and development report, Fud-04. We find that virtually none of the points we made in those comments have been addressed in a satisfactory manner, neither by the Government, the authorities, nor by the nuclear industry.

A thorough reading of all the comments given by the environmental movement since the early 1980's reveals that the issues raised have not been addressed sufficiently to ensure safety in the long-term. It is quite apparent that neither SKI nor the National Council for Nuclear Waste, formerly KASAM, has forwarded the environmental movement's comments to previous Governments in any satisfactory manner, which in effect has deprived successive Governments of the awareness they needed to act in a timely fashion. Considering the goal of achieving a nuclear waste repository that fulfils criteria of long-term safety, both for the environment and for public health, these comments should have been treated far more seriously.

Presently, the environmental organizations have had resources with which to reinforce their competence and to study the progress of the final repository project in greater detail for another three years. MKG has participated in the consultations and has become an active part in the process for a Swedish nuclear waste repository. As a consequence the SSNC and MKG have a good grasp of the current status of the project and its strengths and weaknesses. Furthermore have the other actors in past three years acquired a better understanding of the nature and significance of the issues raised by the environmental movement over the years. In this context we mention that the changes in the composition and operations of the National Council for Nuclear Waste in recent years have afforded greater opportunities for discussion.

Over these past few years, we have come to the conclusion that the situation in Sweden regarding final storage of nuclear waste is far from good. There are serious deficiencies that need to be rectified, both in the processes and in the system per se, that should have been attended to long ago and that now present serious problems. There are also fundamental uncertainties about the objectives of the Swedish nuclear waste repository program as well as about what the nuclear industry is planning to do. The criteria applied in selecting both method and site are unclear and ill-defined. Finally, it has become increasingly apparent that the industry's method-of-choice may not provide safe long-term storage and that the underlying factors have not been addressed in the research and development program to date.

Thus, the Government and the new Radiation Safety Authority have very good reason to seize this opportunity to reform Swedish nuclear waste program such that better oversight and influence on the part of authorities and other actors outside the nuclear industry itself can be achieved. The storage of nuclear waste is a matter that will concern future generations for hundreds of thousands of years. It is incumbent that the present generation ensures that it will not burden those many generations. The present development indicates a large risk for placing a substantial burden upon future generations.

The gravity of the situation has led us to take the liberty to comment not only on the industry's research and development program, but on the entire ongoing process. In our view, it is the responsibility of the Government to take

the issues relating to nuclear waste management and its long-term safety very seriously, and to act promptly in order to issue clear directives to other actors in the process. The new Radiation Safety Authority and the National Council for Nuclear Waste are central actors, but a very clear expression of political will to change on the part of the Government is required in order to effect change. Consequently, we address a good share of our comments directly to the Government.

## 2. Observations and recommendations to the Government

In the Introduction and in Section 3 we discuss some of the problems in the Swedish system for managing high-level nuclear waste. In the present section we elaborate our views and recommend a number of specific measures that the Government should include as conditions in its decision on the Fud 07 research and development program.

### *2.1 The Government must in its forthcoming decision regarding the industry's 2007 research and development program set out requirements that are needed to bring order to the ongoing work on nuclear waste disposition*

Every three years the Government takes a decision on the ongoing research and development effort of the Swedish nuclear industry. These decisions constitute the Government's primary opportunity to steer the further course of Swedish nuclear waste management. The Government formulated conditions or requirements in conjunction with such a decision most recently in 2000 with regard to Fud-98. The Government has taken three decisions since then (including the approval of Fud-K, a supplement to Fud-98), but without stating any conditions.

In the following the SSNC and MKG show that there is urgent need for the government to intervene in the industry's research and development program. The industry does not fulfil the requirement of the Nuclear Technology Act to undertake the full spectrum of research that is needed to ensure the safety of handling and final storage of nuclear waste. The Government must intervene and set the conditions required to redress these breaches when it takes its decision on Fud-07. Experience indicates that the Government should not address the industry alone. The industry conscientiously avoids seeking knowledge that does not serve its interests. Consequently, Government agencies need to undertake a research and development program of their own. The Nuclear Waste Financing Act provides for agency use of the Swedish Nuclear Waste Fund for this purpose. In the statutes of the new Radiation Safety Authority the Government should specify a responsibility to undertake such research as is necessary to enable the agency to perform a thorough and comprehensive vetting of the industry's application for permission to construct a final repository for nuclear fuel waste.

### *2.2 The Government must assure an effective quality control of the industry's work*

The SSNC and MKG show in these comments that the industry's research and development work evades potential problems. The industry publishes very little of its research in scientific journals, which would allow examination of its work on the part of others in the scientific community. Moreover, in most of the branches of science and technology that relate to nuclear waste management the industry has a monopoly on research financing; in effect, researchers and consultants who work for the industry have become entirely dependent on the industry. Such dependency implies a risk that not all aspects of the task will be studied and that problems are not examined in the ways and to the extent that they should be in order to assure the excellence of the final result. A related problem is that the results of experiments conducted at the laboratory at Äspö are neither published nor otherwise accessible to public scrutiny, despite the fact that the research is supported by public means through the Nuclear Waste Fund. In sum, there are serious weaknesses in the quality assurance of the industry's work to date, and one cannot rule out the possibility that the industry out of self-interest is withholding problematic findings.

The Nuclear Power Inspectorate, SKI, has commenced study of how the industry's research and development program might be quality assured. This comes at a far too late stage in the process. The industry has become accustomed to merely passive reception of their results, and they are not subjected to independent scientific examination or to critical assessment on the part of the SKI. It is imperative that the Government in its decision on Fud-07 requires full transparency and openness concerning the findings of publicly funded research in order to make it possible to assure the quality of the research and development program.

### *2.3 The Government needs to review the industry's use of resources from the Swedish Nuclear Waste Fund and empower the Radiation Safety Authority to ensure their proper use*

The SSNC and MKG would like to call the Government's attention to the lack of guidelines that specify and limit how the industry may use money from the Nuclear Waste Fund. The industry regards the funds as its own and, judging from the record to date, the Nuclear Power Inspectorate would appear to concur.

There is no real external audit or examination of the industry's use of funds from the Nuclear Waste Fund. The fund consists of accrued payments by users of nuclear-generated electricity. The payments are obligatory, and, therefore, for all practical purposes the funds are equivalent to public means. The only report the industry submits to the Nuclear Power Inspectorate is an estimate of the amount of money it expects to use in the future – information

used to calculate the amount of the surcharge to users – and how much it has used since the last disbursement.

The laxity of this arrangement has led to a situation where the industry does not use the funds efficiently. For example, the industry in its most recent report (PLAN 2007) indicated that its subsidiary for the waste repository project, SKB AB, would use SEK 245 million of a total 1 567 million for administration, which represents 20 percent of the total amount drawn on the Fund. This item has risen from about 15 percent of the total at the start of this decade, whereas costs for research and development have remained unchanged at a bit under 30 percent of expenditures.

Without oversight, the industry has no incentive to manage the money from the Nuclear Waste Fund in an appropriate manner with regard to societal interests. Only recently have authorities begun to take an interest in how the industry uses resources from the Fund. The Government should deliberate what measures are necessary to come to grips with the problem, and whether it can be resolved in the context of the Government decision on the industry's research and development program, Fud-07.

The industry spends a good amount of money on resources to "develop and further secure public confidence in the [nuclear fuel waste] program", i.e., in its own KBS-system (SKB Operations plan 2008-2011, SKI dnr 2007/1931). In the course of the consultations MKG has asked the industry how much money they allocate to information and public relations. The industry replied that they use about 1 per cent of the company's turnover – SEK 1.2 million per annum – for "exhibits, information meetings, publications, web, events open to all actors, press relations, internal information and other information activities". The total budget for the work surrounding the environmental impact statement and public relations for 2008 totals SEK 50.7 million, a figure that includes industry-commissioned social science research. It remains unclear whether this item includes the extensive information activities at the final repository for low- and medium level waste, SFR (at Forsmark) and the Äspö laboratory. Whichever the case, the industry subsidiary, SKB AB, has a considerable number of information officers who work full-time with external information. The industry furthermore uses consultants to help them lobby political decision-makers. The lax requirements regarding accounting make it next to impossible for outside observers to know how much the industry spends to bolster public confidence in the KBS project.

The Nuclear Waste Financing Act (2006:647 4§) permits the industry to draw funds from the Nuclear Waste Fund for the purpose of public information concerning the management and final storage of irradiated nuclear fuel and other nuclear waste. Be that as it may, use of such large sums of public money to one-sidedly argue a controversial method for final storage of nuclear fuel waste should be called into question.

*2.4 The Government must make it clear that a permit to establish a final repository for high-level waste will not be given until sufficient evidence is available that supports the chosen method and chosen location, and that provide for guaranteed long-term safety*

An examination of the research plan outlined in Fud-07 reveals many issues of importance to 'SR-Site' (the safety analysis that will form a part of the industry's application for a permit to build a final repository) that will not have been penetrated before the application is submitted. Some of the issues, treated to some extent in Part III of Fud-07 need to be resolved in order to be able to construct a safe final repository and to fill it and seal it safely. Even more important in this regard are issues relating to long-term safety, treated in Part IV (entitled "Safety analysis and research in the natural sciences")

One crucial question is how much of the research and development work that is fundamental to the long-term safety of a repository can be left undone until after the application is submitted. In our view, many uncertainties remain that have bearing on long-term safety, some of which are critical, and it would appear to take many years of further research to resolve them. But they must be resolved before the question of giving a permit can be considered. The recent comments from the regulatory authorities on the most recent safety report, SR-Can, second this assessment. The new Radiation Safety Authority must keep these issues under close scrutiny and alert the Government to any gaps in the knowledge needed to guarantee the long-term environmental safety of a repository of the kind the industry intends to build.

Government approval of an application to build is an ultimate decision; in practice it may be impossible to modify or rescind. The SSNC and MKG therefore urge all parties – the industry, the authorities, and the Government – to accord factors relating to long-term environmental safety great importance in the process of choosing the storage method and selecting the site.

Both the Nuclear Technology Act and the Environmental Code (chapter 17, 1§) invest the Government with ultimate responsibility when it comes to giving a permit to the industry to begin constructing a final repository for nuclear fuel waste. As a consequence, both the Radiation Safety Authority and the regional Environmental Court, respectively, will submit comments to the Government prior to the decision. The Government, however, is not bound by the advice of either institution, but the law empowers it to grant a permit against their recommendations.

We, the SSNC and MKG, are of the opinion that the Government should not contradict the Authority or the Court if either, or both, have doubts about the acceptability of the environmental impacts of the project. The Government should consider stating, as a matter of principle, that long-term environmental safety must be the decisive factor in connection with the authorization to build a final repository, even if such a declaration may limit Government discretion in

this matter. This is important, both for public confidence in the project and for the municipalities, who can then rest assured that the Government has long-term environmental safety in their community utmost in mind.

Our concern is not merely hypothetical. In the matter of giving a permit for an increase in thermal effect at Swedish reactors Ringhals and Oskarshamn (two separate court cases), the Government decided to grant the application and thereby override the findings of the courts in Vänersborg and Växjö, respectively, which had rejected the applications because of the anticipated environmental impacts.

In this connection we should mention that the industry has repeatedly assured participants in the EIS consultations that the Government will not use the option provided in the Environmental Code (chapter 17 6§) to override municipal governments' traditional right of veto when it comes to siting the final repository for nuclear fuel waste. Should the Government choose to override doubts or concerns on the part of either the Authority or the Court and give a permit, there is a substantial risk that no municipality will voluntarily accept the project, in which case the Government would have to set aside the municipalities' right of veto to make it possible for the project to proceed.

### *2.5 The Government must instruct the Radiation Safety Authority to develop its own full and independent assessment tools and knowledge base to be able to review the industry's research and development work, with particular emphasis on weaker aspects of the industry's work*

The public institution that is responsible for examining the nuclear industry's application to build a final repository for nuclear fuel waste is the Radiation Safety Authority. It is crucially important that the Authority have a solid basis for evaluating the application that is independent of the information and data provided by the applicant. The application will be assessed with reference to both the Nuclear Technology Act and the Radiation Protection Act, which have been amended to harmonize with the provisions of the 'general rules of consideration' in the Environmental Code. The Environmental Court will therefore accord the findings of the Radiation Safety Authority great importance.

The Nuclear Power Inspectorate, SKI, has so far refrained from taking any initiatives of its own to investigate issues raised by third parties, i.e., groups or institutions outside the industry. Rather than looking into questions that the industry might find inconvenient or embarrassing to have examined, SKI has abstained, explaining that responsibility for the research in question rests with the industry. The Radiation Protection Authority, SSI, has had a somewhat higher level of ambition and has started its own investigations of certain issues where they have found the industry's research and development program lacking. But SSI's resources have been limited, and when SSI has sought supplementary allocations to finance such studies, SKI has opposed the idea.

SKI's actions have meant that the industry has been entrusted with the task of investigating questions that it does not want to look into. Meanwhile, SKI has failed to build up the degree of competence that is required for the authority to be able to recognize and evaluate shortfalls and weaknesses in the industry's research and development effort.

The Government must demand the Radiation Safety Authority to develop a solid, independent basis on which to examine the industry's research and development program, with particular attention to the gaps in the industry's research program to date. This does not imply an assumption of the industry's responsibility; it is simply a question of ensuring that the Authority has an adequate basis on which to evaluate the industry's application.

*2.6 The Government must expand the budget of the Radiation Safety Authority to enable the Authority to perform a thorough examination of the industry's forthcoming application to construct a repository*

It is incumbent on the Government to instruct the new Radiation Safety Authority and provide the necessary resources for it to obtain independent facts and data that will enable the Authority to perform a thorough examination. The Nuclear Waste Financing Act (chapter 4, 4§) provides for such research. Funds for this purpose may be drawn from the Nuclear Waste Fund; there is no need for appropriations from the budget. Since the Government is also able to adjust the amount of the surcharge on use of nuclear-generated electricity to finance nuclear waste management, any additional revenue that may be required to enable government institutions to perform their duties in examining the nuclear waste repository may be raised from that source. We should like to point out in this connection that the industry – often seconded by SKI, as well – has contended that the money in the Nuclear Waste Fund is theirs and that they may use it as they please. This is not so. The money held in the Fund is the accumulated revenue from a politically imposed, obligatory surcharge paid by users of nuclear-generated electricity. As such, it is to be equated with public funds, which are to be used at the Government's discretion to ensure that nuclear waste is managed and stored in the safest and environmentally most acceptable way.

*2.7 The Government must ensure that currently outstanding issues and unsolved problems in the industry's research and development project are thoroughly investigated, and solutions arrived at, before permission to begin construction can be given*

The research plans outlined in the Fud-07 report put heavy emphasis on the technical know-how surrounding the construction of the final repository, the design of the encapsulation facility, the isolation of fuel waste in copper canisters, the deposition of canisters in holes and filling the repository with bentonite clay. In this part of the report (Part III. Technical development within the nuclear waste program), the industry gives the impression that it for all

practical purposes is ready to start constructing a final repository. Whatever knowledge is lacking will be acquired in the construction process, the report assures us.

This is fully in keeping with the industry's focus in recent years. The industry has made a big point of the ability to manufacture copper canisters with welded seams, and of the new bentonite laboratory that will provide vital guidance to the filling process. We gauge that the industry may succeed to practically implement these subtasks. The important thing, however, is not whether a repository of the KBS-3 design will be technically feasible, but whether a KBS-3 repository will meet the requirements of long-term safety that a repository for nuclear fuel waste must fulfil.

A close reading of the part of Fud-07 that treats long-term safety (Part IV. Safety analysis and research in the natural sciences) reveals that the industry is far from ready; a great deal of uncertainty on key issues remains — as the report, to its credit, admits. The knowledge needed to model key processes in the long-term remains limited.

Worse, the research plans outlined in the Fud report will not result in a reasonable level of knowledge before the next safety analysis (SR-Site) is to be completed in conjunction with the application for permission to build. This is because knowledge of how the artificial barriers will perform in reality is dependent on longitudinal experiments under realistic conditions. The industry has been far too late in attending to this aspect. The laboratory at Äspö was inaugurated in 1995, yet only in 2001 did full-scale experiments get under way. Because of the late start and problems encountered in the experiments, the industry has not made much progress in verifying its models empirically under realistic conditions.

Our examination of Fud-07 leads us to conclude that the industry still has far to go before it can demonstrate that the KBS-3 method carried out at either of the candidate sites fulfils criteria that would ensure long-term environmental safety. There is a risk that the industry may be tempted to fill the safety analysis model, over which it has total control, with data and assumptions that have little proven basis in reality. If that were to happen, the model might very well produce diagrams, etc., that indicate fulfilment of the criteria of long-term safety, but which have not been confirmed under realistic conditions.

In their comments on the industry's most recent safety analysis report, SR-Can, the authorities pointed out a number of areas where the safety analysis needs to be amended. Taking these comments as their point of departure, SSI and SKI and the new Radiation Safety Authority should, in their comments on Fud-07 and later, clearly specify the areas where the industry needs to do more before the application is submitted.

The SSNC and MKG would like to draw the Government's and the authorities' attention to several areas that may require considerable involvement on the part of the authorities and detailed assessment of the quality of the industry's work, namely:

- a study of copper corrosion
- a study of microbial activity and barrier functions
- a study of the performance of bentonite clay after the repository has been sealed and capped; and
- a study of the extreme tectonic pressures in the formation at the Forsmark site and an estimation of the risk for a total breakdown of the repository

In the opinion of the SSNC and MKG, the Government should make it clear to the industry that authorization to build a final repository will not be forthcoming until all important issues relating to long-term safety have been clarified and resolved.

*2.8 The Government must see to it that work commences on drafting public policy that sets out the objectives and functions that a final repository shall fulfil*

The SSNC and MKG have long pointed out the lack of consensus in Swedish society concerning the long-term objectives that should guide the management of nuclear fuel waste. This lack of consensus makes it impossible to assess the ability of different approaches to fuel waste storage to fulfil the requirements that would ensure long-term safety with respect to the environment and human health. The industry plans to apply for authorization to construct a final repository according to the so-called KBS-3 method. Unless clear-cut objectives are formulated, either by the Government or by the Parliament, the Environmental Courts, regulatory authorities and, ultimately, the Government will find it very difficult to determine whether or not the industry's proposal is acceptable. Nor will it be possible to determine whether other methods for the long-term management of nuclear fuel waste might better fulfil the objectives. Examples of alternative methods that have been proposed include deposition in deep boreholes, guarded storage in dry intermediate storage vaults, and transmutation.

Among the questions that need to be discussed and decided at the highest level of political responsibility, with the advice of the Radiation Safety Authority, the National Council on Nuclear Waste and other actors are:

- What level of long-term environmental safety should be striven for?
- Should the long-term safety of a final repository be based on artificial or natural barriers?
- How difficult should it be for thieves or terrorists to penetrate the barriers and reach the waste, considering long-term risks for nuclear proliferation?

- What degree of retrievability should the repository afford in various phases of storage, in view of the risks and opportunities associated with retrievability?
- What requirements regarding long-term supervision of the repository are acceptable?
- What knowledge concerning future energy sources should be awaited before a decision on the final repository is taken?

The Government should, in conjunction with the Government decision on the Fud-07 research and development program, initiate a political process to ensure that the overall objectives that a final repository for nuclear fuel waste should fulfil are clear to both authorities and the environmental courts before they are presented with an application from the industry to build a final repository.

*2.9 The Government must make it clear that it will not be possible for the industry to neglect or avoid giving alternative methods serious consideration in its environmental impact statement (EIS)*

In the Fud-07 report the industry refers to its work to develop a variant of the KBS-3 method with horizontal deposition of canisters as an “alternative design”. This is the phraseology used in the Environmental Code (ch 6 sect 4) in a specification of the obligatory contents of an EIS document. At the same time, the industry terms the methods that all other actors consider alternative methods (transmutation, long-term intermediate storage and storage in deep boreholes) “other methods”.

The Government, county administrations and regulatory authorities have long referred to these latter methods as “alternative methods”. This, the phraseology used in Swedish environmental law, was also used consistently in the two seminars arranged by the National Council on Nuclear Waste in 2006.

The industry’s idiosyncratic use of the term “alternative” in its Fud-plans seems to reflect a tactic on the part of the industry as the courts’ examination draws nigh. On previous occasions, the industry has stated that it does not intend to describe alternative methods such as deep boreholes, transmutation and long-term intermediate storage in the application, but in a separate appendix to the application.

In August 2006, the county administration in Uppsala County [in which Forsmark is located] reacted sharply (dnr 559-6890-06, 2006-08-29) to the industry’s attempt to evade the requirement of thorough descriptions of alternative methods in accordance with the Environmental Code, stating that they have (our un-official translation) “pointed out that the account of alternatives in the EIS should treat all possible alternative localizations and designs that are, or have been brought up in the course of the EIS consultation process or in the research and development effort”. The regulatory authorities

and, to some extent the municipalities, too, have been critical of the industry's manner of treating alternative methods.

The SSNC and MKG urge the Government to make it unmistakably clear to the industry that such attempts to truncate the discussion of alternative methods in the EIS are unacceptable. We should also direct the Government's attention to the fact that the industry, according to its plan of action for 2008-2011 (SKI dnr 2007:1931), is considering spending an additional SEK 130 million (in addition, that is, to the amount already spent) on developing the horizontal deposition concept, in order to "bring this variant up to the same level as the reference design". It cannot be ruled out that the industry is committing these funds solely for the purpose of enhancing its credibility in the eyes of the Environmental Court. Meanwhile, the industry has been totally unwilling to commit any money whatsoever into determining the long-term safety of the deep borehole alternative, where an investment of some SEK 150-200 million is believed to be enough to achieve a decisive result.

*2.10 The Government should instruct the Radiation Safety Authority to develop its own independent assessment tools and knowledge base for its assessment of the industry's presentation, in the forthcoming application documents, of alternative methods for storing high-level nuclear waste*

In our view, more research on a considerably broader front is needed to produce an adequate basis for the examination of the industry's proposed choice of method for final storage of nuclear fuel waste that the authorities, the Environmental Courts and the Government are expected to undertake.

The SSNC raised the possibility that deep boreholes might provide better long-term safety – both for the environment and vis-à-vis the risk of nuclear proliferation – than the industry's method of choice some sixteen years ago in its comment on Fud-92. The deep borehole alternative aroused some attention in the late 1980s when the industry made an initial survey of the alternatives to its own KBS concept. The Radiation Protection Authority, SSI, too, broached the deep borehole alternative in its comment on Fud-92 and in a separate letter to the Government (SSI dnr 8200/1813/92). Since then, the environmental movement has continuously called for more serious consideration of the alternative.

Already in the research plans set out in Fud-92, and in the closely related so-called PASS Project, the industry made a first attempt to dismiss the deep borehole alternative as far inferior to its own method. Since then, and up to the present day, the industry has taken measures to avoid that this alternative be further explored, in part by performing evaluations that attempt to discredit deep boreholes as an option. In its plan of action with Fud-07 for 2008-2011 SKB AB writes (SKI dnr 2007/1931, our un-official translation):

> "One goal is that the [KBS] program is approved in its present state without demands for extensive additional work on, for example, the deep borehole alternative."

Thus, there is very little likelihood – as little today as in the past – that the industry will make any serious effort to explore the feasibility of deep boreholes as a storage option or to assess its merits with respect to long-term environmental safety. As we have seen, the industry makes no secret of its intention *not* to make any such efforts. In the meantime SKB is expending a good deal of energy on a discussion of alternatives to be included in the EIS, with the express intent of making the deep borehole alternative appear unrealistic and unsafe.

The SSNC and MKG argue that it is unrealistic to expect the industry to do a proper job of producing the basis for a fair evaluation of the feasibility and long-term safety of the deep borehole alternative. Recent technological developments in the area of deep drilling suggest that such a project might be carried out safely and successfully, that deep boreholes would afford better protection of the environment than the industry's method of choice, and that a repository in deep bedrock might be achieved at less cost than if the KBS concept is pursued.

The industry has made a comparison of their KBS method and the deep borehole method (see section 4.10 below).

The SSNC and MKG argue that a fair comparison of the two, provided that the deep borehole alternative is further explored, might very well lead to the following outcome:

| Criterion/Basis for comparison | KBS-3 | Deep boreholes |
|---|---|---|
| No burden on future generations | = | + |
| Environmental safety demands | = | + |
| Security | = | = |
| Radiation protection | = | = |
| Safeguards | = | + |
| Costs | = | + |

The deep borehole alternative comes out equal to (=) or better than (+) the KBS approach (used as the reference point in the table). Further study of the deep borehole concept is required before the outcome in the table can be verified. Among other things, the stability of the salinity barrier at depths of 1-2 kilometres through one or more glaciation periods needs to be determined. But, otherwise, we have no reason to doubt that the outcome of an unbiased comparison be as above.

The industry actively seeks to prevent further study of the deep borehole option. Thus, the Government must see to it that the regulatory authorities are empowered, and have sufficient resources, to commission research of their own to provide an adequate basis for an evaluation of the deep borehole alternative, which is of crucial importance in the vetting of the repository project under the Environmental Code. The industry has claimed (SKB R-00-28) that it would take some thirty years and SEK 4 billion to research the deep borehole alternative. This is a gross exaggeration of both the time and resources that such a study would require.

One possibility to substantially improve our ability to judge the suitability of deep boreholes for storage of nuclear fuel waste might be to support ongoing scientific research within the framework of the Swedish Deep Drilling Project (http://www.sddp.se). Collaboration in this area also offers the possibility of co-financing with other actors. A project that would answer many central questions about deep boreholes need not cost more than the SEK 130 million that the industry plans to spend on the variant of KBS-3 with horizontal deposition of canisters.

*2.11 The Government needs to make it clear that both long-term environmental safety and the security risks that are imposed by possible deliberate or speculative violation of the repository poses weigh heavily in any evaluation of the various alternative methods for storage of high-level nuclear waste*

For several hundred-thousand years there will be a risk that the plutonium stored in the final repository may be used to produce nuclear weapons. What is more, radioactive material may be used to make sub-critical radioactive 'dirty bombs'. In the Swedish summary of the industry's safety analysis last year, SR-Can (SKB R-07-24), the industry describes the long-term threat, as follows (our un-official translation, p. 78):

> "*Neither can ill-willed deliberate violation be excluded. The spent fuel is dangerous and can therefore be used to damage both human life and the environment. Parts of the fuel can, after extensive processing, be used to manufacture weapons. Forcing one's way down to the repository is a long and complex undertaking that cannot reasonably succeed without societal consent, at least not as long as society is organized as it is today. Such an operation would also require a great amount of resources. Should a society or group of individuals have such evil intent, there would most probably be easier ways for them to reach the same objective*."

The nuclear industry writes "not as long as society is organized as it is today" and uses evaluative terms like "complex," "reasonably" and "most probably". This usage reflects two things: (1) that the industry recognizes that society as

we know it cannot be taken for granted, and (2) that the industry is not in a position to predict the future with any certainty.

The SSNC and MKG do not share the industry's opinion that a desire to use the contents of the repository is unlikely. On the contrary, we can think of a number of scenarios in which the material might be put to military uses or used to spread terror. Inasmuch as plutonium-239, the principal isotope in weapons-grade plutonium, has a half-life of 24,110 years, the problem will be with us for several hundred-thousand years.

After about one thousand years the radioactivity in the waste will have declined to the extent that the "extensive processing," as the industry describes ordinary reprocessing, can be carried out with a lower level of radiation protection precaution than is needed today. Reprocessing of irradiated fuel is, furthermore, a proven technology, well-known since the 1940s, when it was developed in the USA's wartime nuclear program.

Let us consider a simple scenario that belies the industry's contention that there would be "easier ways to reach the same objective": Without getting into the issue of whether Iran or Iraq has wanted to obtain nuclear weapons, we can observe that had anyone wanted to acquire nuclear weapons these past few decades, by far the easiest way to come by the plutonium required would have been to plunder a repository for nuclear fuel waste of the kind proposed by the Swedish nuclear industry, if such a repository were present in these countries.

Over the next century or so, the global energy system will most probably rely increasingly on renewable energy sources. In the long-term, military or civilian use of nuclear technology may well have ceased. In such a world – which is not unlikely a good part of the coming 100,000 years – plutonium in repositories of the kind the Swedish nuclear industry plans to construct will be the readiest source of material for nuclear weapons.

The SSNC and MKG urge the Government to underline the importance of long-term environmental protection and protection against the risk of deliberate and speculative violation of a repository for nuclear fuel waste in any evaluation of alternative nuclear waste storage strategies. The new Radiation Safety Authority must take particular account of the risk of nuclear proliferation in the long-term in a much more serious manner than the Nuclear Power Inspectorate, SKI, has done to date.

*2.12 The Government must ensure that the Radiation Safety Authority continues to develop its own independent assessment tools and knowledge base for its evaluation of an inland location of the repository with respect to long-term environmental safety*

The question of siting, of finding the best possible location, is one of the most crucial environmental issues relating to a final repository for nuclear fuel waste. Yet, given the industry's choice of candidate sites, both in the immediate proximity to nuclear power plants, it would appear to be pure chance should either of them turn out to be the best location from an environmental point of view. The SSNC and other Swedish environmental organizations have long criticized the industry's localization process for not focusing strongly enough on optimizing long-term environmental safety.

The issue of siting and long-term environmental protection has been studied over this past decade. The aim has been to ensure a long period of time between leakage from the repository and contact with human beings. Both of the candidate sites that the industry now focuses on involve formations characterized by outflow of groundwater; localization at either site would imply rather rapid penetration of the natural barriers, in as little as 50-100 years after a breach in the repository. Localization in a formation characterized by inflow of groundwater might, in contrast, afford a lag of up to 50,000 to 100,000 years before leakage reached the surface. The lag also means that the radioactivity would have decreased considerably before the leakage came in contact with human activity.

SKI and SSI have examined the industry's most recent report on this issue. The authorities find the modelling of regional groundwater flows well-executed, but note that the industry has refrained from drawing important conclusions from the data generated. The authorities point out that the industry must explain its choice of site in the coming EIS document. The siting should also be discussed in the light of the requirement of best available technology (BAT), demonstrating concern for optimization. Any systematic localization process should include inland as well as coastal sites in the survey phase, and safety aspects should be given highest priority.

The SSNC and MKG consider it important that the authorities continue to develop their own knowledge of macro regional groundwater flows so that the Radiation Safety Authority will be able to perform an independent analysis of this crucial issue when the industry submits its application to build. The Government should see to it that the Authority develops its knowledge about this aspect that is crucially important to the long-term environmental safety of the project.

*2.13 The Government should alert the Radiation Safety Authority to the need to make sure that both collective radiation doses from diffuse sources and the impact of radiation on the entire eco-system are included in safety analyses*

In assessing the environmental impacts of the KBS method applied to a coastal site, the anticipated collective radiation dose is an important factor. So far the industry, i.e., SKB AB, and the regulatory authorities have focused their attention on analyzing the expected individual doses that may result from leakage from a final repository. A coastal location that would imply relatively rapid dispersal of radiation in the sea would expose rather many people and other organisms to ionizing radiation, and the collective dose may be very high. An ethical (and economic) weighing of safeguards against future damage presumes some idea of the future collective doses that can be anticipated and the number of people that may suffer injury or die in different scenarios.

In our view, the Government should alert the Radiation Safety Authority to the need of such data, and the industry should make clear that dispersal and dilution of radioactivity in the groundwater and the sea is an essential feature of the KBS method. It is vitally important that the planned diffusion of radioactivity and its environmental consequences be made explicit in the EIS document.

Radiation protection agencies and researchers around the world are working to gain a better understanding of the effects of radiation on the natural environment. It is important that this work is continued, both on an international scale and in Sweden. It is equally important that impacts on the natural environment be included in the assessment of the long-term environmental safety of a final repository for nuclear fuel waste.

The SSNC and MKG urge the Government to instruct the Radiation Safety Authority to continue to watch over protection of the environment, and not only humans, from the long-term risks with a final repository.

*2.14 The Government should make it clear to the industry, to local government and to other actors that long-term environmental safety is an overriding criterion that may not be compromised by hastening to a decision to establish a repository*

It is the industry's intention, as soon as possible, to obtain a permit to start constructing a final repository according to a method that was chosen some thirty years ago. The reasons for the industry's impatience to start building are several. For one thing, it is important for the nuclear industry to demonstrate to the rest of the world a feasible solution to the waste problem. The local municipalities are also eager to reach closure, it seems.

There are, however, other and in our view more important reasons that caution against rushing to decision. First and foremost, there are the remaining fundamental uncertainties about the long-term safety of the industry's proposed method. Second, there should be time for an independent study of the deep borehole storage alternative to permit its evaluation on a par with the industry's method of choice, KBS. Third, the choice of a method for storage of nuclear waste also has to do with issues relating to the future global energy supply, particularly whether or not nuclear energy will continue to play a significant role. This in turn raises the question of the value of irradiated nuclear fuel as a potential source of energy. The world will know much more about the global energy future within the next decade or so.

The industry argues that if it is not granted to start the repository project there is a risk that no repository will be built, or that the resources in the Nuclear Waste Fund will evaporate. The SSNC and MKG are considerably more optimistic on that account. A hasty decision to build a repository may turn out to be a waste of resources and money out of the Fund and, furthermore, lead to unacceptable risks to future generations and the environment.

The Government should make it clear to the industry that concern for the performance of a repository in the long-term cannot be compromised by a present-day desire to bring the project to a closure.

### *2.15 The Government should review and revise legislation in the area of radiation safety*

The Government should review Swedish law in the area of radiation protection. With the creation of the new Radiation Safety Authority the need arises to revise and harmonize sectored law in the area (more precisely, the Nuclear Technology Act, the Radiation Protection Act and the Nuclear Waste Financing Act). In our view, the revision should go so far as to incorporate all three laws into the Environmental Code. In this way nuclear energy – clearly one the potentially most hazardous industries Sweden have - would be included in the law that normally regulates environmentally hazardous activity. This would also facilitate the consideration of nuclear technology and radiation protection in relation to Sweden's national environmental objectives and strivings toward overall ecological sustainability.

### *2.16 The Government should review and reorganize the administrative structure of social science research relating to nuclear waste management*

In recent years the industry has, through the use of a good deal of money drawn on the Nuclear Waste Fund, assumed a dominant role as commissioner of social science research relating to the issue of nuclear waste management. The industry has used this dominance to try to steer the research into areas and toward research questions that serve their own interests. Three examples

(taken from the most recent announcement of available research funding) reflect the kind of questions the industry would like to see investigated:

- Should formal authority to take a decision [on a final repository for nuclear waste] be more local and thereby reflect the local community's attitudes toward, and familiarity with, the project?
- Is it legitimate to formulate more or less absolute requirements for a permit according to the Environmental Code and the Nuclear Technology Act and then distribute responsibility for the various requirements among the respective authorities?
- Is it reasonable to impose a requirement of best available technology even though the resources that a marginal increase of risk would make available might save human lives if they were instead applied to improve traffic safety?

The SSNC and MKG find the industry's attempts to steer use of the funds in the Nuclear Waste Fund in this manner totally unacceptable – both from a scientific point of view and in a societal perspective. At the same time we consider social science research in this area very important. The Government should initiate a study of how social science research in this area may be financed out of the Nuclear Waste Fund and how it may be organized in a way that preserves the integrity of the research and ensures its relevance, not to the interests of the industry, but to society as a whole.

*2.17 The Government should take measures to ensure that environmental organizations can receive funds out of the Swedish Nuclear Waste Fund also after 2008*

The Nuclear Waste Financing Act has made it possible for environmental organizations to receive economic support from the Nuclear Waste Fund. A trial period, 2005-2008, is currently being evaluated by the Swedish Agency for Public Management. Among other things, the trial period has made it possible for the SSNC, through its involvement in MKG, to take active part in the consultation process on the EIS that will accompany the Swedish nuclear industry's application to build a final repository for nuclear fuel waste.

In our view, MKG has lived up to the intentions that inspired the trial period; how third parties judge this will soon be known when SAFAD publishes its findings. To sustain and strengthen the future consultation process and the evaluation of the industry's EIS it is important for the environmental movement to continue to be able to receive funding from the Nuclear Waste Fund.

The Government must ensure that Finansieringsförordningen is amended so that environmental organizations can be funded out of the Nuclear Waste Fund even after 2008.

## 3. Overall factors and issues that limit the prospects of handling and storing nuclear fuel waste in an environmentally acceptable manner

The SSNC and MKG believe we have identified a number of problem areas that have made it difficult to approach the question of the environmentally best way to store nuclear waste in an objective manner. We feel it is important to raise these issues in the interests of improving the Swedish nuclear waste storage process. The following raises ten principal concerns.

### *3.1 The apparent difficulty among politicians and policy-makers to distinguish between the issue of nuclear energy and the problems associated with nuclear waste*

The question of how best to manage and store nuclear fuel waste is still in search of an answer. No country in the world has even started to construct a final repository for high-level nuclear waste. If Sweden decides to establish a repository of the Swedish KBS model, it will be a sensation worldwide. There is a very evident connection between the Swedish nuclear industry's haste to reach a 'solution' and the campaign to re-launch nuclear energy that is currently under way around the world.

In Sweden, the interwoven nature of the two issues, nuclear waste and nuclear energy, has consistently blocked a dispassionate discussion of the best possible way to manage and store nuclear waste. With the exception of the Fälldin Government 1976-1977, no Swedish Government has been willing to take the risk that the waste problem might endanger the continued operation of nuclear reactors. Fears that activities directed to rectify apparent weaknesses in the industry's nuclear waste management program might spawn doubts about the nuclear power program per se have hampered constructive development.

### *3.2 The industry's unwillingness to consider alternatives to its original 'solution' for a final repository*

The Swedish nuclear industry's method of choice for final storage of nuclear fuel waste was arrived at in some haste in the turbulence that surrounded the issues of nuclear power and nuclear waste management in the 1970s. Thus, in essence the method is thirty years old. Although some modifications have been made – e.g., the materials used in man-made barriers (currently copper and bentonite clay) – the industry has been unwilling to discuss alternative methods that might prove environmentally sounder. A more open attitude was apparently feared to leave the impression of uncertainty about the adequacy of the method the industry had already selected — which, in turn, might lend support to broader criticisms of nuclear energy; therefore, the industry has not considered an objective evaluation of alternatives in their interests. The design of the Swedish nuclear waste program has proved unable to rectify this problem.

### *3.3 A public authority that has shirked its duty*

The Nuclear Power Inspectorate, SKI, has been criticized for its ties to the nuclear power industry, in large part due to long-term acquaintanceships and collegial bonds between officers of the authority and engineers and executives in the industry.

These close ties may have influenced SKI's performance. In our experience, SKI has frequently sided with the industry, in, for example, the authority's recommendations to the Government concerning the industry's research and development reports (the Fud program) at three-year intervals. On occasion SKI has also suppressed important comments of the Radiation Protection Authority, SSI, in formal comment on the industry's research and development program (which, as noted above, is to be filed with the SKI). Concerns relating to the long-term safety of the KBS scheme have therefore not reached the Government. Views expressed in solicited comment from environmental organizations have suffered the same fate.

SKI's extremely lax control of how the industry has used money out of the Nuclear Waste Fund is also remarkable. The industry has been allowed to draw more than two thousand-million Swedish crowns each year with hardly any documentation of the purposes to which the money will be put. Nor has any post facto auditing been conducted to see whether funds drawn have been used efficiently. As recently as this past year [2007] SKI initiated a control procedure, but much work will be required to change engrained systems that the industry has built up to serve its own needs and interests.

The transparency of the interaction between SKI and the industry is spotty. Numerous contacts have not been recorded in the authority's register. In fact, it was not until MKG began requesting copies of the minutes of meetings with the industry that contacts between SKI and the industry were recorded at all. Similarly, documentation of contacts with the industry relating to drafts from the Nuclear Waste Fund and how the funds were used is scant.

There is an obvious need for major change in the manner in which SKI manages its relations with the nuclear industry. The forthcoming fusion of the Inspectorate with the Radiation Protection Authority to form the Radiation Safety Authority affords a good opportunity to introduce new routines. One important task facing the leadership of the new authority is to reform the industry-friendly culture that has prevailed in the departments of SKI concerned with nuclear waste management.

### *3.4 The distribution of responsibility for managing nuclear waste*

The Nuclear Technology Act gives the industry prime responsibility for developing a program to manage and store nuclear waste. This absolute interpretation of "the producer pays principle", admirable per se, requires

rigorous public control of what the industry is doing. Without adequate checks, the principle of entrusting the task to the industry will not work. What is more, the Act contains no provisions for sanctions, should the industry fail to meet its responsibilities.

The distribution of responsibility for the Swedish nuclear waste program is in need of fundamental revision. The polluter pays principle is provided for in Nuclear Waste Financing Act. Although its application to date has had its shortcomings due to lax controls, the principle is sound. But it is nonetheless essential that the Radiation Safety Authority must be empowered and able to conduct independent study to ensure that problems and aspects that the industry does not want explored, are looked into. Such studies need to be done, even if they may require extensive research, including experimentation.

### *3.5 Legislation pertaining to nuclear technologies is poorly adapted to environmental concerns*

The regulation of nuclear technologies under sector-specific legislation is a problem. The Environmental Code, introduced in 2000, shall have precedence in all matters relating to the environment; consequently, the Nuclear Technology Act and the Radiation Protection Act have been amended to conform to the Code. The problems arise out of the fact that the SKI has apparently not embraced the principles and environmental rationales set out in the Code. This nonconformity has repeatedly caused problems in connection with environmental impact assessments, as SKI's assessments do not always correspond to the concerns of the environmental courts.

The Swedish nuclear industry has, furthermore, been quick to exploit any room for manoeuvre that the existence of parallel legislation provides.

### *3.6 The industry dominates the research and development effort*

Over the past three decades the Swedish nuclear industry has built up a research and development program of its own. In addition, research tasks commissioned by the industry support a number of consultancies as well as numerous activities in academic institutions. Some of these consultants and research teams are totally dependent on maintaining good relations with the industry, since other sources of funding have disappeared. The widespread, but erroneous belief that 'SKB' is a Government authority plays a role here. The industry uses the abbreviation SKB in all its external communication. The similarity to the responsible authority, SKI, is obvious.

[Tranlators note. The full company name of the Nuclear Fuel and Waste Management Co in Swedish is Svensk Kärnbränslehantering AB. However, the suffix 'AB' being the Swedish denotation for a limited corporation and Svensk Kärnbränslehantering AB is in fact a wholly owned subsidiary to the nuclear industry dedicated to the repository project.]

The industry is anxious to give the impression that it is very scientific, but considering the amount of resources the industry has committed to research and development, surprisingly little scientific work has been published. Very little of the work done by the industry has been subject to peer review, which means that the ordinary mechanism for scientific quality control has not been in play. What is more, none of the findings from important experiments conducted at the Äspö laboratory are accessible to the public. In sum, then, the research and development program in fact has a very weak foundation in science.

### *3.7 Industry predominates as information source*

The industry enjoys a virtual monopoly on information in the area of nuclear waste management. Government authorities have rather limited budgets for information, which they, furthermore, hardly use, and environmental organizations are expressly forbidden to use funds from the Nuclear Waste Fund for nationwide information efforts. The industry, by contrast, is free to spend large sums of money to spread their information and views as they see fit. In the two candidate communities for a final repository, Oskarshamn and Östhammar, saturation campaigns have been the rule. In these communities, and among many Swedes nationwide, the idea has spread that the problem of nuclear waste storage has been 'solved' – a claim that cannot legitimately be made until the environmental courts have vetted and approved the industry's application.

### *3.8 The localization process has resulted in an environmentally dubious choice of site*

The search for a suitable site for a final repository for high-level radioactive waste has been under way many years and has gone through many phases. With the industry's decision to go ahead with detailed inventories of two sites, both adjacent to nuclear power plants, all ambition to apply criteria that would ensure long-term environmental protection has been abandoned. In an era when environmental protection and long-term ecological sustainability over multiple generations have become a popular concern, the nuclear industry has tended in the opposite direction, claiming that sufficiently good bedrock can be found just about anywhere in the country, and that it is impossible to say that one formation is any better than another.

This is a patently unscientific contention, but it is part of a greater effort on the part of the industry to shift the emphasis of the localization project away from long-term environmental safety and over to issues relating to industrial policy and political and popular acceptance of a repository as selection criteria.

### *3.9 The KBS project is essentially a model*

Despite efforts on the part of the industry to make it appear that there is a close relationship between the physical environment in which the nuclear fuel waste will be deposited and the safety analysis the industry performs, in actual fact the relationship is very loose. The safety analysis is mainly a model, and reality is *presumed* to have appropriate characteristics. The point of work undertaken in the course of site inventories, etc., and experiments at the Äspö laboratory is to make it seem likely that the models will be able to show the repository to be safe.

This approach to environmental safety requires stringent quality control, both of the models and the empirical data as well as how they are presented. Quality control has been quite poor, considering the importance of what is at stake.

### *3.10 Lack of funding long prevented environmental organizations from working with the nuclear waste management issue.*

For many years the environmental organizations have tried to balance the information advantage that the industry has enjoyed and sought to receive funding that would permit them to take active part in the nuclear waste repository project. The money made available these past few years has come late; furthermore, it may not be used for nationwide information activities, even though the industry is not bound by any such restraints.

During the few years we have been able to receive funding out of the Nuclear Waste Fund, the environmental issues relating to the project that we have raised have assumed a more central place in the consultations leading up to an environmental impact statement and application for permission to begin constructing a final repository. This benefits the decision-making process. It is important that the environmental organizations receive more resources for their work in this area. When, furthermore, the issue of nuclear waste may be expected soon to assume more national scope, the relationship between the industry's and other actors' access to resources for communication should also be made more equal.

One result of the move to allow environmental organizations to receive money from the Nuclear Waste Fund is that the organizations have developed a better appreciation of the fundamental problems and issues that affect the industry's ability to achieve an environmentally acceptable way to manage and store nuclear fuel waste.

## 4. Elaborated arguments for the observations and recommendations given in section 2

In this section we elaborate on our views and recommendations for the specific suggestions for the Government decision on the Fud 07 research and development program given in section 2. Some of these elaborations are partly the same as those in section 2, whereas some contain a more detailed analysis.

### *4.1 The need for the Government to set out requirements that are needed to bring the work on nuclear waste storage to an acceptable conclusion in its forthcoming decision regarding the industry's 2007 research and development program*

Every three years the Government takes a decision on the ongoing research and development effort of the Swedish nuclear industry. These decisions constitute the Government's prime opportunity to steer the further course of Swedish nuclear waste management. The Government formulated conditions or requirements in conjunction with such a decision most recently in 2000 with regard to Fud-98. The Government has taken three decisions since then (including the approval of Fud-K, a supplement to Fud-98), but without stating any conditions.

The industry has failed to fulfil the requirement of the Nuclear Technology Act to undertake the full spectrum of research that is needed to ensure the safety of handling and final storage of nuclear waste. The Government must intervene and set the conditions required to redress these breaches when it takes its decision on Fud-07. Experience indicates that the Government should not address the industry alone. The industry conscientiously avoids seeking knowledge that does not serve its interests. Consequently, Government agencies need to undertake a research and development program of their own. The Finansieringslagen provides for agency use of the Swedish Nuclear Waste Fund for this purpose. In the statutes of the new Radiation Safety Authority the Government should specify a responsibility to undertake such research as is necessary to enable the agency to perform a thorough and comprehensive vetting of the industry's application for permission to construct a final repository for nuclear fuel waste.

### *4.2 The need to ensure an effective quality control of the industry's work*

The SSNC and MKG show in these comments that the industry's research and development work evades potential problems. The industry publishes very little of its research in scientific journals, which would allow examination of its work on the part of others in the scientific community. Moreover, in most of the branches of science and technology that relate to nuclear waste management the industry has a monopoly on research financing; in effect, researchers and consultants who work for the industry have become entirely dependent on the

industry. Such dependency implies a risk that not all aspects of the task will be studied and that problems are not examined in the ways and to the extent that they should be in order to assure the excellence of the final result. A related problem is that the results of experiments conducted at the laboratory at Äspö are neither published nor otherwise accessible to public scrutiny, despite the fact that the research is supported by public means through the Nuclear Waste Fund. In sum, there are serious weaknesses in the quality assurance of the industry's work to date, and one cannot rule out the possibility that the industry out of self-interest is withholding problematic findings.

The Nuclear Power Inspectorate, SKI, has commenced study of how the industry's research and development program might be quality assured. This comes at a far too late stage in the process. The industry has become accustomed to merely passive reception of their results, and they are not subjected to independent scientific examination or to critical assessment on the part of the SKI.

*4.3 The need to review the industry's use of funds out of the Swedish Nuclear Waste Fund and empower the Radiation Safety Authority to ensure their proper use.*

The SSNC and MKG would like to call the Government's attention to the lack of guidelines that specify (and limit) how the industry may use money from the Nuclear Waste Fund; this applies to both the sums and the purposes to which they are used. The industry regards the funds as its own and, judging from the record to date, the Nuclear Power Inspectorate would appear to concur.

There is no real external audit or examination of the industry's use of funds from the Nuclear Waste Fund. The fund consists of accrued payments by users of nuclear-generated electricity. The payments are obligatory, and, therefore, for all practical purposes the funds are equivalent to public means. The only report the industry submits to the Nuclear Power Inspectorate is an estimate of the amount of money it expects to use in the future – information used to calculate the amount of the surcharge to users – and how much it has used since the last disbursement.

The laxity of this arrangement has led to a situation where the industry does not use the funds efficiently. For example, the industry in its most recent report (PLAN 2007) indicated that its subsidiary for the waste repository project, SKB AB, would use SEK 245 million of a total 1 567 million for administration, which represents 20 percent of the total amount drawn on the Fund. This item has risen from about 15 percent of the total at the start of this decade, whereas costs for research and development have remained unchanged at a bit under 30 percent of expenditures. Without oversight, the industry has no incentive to manage the money from the Nuclear Waste Fund in an appropriate manner with regard to societal interests. Only recently have authorities begun to take

an interest in how the industry uses resources from the Fund. The Government should deliberate what measures are necessary to come to grips with the problem, and whether it can be resolved in the context of the Government decision on the industry's research and development program, Fud-07.

The industry spends a good amount of money on resources to "develop and further secure public confidence in the [nuclear fuel waste] program", i.e., in its own KBS-system (SKB Operations plan 2008-2011, SKI dnr 2007/1931). In the course of the consultations MKG has asked the industry how much money they allocate to information and public relations. The industry replied that they use about 1 per cent of the company's turnover – SEK 1.2 million per annum – for "exhibits, information meetings, publications, web, events open to all actors, press relations, internal information and other information activities". The total budget for the work surrounding the environmental impact statement and public relations for 2008 totals SEK 50.7 million, a figure that includes industry-commissioned social science research. It remains unclear whether this item includes the extensive information activities at the final repository for low- and medium level waste, SFR (at Forsmark) and the Äspö laboratory. Whichever the case, the industry subsidiary, SKB AB, has a considerable number of information officers who work full-time with external information. The industry furthermore uses consultants to help them lobby political decision-makers. The lax requirements regarding accounting make it next to impossible for outside observers to know how much the industry spends to bolster public confidence in the KBS project.

The Nuclear Waste Financing Act (2006:647 4§) permits the industry to draw funds from the Nuclear Waste Fund for the purpose of public information concerning the management and final storage of irradiated nuclear fuel and other nuclear waste. Be that as it may, use of such large sums of public money to produce partisan propaganda for a controversial method for final storage of nuclear fuel waste may be called into question.

### *4.4 The need for the Government to make it clear that the permit to establish a final store for high-level waste will not be given until sufficient data and argumentation that support the chosen method and chosen location and that provide for guaranteed long-term safety, have been produced*

Government approval of an application to build is an ultimate decision; in practice it may be impossible to modify or rescind. The SSNC and MKG therefore urge all parties – the industry, the authorities, and the Government – to accord factors relating to long-term environmental safety great importance in the process of choosing the storage method and selecting the site

It has been our experience in the consultations to date that when asked about unresolved issues pertaining the repository, the industry frequently responds, “We’re working on that,” or “We’ll be able to answer that when we’ve come a bit further in the FoU process.” It is our impression that the regulatory authorities, SSI and SKI have had the same experience. These references to future research findings would seem to be a tactic. The question is whether the industry may actually be planning to submit an application for a permit to build a repository without having presented enough data to permit a proper safety analysis, together with an explanation that the gaps will be filled once the permit has been granted.

Examining the research plan for the coming period, we get the impression, however, that a large number of questions of importance to the coming safety analysis for the application (SR-Site) will not have been sufficiently examined before the application is submitted. Some of these questions, treated in Part III of the Fud-report, need to be answered in order for the industry to be able to undertake the construction, depositing and filling/sealing processes safely; even more critical are the questions concerning long-term safety (Part IV).

How much of the research and development work that is decisive to the long-term safety of the project *can* be left until after the application has been submitted? The question needs to be raised. Of particular interest are questions relating to how the industry handles problems encountered in the full-scale experiments carried out at the Äspö laboratory. An illustrative example is the discovery that bentonite clay cannot be placed around the canisters without protecting it from the groundwater in the bedrock during the deposition process. This problem calls for a full-scale demonstration of how this can be done, taking account of the fact that real canisters will be giving off a considerable about of radiation. No acceptable safety analysis can be performed without this knowledge.

Another set of questions relates to the fact that the industry has not reported the findings of longitudinal experiments regarding copper corrosion and erosion of the bentonite buffer. Experiments being carried out at Äspö, near the Oskarshamn nuclear power station, may produce answers to a number of questions that are of central importance to the safety of a final repository. At a consultation in December 2007 the industry said that the reports, which are currently being written up, would not be made public until after the deadline for solicited comment on Fud-07.

Several of the Äspö experiments have to do with the artificial barriers, i.e., the copper canister to contain the fuel waste, and the bentonite clay that will surround the canister. These studies are:

- Prototype Repository Project
- Long Term Test of Buffer Material
- Canister Retrieval Test

- Temperature Buffer Test
- Large-scale Gas Injection Test
- In Situ Corrosion Testing of Miniature Canisters
- Alternative Buffer Materials Project

The Fud-report makes reference to these findings here and there, but it has proven difficult to obtain the reports themselves. Despite the fact that the Äspö laboratory is largely publicly financed out of the Nuclear Waste Fund, the industry, SKB, has turned it into an international laboratory. This has had two serious consequences as to insight into the work being done there. First, most of the results have been published in a series denoted IPR. Several references to IPR reports are made in Fud-07, but they have not been posted on SKB's website, and the industry has refused to supply a list of the titles in the series. They have, however, said that we may request IPR reports that we have learned about, and SKB will make a judgement as to whether they can be released on a case-by-case basis. The industry puts this down to its international cooperation. Secondly, the international aspect slows the publication process significantly.

The industry publishes an annual Planning Report – e.g., *IPR-07-06, Äspö Hard Rock Laboratory: Planning Report for 2007* – and a quarterly Status Report – e.g., *IPR-07-11, Äspö Hard Rock Laboratory: Status Report April-June 2007.* Furthermore, it publishes an open annual report in the TR series – e.g., *TR-07-10, Äspö Hard Rock Laboratory: Annual 2006, June 2007*. The reports are available on MKG's website on the page where MKG I December 2007 presented its ongoing examination of the industry's research program (http://www.mkg.se/index.php?id=news148).

A close reading of the above-mentioned reports leaves the impression that a large number of the experiments have run into difficulties, and that some have not produced the expected outcomes. Primary examples are how the bentonite clay in the buffer and the refilling materials react in the experiments. The reports made available to date do not reveal how the copper canister has fared, but there is seems that considerable research is required to understand the results of the Äspö work. One looks in vain for a discussion of these problems in the industry's research plan.

The MKG and the SSNC argue that there are so many uncertainties in the industry's documentation bearing on long-term safety that it will take considerable time to clarify these issues. But they must be resolved before permit can be approved. The recent comments from the regulatory authorities on the most recent safety report, SR-Can, second this assessment. The new Radiation Safety Authority must keep these issues under close scrutiny and alert the Government to any gaps in the knowledge needed to guarantee the long-term environmental safety of a repository of the kind the industry intends to build.

Both the Nuclear Technology Act and the Environmental Code (chapter 17 1§) invest the Government with ultimate responsibility when it comes to give a permit to the industry to begin constructing a final repository for nuclear fuel waste. As a consequence, both the Radiation Safety Authority and the regional Environmental Court, respectively, will submit comments to the Government prior to the decision. The Government, however, is not bound by the advice of either institution but the law empowers it to grant a permit against their recommendations.

We, the SSNC and MKG, are of the opinion that the Government should not contradict the Authority or the Court if either, or both, have doubts about the acceptability of the environmental impacts of the project. The Government should consider stating, as a matter of principle, that long-term environmental safety must be the decisive factor in connection with the authorization to construct a final repository, even if such a declaration may limit Government discretion in this matter. This is important, both for public confidence in the project and for the municipalities, who can then rest assured that the Government has long-term environmental safety in their community utmost in mind.

Our concern is not merely hypothetical. In the matter of giving a permit for an increase in thermal effect at Swedish reactors Ringhals and Oskarshamn (two separate court cases), the Government decided to grant the application and thereby override the findings of the courts in Vänersborg and Växjö, respectively, which had rejected the applications because of the anticipated environmental impacts.

In this connection we should mention that the industry has repeatedly assured participants in the EIS consultations that the Government will not use the option provided in the Environmental Code (ch 17 sect 6) to override municipal governments' traditional right of veto when it comes to siting the final repository for nuclear fuel waste. Should the Government choose to override doubts or concerns on the part of either the Authority or the Court and grant the permit, there is a substantial risk that no municipality will voluntarily accept the project, in which case the Government would have to set aside the municipalities' right of veto to make it possible for the project to proceed.

### *4.5 The need for the Government to instruct the Radiation Safety Authority to make a full, independent assessment of the industry's research and development work, with particular emphasis on its weaker aspects.*

It is crucially important that the Radiation Safety Authority, the public institution responsible for examining the nuclear industry's application to build a final repository for nuclear fuel waste, have a solid basis for evaluating the application that is independent of the information and data provided by the applicant. The application will be assessed with reference to both the Nuclear Technology Act and the Radiation Protection Act, which have been amended

to harmonize with the provisions of the general rules of consideration in the Environmental Code. The Environmental Court will therefore accord the Radiation Safety Authority's statements great importance.

The Nuclear Power Inspectorate, SKI, has so far refrained from taking any initiatives of its own to investigate issues raised by third parties, i.e., groups or institutions outside the industry. Rather than looking into questions that the industry might find inconvenient or embarrassing to have examined, SKI has abstained, explaining that responsibility for the research in question rests with the industry. The Radiation Protection Authority, SSI, has had a somewhat higher level of ambition and has started its own investigations of certain issues where they have found the industry's research and development program lacking. But SSI's resources have been limited, and when SSI has sought supplementary allocations to finance such studies, SKI has opposed the idea.

SKI's actions entail the industry with the task of investigating questions that it does not want to look into. Meanwhile, SKI has failed to build up the degree of competence that is required for the authority to be able to reveal shortfalls and weaknesses in the industry's research and development effort.

The Radiation Safety Authority must be instructed to develop a solid, independent basis on which to examine the industry's research and development program, with particular attention to the gaps in the industry's research program to date. This does not imply a relocation of the industry's responsibilities to the Authority, but to ensure that the Authority has an adequate basis on which to evaluate the industry's application.

### *4.6 The need to expand the budget of the Radiation Safety Authority to enable the Authority to acquire a sufficient basis on which to examine of the industry's future application*

Det är viktigt att det finns resurser så att Strålsäkerhetsmyndigheten kan ta fram ett eget från industrin oberoende underlag som är tillräckligt för granskningsarbetet. Finansieringslagen innehåller denna möjlighet (§ 4 pkt 4) vilket innebär att de medel som behövs kan tas ur Kärnavfallsfonden och på så sätt behöver inte statsbudgeten belastas. Eftersom regeringen dessutom beslutar om den kärnavfallsavgift som tas ut av den som använder kärnkraftselektricitet så kan regeringen vid behov justera denna avgift för att kompensera för ett ökat behov av resurser för samhällets granskning av industrins arbete. Här är det på sin plats att påpeka att både industrin och till stor del även myndigheten (SKI) historiskt har hävdat att industrin fritt disponerar över medlen i Kärnavfallsfonden. Det är naturligtvis inte så – medlen har betalats av användarna av kärnkraftsel och bör betraktas som allmänna medel regeringen beslutar om och som ska användas för att se till att den långsiktigt miljömässigt bästa hantering av det svenska kärnavfallet kommer till stånd.

*4.7 The need to ensure that currently outstanding issues and unsolved problems in the industry's research and development project are thoroughly investigated, and solutions arrived at, before a permit to begin construction of a repository can be given*

In order to get a grasp of the industry's priorities in the Fud-07 research plan, we may consider the outstanding issues and problems that have a bearing on the long-term safety of the repository. These are

- Have the site investigations produced enough knowledge?
    - Have explorative studies at Laxemar provided enough knowledge and data about the formations and groundwater flows in the focal area in south and west Laxemar?
    - Does the industry know enough about the risks involved in using the lens at Forsmark for a repository, with regard to its possible instability due to tectonic dynamics in the surrounding bedrock? Have the dynamics of the area been thoroughly mapped?
- How certain is the knowledge about the long-term durability of the bentonite buffer, e.g., with regard to the risk of buffer erosion?
- Is enough known about the 'maturity' of the bentonite buffer in the loading phase? That is, will the bentonite actually perform as the models predict when it comes to swelling and water saturation (re-saturation)?
- Is enough known about the risk of copper corrosion, particularly in the light of new research findings that indicate corrosion processes in anaerobic environments, particularly at higher temperatures?
- What levels of stress will a final repository be subjected to during glaciation (e.g., additional load, hydrological variation, microbiological agents, geological uplift and depression, seismic events)?
- What future impacts due to climate variation may be expected? New evidence suggests that the sea level may rise as much as 50 meters, should all the ice in Greenland and a major share of the ice in Antarctica melt. Should this happen in the span of one thousand years, how might it affect the repository? Also, what is the probability that current global warming may hasten the next period of glaciation?

The research plans outlined in the Fud-07 report put heavy emphasis on the technical know-how surrounding the construction of the final repository, the design of the encapsulation facility, the isolation of fuel waste in copper canisters, the deposition of canisters in holes and filling the repository with bentonite clay. In this part of the report (Part III. Technical development within the nuclear waste program), the industry gives the impression that it for all practical purposes is ready to start constructing a final repository. Whatever knowledge is lacking will be acquired in the construction process, the report assures us.

This is fully in keeping with the industry's focus in recent years. The industry has made a big point of the ability to manufacture copper canisters with

welded seams, and of the new bentonite laboratory that will provide vital guidance to the filling process. We gauge that the industry may succeed to practically implement these subtasks. The important thing, however, is not whether a repository of the KBS-3 design will be technically feasible, but whether a KBS-3 repository will meet the requirements of long-term safety that a repository for nuclear fuel waste must fulfil.

A close reading of the part of Fud-07 that treats long-term safety (Part IV. Safety analysis and research in the natural sciences) reveals that the industry is far from ready; a great deal of uncertainty on key issues remains — as the report, to its credit, admits. The knowledge needed to model key processes in the long-term remains limited.

Worse, the research plans outlined in the Fud report will not result in a reasonable level of knowledge before the next safety analysis (SR-Site) is to be completed in conjunction with the application for permission to build. This is because knowledge of how the artificial barriers will perform in reality is dependent on longitudinal experiments under realistic conditions. The industry has been far too late in attending to this aspect. The laboratory at Äspö was inaugurated in 1995, yet only in 2001 did full-scale experiments get under way. Because of the late start and problems encountered in the experiments, the industry has not made much progress in verifying its models empirically under realistic conditions.

In sum, our examination of Fud-07 leads us to conclude that the industry still has far to go before it can demonstrate that the KBS-3 method carried out at either of the candidate sites fulfils criteria that would ensure long-term environmental safety. There is a risk that the industry may be tempted to fill the safety analysis model, over which it has total control, with data and assumptions that have little proven basis in reality. If that were to happen, the model might very well produce diagrams, etc., that indicate fulfilment of the criteria of long-term safety, but which have not been confirmed under realistic conditions.

The safety analysis the industry is undertaking to determine the long-term environmental safety of a KBS repository consists of a complex of models. This means that any deviations in the in-data concerning present and future conditions and developments will impact directly on the validity of the analysis. The industry's understanding of the performance of the bentonite buffer during the first century after deposition is incomplete. In a letter of October 2007 to the industry (SSI dnr 2007/1562/25; SKI dnr 2007/598), the regulatory authorities point out that the industry's work on buffer erosion is at a very preliminary stage.

In the popular edition of the 'Fud-2007' research program ("Fud-2007: Program för forskning, utveckling och demonstration", p. 48) we find the following (our un-official translation):

" Centuries before saturation

When the canisters have been deposited, the access tunnels are filled and capped, and water begins to infiltrate into the tunnels. The buffer absorbs the water, swells, and fills all gaps and crevices. The saturation process may take hundreds of years and is a complex interaction between thermal, hydraulic and mechanical processes.

We don't know how the processes may interact during the saturation phase. Nor do we need to [know] in order to be able to perform a safety analysis. It is important, however, to be able to predict and understand the characteristics of the buffer once it has become saturated, since that is the starting point for the calculation of long-term safety."

Saturation of the bentonite will also depend on hydrological, geochemical and microbial processes. The industry's attitude is disconcerting and shows that the safety analysis is not well enough founded in real conditions.

Furthermore, the saturation of the bentonite clay will depend very much on the hydrological properties of the surrounding bedrock, and these vary considerably between Laxemar and Forsmark. Saturation is a key precondition for long-term safety. How does the industry propose to take account of this factor in the site selection process?

In their comments on the industry's most recent safety analysis report, SR-Can, the authorities pointed out a number of areas where the safety analysis needs to be amended. Taking these comments as their point of departure, SSI and SKI and the new Radiation Safety Authority should, in their comments on Fud-07 and later, clearly specify the areas where the industry needs to do more before the application is submitted.

### *4.8 The need to ensure that work commences on drafting public policy that sets out the objectives and functions that a final repository shall fulfil*

It is impossible to judge how well the industry's proposed repository for nuclear fuel waste fills the objectives and functional requirements Swedish society expects it to fulfil unless those objectives and requirements are clearly spelled out. Particularly, a specification of the environmental objectives the repository should fulfil is needed in order to be able to judge the relevance of the program. This is an absolutely essential step in any environmental impact assessment process in accordance with the Environmental Code. It is not the industry but the society (the Government and Parliament) that should formulate objectives and criteria.

In its research and development (Fud) programme the industry refers only to a step-by-step process that led to the present proposal. In the course of this process the objective has varied. It is, for example, quite clear in the Fud programme that the industry has no position on the dilemma regarding how accessible the repository should be to future generations. On the one hand retrievability after the repository is sealed offers advantages (should better technology for storage, or for use of the residual energy the waste become available), but also disadvantages (the risk of terrorism and nuclear proliferation, or inadvertent intrusion).

Politically formulated objectives and functional criteria are needed in order to determine how well proposed alternative methods fulfil the demand for the management and storage of nuclear fuel waste in a manner that in no way impinges on human health or the environment, now or in the longer term. Unless clear-cut objectives are formulated, either by the Government or by the Parliament, the Environmental Courts, regulatory authorities and, ultimately, the Government will find it very difficult to determine whether or not the industry's proposal is acceptable. Nor will it be possible to determine whether other methods for the long-term management of nuclear fuel waste might better fulfil the objectives. Examples of alternative methods that have been proposed include deposition in deep boreholes, guarded storage in dry intermediate storage vaults, and transmutation.

Among the questions that need to be discussed and decided at the highest level of political responsibility, with the advice of the Radiation Safety Authority, the National Council on Nuclear Waste and other actors are:

- What level of long-term environmental safety should be striven for?
- Should the long-term safety of a final repository be based on man-made or natural barriers?
- How difficult should it be for thieves or terrorists to penetrate the barriers and reach the waste?
- What degree of retrievability should the repository afford in various phases of storage, in view of the risks and opportunities associated with retrievability?
- What requirements regarding long-term supervision of the repository are acceptable?
- What knowledge concerning future energy sources should be awaited before a decision on the final repository is taken?

A political process is needed to ensure that the overall objectives that a final repository for nuclear fuel waste should fulfil are clear to both authorities and the environmental courts before they are presented with an application from the industry to build a final repository.

### *4.9 The need for the Government to make it clear that it will not be possible for the industry to neglect or avoid giving alternative methods serious consideration in its environmental impact statement (EIS)*

In the Fud-07 report the industry refers to its work to develop a variant of the KBS-3 method with horizontal deposition of canisters as an “alternative design”. This is the phraseology used in the Environmental Code in a specification of the obligatory contents of an EIS document. At the same time, the industry terms the methods that all other actors consider alternative methods (transmutation, long-term intermediate storage and storage in very deep boreholes) “other methods”.

The Government, county administrations and regulatory authorities have long referred to these latter methods as “alternative methods”. This, the phraseology used in Swedish environmental law, was also used consistently in the two seminars arranged by the National Council on Nuclear Waste in 2006.

The industry’s idiosyncratic use of the term “alternative” in its Fud-plans seems to reflect a tactic on the part of the industry as the courts’ examination draws nigh. On previous occasions, the industry has stated that it does not intend to describe alternative methods such as deep boreholes, transmutation and long-term intermediate storage in the application, but in a separate appendix to the application.

In August 2006, the Administrative Board in the County of Uppsala [in which Forsmark is located] reacted sharply (dnr 559-6890-06, 2006-08-29) against the industry’s attempt to evade the requirement of thorough account of alternatives according to the Environmental Code. They stated that (our un-official translation):

> " An account of alternatives constitutes one of the fundaments in the assessments that – in the deliberations under the Environmental Code – shall be undertaken in accordance with the general rules of consideration regarding best available technology and appropriate siting, so as to provide for the least possible impingement on human health and the environment (chapter 2, 3-4§ of the Environmental Code).
>
> The account of alternatives should therefore make [the applicant’s] strategic reasoning concerning human health and the environment explicit, including issues relating to long-term safety and thrift use of resources. The EIS is also presumed to have an appropriate structure with regard to comprehensiveness and comparability with respect to the various alternatives.

> With regard to the mandatory demand of the EIS to account for the so-called null alternative, which among other things may demonstrate the urgency of the planned activity, and the need for a broad discussion of alternative sites and designs/methods/technology, the County Board has pointed out that the account of alternatives in the EIS should treat all possible alternative localizations and designs that are, or have been brought up in the course of the EIS consultation process or in the research and development effort. The discussion should, in the view of the County Board, be sufficiently comprehensive to allow to permit a balanced, comparative assessment of the advantages and disadvantages of each alternative, with particular attention to the impacts on human health and the environment, as well as thrift use of natural resources, as set out in 1 chapter, 1 § of the Environmental Code.
>
> The discussion of alternatives should, in the judgement of the County Board, also contain an analysis of the possibilities to reduce the volume of the waste and its toxicity (e.g., through separation and transmutation), inasmuch as it might reduce the risk of environmental impact."

The regulatory authorities and, to some extent the municipalities, too, have been critical of the industry's manner of treating alternative methods.

The industry's attempts to truncate the discussion of alternative methods in the EIS are unacceptable. According to its plan of action for 2008-2011 (SKI dnr 2007:1931), the industry is considering spending an additional SEK 130 million in addition to the amount already spent on developing the horizontal deposition concept, in order to "bring this variant up to the same level as the reference design". It cannot be ruled out that the industry is committing these funds solely for the purpose of enhancing its credibility in the eyes of the Environmental Court. Meanwhile, the industry has been totally unwilling to commit any money whatsoever into determining the long-term safety of the deep borehole alternative, where an investment of some SEK 150-200 million is believed to be enough to achieve a decisive result.

*4.10 The need to instruct the Radiation Safety Authority to draft a framework for its assessment of the industry's consideration of alternative methods for storing high-level nuclear waste in the forthcoming application documents.*

More research on a considerably broader front is needed to produce an adequate basis for the examination of the industry's proposed choice of method for final storage of nuclear fuel waste that authorities, the Environmental Courts and the Government are expected to undertake. In the

research program outlined in Fud-07, the industry's level of ambition when it comes to exploring alternative methods is entirely too low. What is more, the industry refers to the alternatives as "other methods" which is of juridical significance in the context of the examination of the application to build. Only two such methods are mentioned - deep boreholes and transmutation – and deep boreholes are treated only cursory. No null alternative is included. Thus, it is quite clear that the industry unilaterally has decided to confine its focus to one method, the suitability of which has not been seriously evaluated in relation to other methods.

The SSNC raised the possibility that deep boreholes might provide better long-term safety – both for the environment and vis-à-vis the risk of nuclear proliferation – than the industry's method of choice some sixteen years ago in its comment on Fud-92. The deep borehole alternative aroused some attention in the late 1980s when the industry made an initial survey of the alternatives to its own KBS concept. The Radiation Protection Authority, SSI, too, broached the deep borehole alternative in its comment on Fud-92 and in a separate letter to the Government (SSI dnr 8200/1813/92). Since then, the environmental movement has continuously called for more serious consideration of the alternative.

The industry has been unwilling from the start. Even in the research plans set out in Fud-92 and in the so-called PASS Project shortly thereafter, the industry made a first attempt to dismiss the deep borehole alternative as far inferior to its own method. Since then, and up to the present day, the industry has taken measures to avoid that this alternative be further explored, in part by performing evaluations that attempt to discredit deep boreholes as an option. In its plan of action with Fud-07 for 2008-2011 SKB AB writes (SKI dnr 2007/1931, our un-official translation):

> "One goal is that the [KBS] program is approved in its present state without demands for extensive additional work on, for example, the deep borehole alternative."

Thus, there is very little likelihood – as little today as in the past – that the industry will make any serious effort to explore the feasibility of deep boreholes as a storage option or to assess its merits with respect to long-term environmental safety. As we have seen, the industry makes no secret of its intention *not* to make any such efforts. In the meantime SKB is expending a good deal of energy on a discussion of alternatives to be included in the EIS, with the express intent of making the deep borehole alternative appear unrealistic and unsafe. The SSNC and MKG argue that it is unrealistic to expect the industry to do a proper job of producing the basis for a fair evaluation of the feasibility and long-term safety of the deep borehole alternative. Recent technological developments in the area of deep drilling suggest that such a project might be carried out safely and successfully, that deep boreholes would afford better protection of the environment than the

industry's method of choice, and that a repository in deep bedrock might be achieved at less cost than if the KBS concept is pursued.

Over the years, the industry has conducted numerous experiments ostensibly to evaluate alternative methods, but designed to demonstrate the superiority of the KBS method. For example: The research plan in Fud-07 (p 390) shows the following table that compares deep boreholes and the KBS method with respect to six criteria:

| Criterion/Basis for comparison | KBS-3 | Deep boreholes |
|---|---|---|
| No burden on future generations | = | – |
| Environmental safety demands | = | + |
| Security | = | – |
| Radiation protection | = | – |
| Safeguards | = | + |
| Costs | = | – |

The industry's assessment the point 'no burden on future generations' is highly surprising. If the long-term environmental safety of the deep borehole alternative is better, and if the safeguards protecting against the risk of future nuclear proliferation are better, then the burden on future generations must be lighter, not heavier. Also, it is not clear what the industry means by 'security' and 'radiation protection'. If the criteria refer to the execution of the respective methods, it is difficult to understand how they can be compared. Furthermore, there is reason to believe that the total cost of the deep borehole alternative might be less than the cost of the KBS project, even though there will be greater costs to develop the method. On balance, a more correct comparison might – once some further study of the deep borehole alternative, independent of the industry – have the following outcome:

| Criterion/Basis for comparison | KBS-3 | Deep boreholes |
|---|---|---|
| No burden on future generations | = | + |
| Environmental safety demands | = | + |
| Security | = | = |
| Radiation protection | = | = |
| Safeguards | = | + |
| Costs | = | + |

The deep borehole alternative comes out equal to (=) or better than (+) the KBS approach (used as the reference point in the table). Further study of the deep borehole concept is required before the outcome in the table can be

verified.  Otherwise, we have no reason to doubt that the outcome of an unbiased comparison may be as above.

In its Fud-report 2007 the industry states that it has no intention of pursuing the deep borehole alternative, other than to follow the general development in the field worldwide. Yet it is quite clear that the industry lacks the knowledge needed in order to draw the conclusions it draws. Further study is needed. In particular, the stability of the salinity boundary at depths of 1-2 kilometres through one or more glaciation periods needs to be determined. The industry actively seeks to prevent further study of the deep borehole option. Thus, the Government must see to it that the regulatory authorities are empowered, and have sufficient resources, to commission research of their own to provide an adequate basis for an evaluation of the deep borehole alternative, which is of crucial importance in the vetting of the repository project under the Environmental Code. The industry has claimed (SKB R-00-28) that it would take some thirty years and SEK 4 billion to research the deep borehole alternative. This is a gross exaggeration of both the time and resources that such a study would require.

One possibility to substantially improve our ability to judge the suitability of deep boreholes for storage of nuclear fuel waste might be to support ongoing scientific research within the framework of the Swedish Deep Drilling Project (http://www.sddp.se). Collaboration in this area also offers the possibility of co-financing with other actors. A project that would answer many central questions about deep boreholes need not cost more than the SEK 130 million that the industry plans to spend on the variant of KBS-3 with horizontal deposition of canisters.

*4.11 The need for the Government to make it clear that both long-term environmental safety and the security risks that possible deliberate or speculative violation of the repository poses weigh heavily in any evaluation of the various alternative methods for storage of high-level nuclear waste.*

The Fud-report does not discuss the long-term risk of nuclear proliferation. Safeguards to keep fissionable material (plutonium) out of the wrong hands during the initial phases of loading and storing are treated in Section 6.7, but there is no plan for keeping the repository secure once it is sealed.

There is a widespread presumption, or myth, that it would be difficult for anyone to get down into a KBS repository and retrieve fuel waste once the repository is sealed. Some demonstration of the purported difficulty is called for. It must reasonably be easier to penetrate an existing tunnel that has been filled with clay and crushed rock than to create a new route of access. Moreover, the hazardous, and thus “protective”, radiation around the canisters subsides relatively quickly; after a few thousand years handling the canisters would pose no greater difficulty. Several conceivable scenarios indicate a

substantial risk that the repository may be used as a source of material for the manufacture of nuclear weapons. Neither risk scenarios of this kind nor the issue of long-term risk of nuclear proliferation is discussed in the Fud report.

Thus, for several hundred-thousand years there will be a risk that the plutonium stored in the final repository may be used to produce nuclear weapons. What is more, radioactive material may be used to make sub-critical radioactive 'dirty bombs'. In the Swedish summary of the industry's safety analysis last year, SR-Can (SKB R-07-24, the industry describes the long-term threat, as follows (our un-official translation, p. 78):

> "Neither can ill-willed deliberate violation be excluded. The spent fuel is dangerous and can therefore be used to damage both human life and the environment. Parts of the fuel can, after extensive processing, be used to manufacture weapons. Forcing one's way down to the repository is a long and complex undertaking that cannot reasonably succeed without societal consent, at least not as long as society is organized as it is today. Such an operation would also require a great amount of resources. Should a society or group of individuals have such evil intent, there would most probably be easier ways for them to reach the same objective."

The nuclear industry writes "not as long as society is organized as it is today" and uses evaluative terms like "complex," "reasonably" and "most probably". This usage reflects two things: (1) that the industry recognizes that society as we know it cannot be taken for granted, and (2) that the industry is not in a position to predict the future with any certainty.

The SSNC and MKG do not share the industry's opinion that a desire to use the contents of the repository is unlikely. On the contrary, we can think of a number of scenarios in which the material might be put to military uses or used to spread terror. Inasmuch as plutonium-239, the principal isotope in weapons-grade plutonium, has a half-life of 24,110 years, the problem will be with us for several hundred-thousand years.

After about one thousand years the radioactivity in the waste will have declined to the extent that the "extensive processing," as the industry describes ordinary reprocessing, can be carried out with a lower level of radiation protection precaution than is needed today. Reprocessing of irradiated fuel is, furthermore, a proven technology, well-known since the 1940s, when it was developed in the USA's wartime nuclear program.

Let us consider a simple scenario that belies the industry's contention that there would be "easier ways to reach the same objective": Without getting into the issue of whether Iran or Iraq has wanted to obtain nuclear weapons, we can observe that had anyone wanted to acquire nuclear weapons these past

few decades, by far the easiest way to come by the plutonium required would have been to plunder a repository for nuclear fuel waste of the kind proposed by the Swedish nuclear industry, if such a repository were present in these countries.

Over the next century or so, the global energy system will most probably rely increasingly on renewable energy sources. In the long-term, military or civilian use of nuclear technology may well have ceased. In such a world – which is not unlikely a good part of the coming 100,000 years – plutonium in repositories of the kind the Swedish nuclear industry plans to construct will be the readiest source of material for nuclear weapons.

### *4.12 The need to ensure that the Radiation Safety Authority continues to develop its own work to inform its evaluation of an inland location of the repository with respect to long-term environmental safety*

The siting of a repository for nuclear fuel waste must be guided by the objective of finding the best combination of site and method, judged from the perspective of environmental safety and human health in the longer term. The choice of localities for further study (exploratory drilling, etc.) has, however, been guided by local acceptance and industrial convenience, not safety. This contradicts the letter and intention of the law. Arguments relating to taking account of macro-regional groundwater flows, groundwater salinity, and collective radiation doses, assuming dilution of radioactivity in the sea, are all important considerations from an environmental point of view.

The industry has long had its own answer to the question of whether the siting of a final repository should be guided by environmental or other factors: the industry maintains that the bedrock and groundwater conditions nearly anywhere in Sweden are good enough. On that basis they have found it appropriate to choose two sites directly adjacent to nuclear power installations, and it seems that they intend to present these two sites as alternative sites in the sense of the law.

But a number of important questions concerning the possible environmental advantages of other sites remain to be penetrated. One is the possibility that locating the repository in a zone of groundwater inflow might significantly extend the period it takes for leakage from the repository to reach the surface of the earth and human beings. The industry's discussion of the importance of regional groundwater flows in relation to the long-term environmental safety of a repository on pages 329-332 in the Fud-2007 research and development programme is unnecessarily convoluted and difficult to understand.

The issue of siting and long-term environmental protection has been studied for a decade. The aim has been to ensure a long lag period between leakage from the repository and contact with human beings. Both of the candidate sites that the industry now focuses on involve formations characterized by outflow of

groundwater; localization at either site would imply rather rapid penetration of the natural barriers, as little as 50-100 years after a breach in the repository. Localization in a formation characterized by inflow of groundwater might, in contrast, afford a lag period of up to 50 000 to 100 000 years before leakage reached the surface. The lag period also means that the radioactivity would have diminished considerably before the leakage came in contact with human activity.

In October 2007, the Radiation Protection Authority, SSI, and the Reactor Safety Inspectorate, SKI, addressed (SSI dnr 2007/1562/26, SKI dnr 2007/598) a joint letter to the industry. In it they express satisfaction with the industry's modelling of regional groundwater flows, but comment that the industry had not drawn the consequences of its models. Follow-up studies should be incorporated into the Fud research plan.

The regulatory authorities also broach the problem of groundwater salinity at inland and coastal sites, respectively, and point out that SKB AB needs to study the effect of saline groundwater on the performance of the buffer material (bentonite clay) in the final repository. Judging from the discussion of localization in Fud-2007, the presence of saline groundwater at presumptive sites would not appear to figure in the industry's research plans.

SSI's and SKI's studies of the in- and outflow issue indicate obvious uncertainties regarding the environmental consequences of a coastal siting. Localization of a final repository for nuclear fuel waste inland, in a zone of regional groundwater inflow may provide longer immobility and better opportunities to delay leakage from a repository before radioactivity reaches the surface of the earth. Coastal sites like Oskarshamn and Forsmark, both in zones of groundwater outflow, imply the risk of more rapid spread of radioactivity from the repository into the biosphere. Localization of the repository to an area above the highest coastline in a deep formation characterized by groundwater inflow may, in the long-term, imply less impact on human health and the environment — a prime criterion in the Environmental Code. Any systematic localization process should include inland as well as coastal sites in the survey phase, and safety aspects should be given highest priority.

The Government's decisions on Fud-98 and Fud-K review the arguments concerning in- and outflow of groundwater. The Government presumed at that time that the industry would take account of these arguments in the site selection process.

It is important that the authorities continue to develop their own knowledge of macro regional groundwater flows so that the Radiation Safety Authority will be able to perform an independent analysis of this crucial issue when the industry submits its application to build

*4.13 The need to make sure that both collective radiation doses from diffuse sources and the impact of radiation on the entire eco-system are included in safety analyses*

In assessing the environmental impacts of the KBS method applied to a coastal site, the anticipated collective radiation dose is an important factor. Presently the industry and the regulatory authorities are focused on analyzing the expected individual doses that may result from leakage from a final repository. A coastal location that would imply relatively rapid dispersal of radiation in the sea would expose rather many people and other organisms to ionizing radiation, and the collective dose may be very high. An ethical (and economic) weighing of safeguards against future damage presumes some idea of the future collective doses that can be anticipated and the number of people that may suffer injury or die in various scenarios. It is vitally important that the planned diffusion of radioactivity and its environmental consequences be made explicit in the EIS document.

Radiation protection agencies and researchers around the world are working, not least within the IRC, to gain a better understanding of the effects of radiation on the natural environment. This valuable research must continue, both on an international plane and in Sweden. It is equally important that impacts on the natural environment be included in the assessment of the long-term environmental safety of a final repository for nuclear fuel waste.

*4.14 The need for the Government to make it clear to the industry, to local government and to other actors that long-term environmental safety is an overriding criterion that may not be compromised by hastening the decision to establish a repository*

It is the industry's intention, as soon as possible, to obtain a permit to start constructing a final repository according to a method that was chosen some thirty years ago. The reasons for the industry's impatience to start building are several. For one thing, it is important for the nuclear industry to demonstrate to the rest of the world a feasible solution to the waste problem. The local municipalities are also eager to reach closure, it seems.

There are, however, other and in our view more important reasons that caution against rushing to decision. First and foremost, there are the remaining fundamental uncertainties about the long-term safety of the industry's proposed method. Second, there should be time for an independent study of the deep borehole storage alternative to permit its evaluation on a par with the industry's method of choice, KBS. Third, the choice of a method for storage of nuclear waste also has to do with issues relating to the future global energy supply, particularly whether or not nuclear energy will continue to play a significant role. This in turn raises the question of the value of irradiated nuclear fuel as a potential source of energy. The world will know much more about the global energy future within the next decade or so.

The industry argues that if it is not granted to start the repository project there is a risk that no repository will be built, or that the resources in the Nuclear Waste Fund will evaporate. The SSNC and MKG are considerably more optimistic on that account. A hasty decision to build a repository may turn out to be a waste of resources and money out of the Fund and, furthermore, lead to unacceptable risks to future generations and the environment.

### *4.15 The need to review and revise legislation in the area of radiation protection*

The Government should review Swedish law in the area of radiation protection. With the creation of the new Radiation Safety Authority the need arises to revise and harmonize sectored law in the area (more precisely, the Nuclear Technology Act, the Radiation Protection Act and Nuclear Waste Financing Act. In our view, the revision should go so far as to incorporate all three laws into the Environmental Code. In this way nuclear energy – clearly one the potentially most hazardous industries Sweden have - would be included in the law that normally regulates environmentally hazardous activity. This would also facilitate the consideration of nuclear technology and radiation protection in relation to Sweden's national environmental objectives and strivings toward overall ecological sustainability.

### *4.16 The need for the Government to review and reorganize the administration of social science research relating to nuclear waste management*

An interesting issue for the deliberations on Fud-07 is to look into the possibilities to transfer the social science research capacity in the industry's Fud program to a less partisan institution.

The industry currently uses about ten million SEK a year to support social science research. Given the present administrative structure, important and interesting issues that should be studied are neglected, while the industry – which is empowered to commission research – tries to steer researchers' interest toward subjects that serve its own interests. Here are some examples of particularly important topics suggested in the 2007 announcement of available research funding:

- Should formal authority to take a decision [on a final repository for nuclear waste] be more local and thereby reflect the local community's attitudes toward, and familiarity with, the project?
- Is it legitimate to formulate more or less absolute requirements for a permit according to the Environmental Code and the Nuclear Technology Act and then distribute responsibility for the various requirements among the respective authorities?
- Is it reasonable to impose a requirement of best available technology even though the resources that a marginal increase of risk would make available

might save human lives if they were, for example, applied to improve traffic safety?

- In an ideal world policy-makers should take their decisions on the basis of a comprehensive assessment of the best interests of people and society at large. Is such an assessment actually possible? Or is society organized such that partisan interests take priority over the common good, the parts to exert power over the whole, and short-term considerations to override long-term ones? What are the areas of conflict, where are they located, and how do they arise? How are power, responsibilities, profits, and losses distributed; what is democracy, and whose democracy shall rule?
- May decisions on parts of a problem complex be taken if they influence the nature of the ultimate decision? If the answer is no, one might conclude that no important decisions can ever be taken, since all decisions of any consequence will influence coming decisions.
- In well-financed projects different actors can make a variety of demands – for more detailed study, for consideration of more aspects, alternative methods and more research, before decisions are taken. One possible consequence of this is that well-financed projects may find it difficult to proceed from the planning phase to the execution phase, inasmuch as there is always the possibility that new demands may be raised. On the other hand in that case, do projects undertaken on limited budgets have a better chance of 'crossing the finish line' and actually being effectuated? Some research questions might be: Is there a link between degree of financing/kind of financing and demands made [on the research], and what is the nature of the relationship, for the possibility to carry out major projects that aim to solve problems of urgent importance to people, the environment and society as a whole?

The announcement may be read in its entirety on MKG's website, on the page where MKG presented (December 2007) its current examination of the industry's research plan: http://www.mkg.se/index.php?id=news148.

It is clear to anyone who has followed the nuclear waste issue here in Sweden that the above 'questions' are deigned to steer research in directions that suit the industry's interests. The fact that the industry commissions social science research in itself may reduce the opportunities for scholars to receive funding for research on the nuclear waste issue from other, independent sources. Thus, it is important for those who evaluate the Fud process to consider ways in which the present organization might be altered so that social science research on nuclear waste might be more independent of the industry.

### *4.17 The need to ensure that environmental organizations can receive funds out of the Swedish Nuclear Waste Fund even after 2008.*

The Nuclear Waste Financing Act has made it possible for environmental organizations to receive economic support from the Nuclear Waste Fund. A trial period, 2005-2008, is currently being evaluated by the Swedish Agency for Public Management. Among other things, the trial period has made it possible for the SSNC, through its involvement in MKG, to take active part in the

consultation process on the EIS that will accompany the Swedish nuclear industry's application to build a final repository for nuclear fuel waste.

In our view, MKG has lived up to the intentions that inspired the trial period; how third parties judge this will soon be known when SAFAD publishes its findings. To sustain and strengthen the future consultation process and the evaluation of the industry's EIS it is important for the environmental movement to continue to be able to receive funding from the Nuclear Waste Fund.

## 5. Closing words

In the foregoing comment on the industry's Fud 07 research program, the SSNC and MKG have expressed substantial concern regarding the manner in which the industry and the principal regulatory agency (the Reactor Safety Inspectorate, SKI) have conducted the waste management process – albeit a certain improvement on the part of SKI has been noted recently.

We believe that the new regulatory authority, the Radiation Safety Authority, has good prospects of doing a better job. But that alone will not suffice. What is needed, above all, for the successful execution of the nuclear waste management project, and for the quality of the project from an environmental point of view, is for the Government to take a more active part in the process than has been the case to date, with explicit instructions and the requisite resources to the Authority and other agencies, and specific requirements made of the industry.

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**Part C:**

Comments from MKG prior to the Government's decision concerning the industry's (SKB) research programme Fud-07
2008-10-30

(12 pages)

mkg
Miljöorganisationernas
kärnavfallsgranskning

2008-10-30

To: The Government
Ministry of the Environment, 103 33 Stockholm

To: Ministry of the Environment, Division for Environmental Quality
Dnr: M2008/2833/Mk

# The Swedish NGO Office for Nuclear Waste Review, MKG's, specific comments prior to the Government's decision concerning on the Nuclear power industry's research programme Fud-07

The Swedish NGO Office for Nuclear Waste Review, MKG, here presents its comments prior to the Government's forthcoming decision according to the Nuclear Technology Act (1984:3) concerning the nuclear power industry's nuclear waste company's (SKB's) research programme Fud-07. This comment is addressed both to the Swedish Government and to the Department for Environmental Quality at the Ministry of the Environment.

MKG disclosed a detailed statement concerning FUD-07 in the spring of 2008. Since then MKG has read the comments from the authorities and the Swedish National Council for Nuclear Waste, and the industry's responses to these comments. The Swedish Radiation Safety Authority (SSM) and the Swedish National Council for Nuclear Waste have in turn commented on the industry's responses. The viewpoints and the new information that has emerged in these communications motivate a completing statement from MKG. We find that it is imperative that the Government take several important issues into careful consideration before its decision in order for the Swedish nuclear waste to be handled in an environmentally optimal fashion. These issues are presented in the following.

## *Problems with the artificial barriers in the KBS-method*

New information gives reason to suspect serious problems for the long-term environmental safety with the KBS-method for final disposal proposed by the industry. These problems concern the artificial barriers that are central to the method. Specifically, research has indicated problems with the bentonite

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clay and that copper-corrosion may occur, both of which are discussed in more detail in the following. These problems have also been raised by the Swedish Radiation Safety Authority (SSM) and the Swedish National Council for Nuclear Waste. MKG urges that the Government consult these authorities about recent findings before making decisions regarding the industry's research programme.

### *Environmental consequences of copper corrosion in water without oxygen*

In the fall of 2007 a research group at the Royal Institute of Technology presented experimental results demonstrating corrosion of copper in oxygen-free water. Recently the same researchers presented the results of a 15 year long similar experiment at an international conference (see picture below).

**FIGURE 1 – Appearance of copper after 15 years of exposure in distilled water at room-temperature. Hydrogen from corrosion can escape from the left container but not from the container to the right. The water volume was equal in the flasks in beginning of the exposure.**

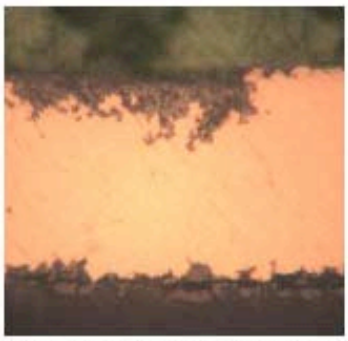

**FIGURE 2 – Light optical cross-section of the initially 100μm metallic copper foil after 15 years exposure in distilled water. Localised corrosion attack is clearly visible.**

Figure 1. Corrosion of copper in oxygen free environment after 15 years (from "Detection of Hydrogen In Corrosion Of Copper In Pure Water", G. Hultquist et al., article presented at the 17th International Corrosion Congress, Las Vegas, 6-10 October 2008)

The pictures show two similar containers with initially the same amount of water and the same foils of copper, but sealed with different lids. The lid of

the right container is made of platinum, which is impervious for all gases. The lid of the left container is made of palladium, which is impervious for all gases but hydrogen. A continuous corrosion process was sustained in the left container because it allowed hydrogen gas to diffuse. After 15 years it is clear to the naked eye that corrosion has occurred in the absence of oxygen. The picture below shows a cross-section of the foil. The whole essay can be found on MKG's homepage.

Several parties have expressed scepticism against the results that were presented by the KTH researchers in fall 2007. MKG has followed this debate closely, and has the impression that the researchers are able to address all criticisms and questions satisfactorily. Furthermore, the researchers have shown that the industry's and the SSI's arguments for not accepting similar results in the 1980´s were not scientifically well-founded.

MKG finds that the long-term experiments settle as a fact that corrosion of copper in oxygen-free water can occur. It is therefore necessary to independently from the industry investigate the possible consequences of this for the environmental safety of the industry's method for final disposal. This question might be of vital importance for long-term environmental safety, and MKG wants in particular to draw attention to the referral from the Royal Institute of Technology on the nuclear industry's research programme Fud-07. This referral discusses the risk of fast corrosion of copper, the risk that hydrogen gas may make the copper canister collapse, and the risk of effects of diffused copper from the canister on the bentonite clay. The referral can be found on MKG's homepage.

The industry does experiments at the Äspö laboratory close to the nuclear power plant in Oskarshamn. Some of the results from those experiments, especially those concerning copper exposed to groundwater at higher temperatures, could now illuminate how corrosion in oxygen-free water might affect a canister of copper. The industry has unfortunately not yet published these results although it is now more than two years since they began being analyzed.

How copper-corrosion might affect the long-term safety of final disposal with the KBS-method has also been the issue for a bill to the Swedish Parliament: Motion 2008/09:fp1086 "Koppar som korrosionsbarriär vid slutförvaring av kärnbränsle" by Barbro Westerholm (fp – the Liberal Party).

MKG requests that the Government consult SSM and the Swedish National Council for Nuclear Waste in this matter, and thereafter considers if the nuclear industry's research programme Fud-07 should be approved before the consequences of copper corrosion in oxygen-free water are further investigated.

### *The environmental consequences of the industry's failure to prove that the bentonite clay barrier will behave as was initially assumed*

The Radiation protection agency has drawn the industry's attention to a number of problems with the long-term safety of the proposed method for final disposal. The authorities' assessment of the industry's own safety analysis, SR-Can, raises many questions. One of the most important is how long time it will take to reach the so called initial condition, given the small amount of water that characterise the rock at Forsmark. First when the initial condition is reached will the copper canister and the clay together fulfil the conditions for long-term environmental safety, as envisioned by the industry's systems description. The industry states now that it might take as long as one hundred years, which is problematic enough. However, authority experts assessing SR-Can have estimated that it may take as long as 30,000 years to reach the initial condition. There is also a concern that the bentonite clay will become desiccated closest to the canister.

Only in the last few years has the industry changed its choice of material for filling the dumping tunnels after disposal of the waste from 70 percent crushed stone to 100 percent friedland clay, and to 100 percent bentonite clay. MKG argues that this is an indication of the industry's rudimentary knowledge about the risks for clay-erosion in the dumping tunnels. SKI and SSI wrote in a letter to the industry on November 22nd 2007 "enligt myndigheternas uppfattning befinner sig SKB:s hantering av bufferterosion på ett mycket preliminärt stadium" [it is the authorities' opinion that SKBs handling of erosion of the barrier is in a very preliminary state].

The industry performs experiments in the Äspö laboratory to investigate how bentonite clay behaves in the rock and in the vicinity of hot copper surfaces. The industry seems reluctant to present these results since they have been considerably delayed, and it is MKG's impression that this may be because the bentonite clay has failed to exhibit the expected properties.

MKG requests that the Government consult SSM and considers if conditions are required in the upcoming decision to approve the nuclear industry's research programme, Fud-07, concerning the industry's and other parties' work with the clay barrier and filling.

### *The need for resources for independent research about nuclear waste disposal*

The fact that the nuclear power industry and the former authority SKI have failed to notice and consider a critical corrosion process – although established twenty years ago – shows that independent research about nuclear waste disposal is of vital importance. It is also of great importance to establish research in areas that the industry out of self-interest refrains from.

The question about independent research is raised in a bill to the Parliament: Motion 2008/09-c-381 "Oberoende forskning om kärnavfall"

[Independent research in nuclear waste] by Eva Selin Lindgren and Sven Bergström (c – the Centre Party).

MKG requests the Government to appoint to an investigation about how to organise independent research supported by The Swedish Nuclear Waste Fund. The investigation should preferably also address how to enable and organize a wide range of nuclear waste disposal research when the industry has no longer any interest in pursuing such research. This will occur in only a few years if the process proceeds according to plans: It is inconceivable that the industry will care to devote resources to cover the field and consider new options and technical solutions for handling nuclear waste once its application for building the final disposal system has been submitted.

MKG notes that it would be a relatively simple matter to transfer the resources that the industry is now using for its social science research programme to an independent research body.

### *Admission of environmental organisations to information and consultation meetings ("samråd")*

During the last four years SKB has refused environmental organisations who receive funding from The Swedish Nuclear Waste Fund to participate in the information meetings and consultation processes that SKB organises. The industry has tried to exclude environmental organisations from the central process by dividing the parties into those who have influence and affect decisions, and those who do not (where environmental organisations are included). Acting on this principle the industry has consistently refused environmental organisations to participate in their own information meetings and in consultation meetings that have been initiated after previous Governmental decisions. This behaviour has also befallen the Swedish National Council for Nuclear Waste, which in its recent referral of Fud-07 has asked the Government to decide that it be admitted to the national consultations. The local districts Oskarshamn and Östhammar are already admitted as observers to these meetings in their capacity as prospective sites for final nuclear waste disposal.

It is MKG's opinion that environmental organisations should have admission to any meetings that are important for understanding the ongoing development in the nuclear waste process. It is extremely inefficient for environmental organisations such as MKG to spend extra time and other resources to obtain this information by alternative, roundabout routes. Another reason for demanding environmental organisations' right for admission is that the industry has declared its intention to handle forthcoming central issues primarily in the national consultations.

Several Governmental decisions have been made - the latest in October 2008 that give environmental organisations the right to apply for funding from The Swedish Nuclear Waste Fund in order to participate in the national consultations and to cover and assess issues relevant for the disposal of nuclear waste and its effects on the environment and on human health. The

industry's behaviour undermines these intentions and reduces the possibility for environmental organisations to use the resources given efficiently. MKG requests the Government to demand the right for environmental organisations that receive means from The Swedish Nuclear Waste Fund to participate in national consultations and information meetings organised by the industry.

### *Improved quality control of the industry's research and development activities*

It is important to ascertain the quality of the industry's research and development activities, which requires increased openness and scientific standards. It stands to reason that the nuclear power industry has a strong incentive to establish a Swedish repository for nuclear waste as fast as possible, since time is money. The industry has already devoted large-scale resources from The Swedish Nuclear Waste Fund to its proposed KBS-3 method, and accordingly a considerable amount of prestige. Emerging problems with the long-term safety of the industry's method call for increased control by the responsible authorities, such as primarily the SSM. MKG stresses the fact that the industry has exhibited an incapacity to handle knowledge and information in previous situations where there has been controversy, for example in assessing the alternative deep bore hole method and in assessing environmental long-term advantages with inland locations of the final nuclear waste repository.

Furthermore it is important that the industry's work with development and research in the Äspö laboratory becomes available for scientific scrutiny by independent parties. These reports are presently proprietary non public documents. MKG requests the Government to consult the SSM in order to achieve a better and intensified quality control of the industry's research and development activities, including availability of its results to all parties.

### *The Radiation Protection Agency's own initiatives and resources*

It is very important that the SSM has access to independent data on which to assess the industry's claims and conclusions. This is equally important for addressing the issues that the industry does not want to consider, and therefore does not provide data for. The importance of independent data seems not always to be apparent for the SSM. To exemplify this, MKG wants to highlight the presentations that the industry and the SSM held at Arlanda on October 6th 2008 concerning the new experimental results of copper corrosion in oxygen-free water. On a question from MKG the representatives for the industry asserted that they doubt the truth of these results, and that even if copper corrosion may exist it will have no negative effect on the safety of the industry's method for final disposal. The SSM stated that they had commissioned a group of experts to study the question, which had come to some conclusions and identified a number of questions that required further study. The SSM told the industry this and that the issue thereby laid in the hands of the industry since the SSM has no resources to

initiate their own investigations, and since it is the responsibility of the industry and not the SSM for doing this.

MKG finds that this state of affairs is profoundly counterproductive for achieving the goals stated by the environmental code act. It is imperative that the SSM is proactive in the process of elucidating controversial issues in the field of nuclear waste. Historically the Swedish authorities have shown a varying level of initiative in obtaining knowledge by initiating investigations of their own. Relatively comprehensible investigations have been made concerning possible environmental advantages of locating a disposal in the inland, but very little concerning possible environmental advantages of deep bore holes.

MKGs realises that the SSM may need extended resources in order to competently assess the quality of the industry's work to exercise professional quality control. MKG requests that the Government, in its coming decision regarding the industry's research programme, emphasizes the importance of independent research on the part of the SSM. Furthermore the Government is requested to emphasize the importance of authorities' quality control of the industry's work. The Government is also requested to provide the SSM with resources from the Swedish Nuclear Waste Fund to fulfil these demands.

### *The importance of comparative safety analyses for all alternative locations*

MKG has interpreted a number of signals from the industry such that it will only present a full safety analysis for the eventually chosen location of a nuclear waste repository. It would therefore seem that not even the remaining two alternatives Östhammar and Oskarshamn will be presented with full safety analyses, so that the SSM and other actors can make an independent assessment regarding their respective environmental consequences, and evaluate the choice of final location by the industry. MKG finds that this is clearly not acceptable according to the environmental code, which emphasizes openness in the choice of the best alternative. To fulfil the intentions of the law and provide sufficient information evaluating the environmental consequences of the choice of location requires full safety analyses of both locations. The SSM and the Swedish National Council for Nuclear Waste also expressed concerns about this in their comments to the Ministry of the Environment in September 2008. MKG requests that the Government, in its coming decision regarding the industry's research programme, emphasizes the importance of having full safety analyses for both locations as basic data for the SSM and the Environmental Court when handling the application.

### *A horizontal orientation within the KBS-concept should not be allowed without a new application according to the Law of Nuclear technology and the Swedish Environmental Legislation*

The industry has, subsequently to submission of the research and development (Fud) programme, informed that they will apply for a final repository according the KBS-method in which the copper canisters could be oriented either vertically or horizontally. It is MKGs assessment that given the short period of time that remains before the industry will submit its application, according to plans, it is impossible for the industry to obtain sufficient knowledge about horizontal orientation of canisters, and that it would therefore be unreasonable to allow alternative orientations. MKG requests that the Government, in its coming decision regarding the industry's research programme, emphasizes that a change from vertical to horizontal orientation within the KBS-method demands new applications for permission. This stance is supported by comments from the Swedish National Council for Nuclear Waste to Ministry of the Environment in September 2008.

### *Full documentation for comparing with an environmentally optimized inland location*

Finding the best location for a final repository is one of the most important environmental issues bearing on the disposal of nuclear waste. It seems an improbable coincidence that the two alternative locations for nuclear waste chosen by the industry, in the vicinity to Sweden's' two largest nuclear power plants, should also be the best locations from an environmental point of view. The Swedish Society for Nature Conservation and other environmental organisations have since long criticized the industry's process for choosing locations on the grounds that it has not sufficiently been focused on optimal long-term safety.

Since around 2000, a number of investigations have considered the time it takes for radioactive diffusion to reach man and environment. The current plans for locating a repository close to the Baltic Sea coast implies very short times on the order of 50 to 100 years following a leakage before radioactive material reaches the ecosphere by means of ground water flow. Location in so-called inflow areas may increase this time to 50-100 thousand years before a leakage reaches the surface. This means that radiation from a leakage in inflow areas has considerably more time to abate before reaching the environment and human beings.

SKI and SSI have examined the industry's latest report on this issue. They found that the industry's modelling of regional groundwater flow was competently performed, but that they had failed to draw important conclusions from the model. The authorities stressed the importance of motivating the choice of locations in a coming application. The industry must disclose how the choice relates to employing the best possible technology and to consideration of optimization. A systematic process of choosing

location must include both inland and near-coast alternatives, and safety aspects must be given the greatest weight.

In its comments on Fud-07 in the spring 2008 the Swedish Society for Nature Conservation and MKG argued that a comparable localisation survey must be done for an inland location (an inflow area above the highest coast line). MKG considers it important that the SSM further develops the knowledge they have attained in the field of regional groundwater flow. This would increase the possibility for the SSM to perform an independent analysis of this important question when the industry submits its application. MKG suggests that the Government in its coming decision regarding the industry's research programme emphasizes the importance that the SSM develops its knowledge in the field of regional groundwater flow, in order to assess if the industry's presents a sufficient basis in its application. This suggestion is related to the need for independent research discussed above.

### *Presenting full accounts of alternatives*

The industry has over the last years downplayed the importance of presenting a full account of alternative locations and methods in the application. MKG requests the Government, in its coming decision regarding the industry's research programme, to emphasize the importance of full available basic data in the description of environmental consequences. Specifically, full documentation for comparing alternatives should be made available with regard alternative locations, methods, including vertical versus horizontal orientation of canisters.

### *Full basic data to compare the KBS-method with the alternative deep bore hole method*

MKG notes with interest that SSM in their latest comment in September 2008 to the industry's research and development (Fud) programme questioned if its plan to "make a deepened material for comparison between deep bore holes and KBS-3" can be regarded an acceptable deepening of the question, since the intention of SKB is to put together all the old material into a concluding report about deep bore holes. SSM argues that they have in fact asked for further studies and investigations based on the shortcomings of previous data, in order to elucidate the relative advantages of these approaches.

MKG concurs with SSM in this view, but we argue that it will be necessary for the SSM to obtain this material by other routes than from SKB. The industry conceivably has no interest to make fair environmental comparisons between these methods.

On this note MKG again wishes to refer to the comparison of these methods made by the Swedish Society for Nature Conservation and MKG, presented in their common commentary on the Fud-07 referral this spring. Our organizations then argued that a fair comparison between the industry's

method and the deep borehole method presumably looks something like this:

| Demands/Comparison | KBS-3 | Deep bore holes |
|---|---|---|
| No burden on future generations | Reference | Better |
| Environmental demands | Reference | Better |
| Demands of safety | Reference | Equivalent |
| Demands of radiation protection | Reference | Equivalent |
| Safeguards | Reference | Better |
| Costs | Reference | Better |

The table compare the alternative deep bore hole method with the industry's KBS-method as reference, and shows that deep bore holes are better or equivalent with regard to all criteria considered by industry in their own analyses. A plus is used to indicate an advantage; costs might for example be smaller for deep bore holes.

MKG requests the Government, in its coming decision regarding the industry's research programme, to emphasize the importance that SSM acquires its own basic data by which to assess whether the industry has fairly evaluated the deep bore hole alternative. This question is again related to the need for independent research discussed above.

### *Improved control of, and limitations on, the industry's use of resources from The Swedish Nuclear Waste Fund*

MKG finds that explicit limitations are lacking on how many resources the industry can obtain from The Swedish Nuclear Waste Fund and for what purposes. The industry seems to perceive these resources as its own and historically SKI has shared this apprehension.

In practice there has been no external audit or evaluation of the industry's use of resources from The Swedish Nuclear Waste Fund. These resources are collected from the users of nuclear power electricity, and can be regarded as public money. The only disclosure that the industry has done on this issue is reporting to the SKI how much money the industry expects to use in the future – information to be used for calculating charges intended for covering the final disposal – and how much money the industry has eventually used. This procedure has lead to inefficiency and to unwarranted use of public resources for one-sided propaganda for their own method.

MKG requests the Government to consider setting up an investigation to examine how the use of resources from The Swedish Nuclear Waste Fund can better be controlled and more efficiently used. Alternatively, the Government can instruct the SSM to handle these issues.

### *Risks of deliberate and/or speculative encroach in a final repository*

There will for several hundred thousand years be a threat that the plutonium in the final repository is used for nuclear weapons. The radioactive material can furthermore be used in so-called radioactive dirty bombs.

The Swedish Society for Nature Conservation and MKG, in their spring 2008 Fud-comments, pointed out several plausible scenarios in which the material could be used for terror or military purposes. Plutonium 239, the most important isotope in plutonium for nuclear weapon construction, has a half-life of 24 110 years, and this problem will therefore persist for several hundred thousand years.

Increased use and importance of renewable sources of energy is a probable development of the global energy system in the next few hundred years. It is likely, in the long term, that there will be no large-scale military or civil use of nuclear technology. In this situation plutonium stored in final repositories of the type that the industry wants to build will be the only feasible source of material for nuclear weapons.

Both the long time environmental safety and the risks of deliberate and speculative encroachment are important for evaluating alternatives for final disposal of nuclear waste. The long-term risks of nuclear weapons proliferation must in the future be better handled by the SSM than SKI historically did.

MKG requests the Government, in its coming decision regarding the industry's research programme, to emphasize the importance of data independent from the industry on which the SSM can assess the risks of deliberate and speculative encroachment of a final repository for nuclear waste, and in particular the long term risks of nuclear weapons proliferation.

### *Concluding comments*

In this document MKG has disclosed a number of viewpoints to be taken into account when the Government makes its coming decision regarding the industry's research programme Fud-07. Several of these viewpoints are developed in the comments from the Swedish Society for Nature Conservation and MKG to SKI in the spring of 2008. These comments can be found on MKGs homepage.

MKG urges that it is imperative to take these issues into consideration prior to the following decision in order for the development in the area of nuclear waste disposal to lead to the environmentally best handling of the nuclear waste. MKG intends to ask for a meeting with representatives for the Government and the Ministry of the Environment to inform about MKGs viewpoints and discuss the contents of this comment.

Kind regards,

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Hultsfred Municipality (Hultsfreds kommun)
The Regional Council in Kalmar County (Regionförbundet i Kalmar län)
Uppsala Regional Council (Regionförbundet i Uppsala)
The Swedish Environmental Movement's Nuclear Waste Secretariat (Milkas)
SERO
Greenpeace
Swedish Nuclear Fuel and Waste Management Co, SKB

**Part D:**

Brief background on the Fud-process (RD&D process) in Sweden

(2 pages)

Miljöorganisationernas kärnavfallsgranskning

2007-09-27
(Rev 2008-09-30, English translation 2009-03-29)

# Final disposal of used nuclear power fuel: Short background describing the FUD-process and the handling of the industry's research plan FUD-07

Every third year the Nuclear power industry's nuclear waste company, SKB, shall report its work with handling nuclear waste to the authorities. This is regulated in the Act on Nuclear Activities and Ordinance on Nuclear Activities and the authority responsible for this is, since the first July 2008, the Swedish Radiation Safety Authority, SSM. The report is named FUD-program where FUD is an acronym for the Swedish words for research, development and demonstration. The most recent report in this series, FUD-07, was submitted to the Swedish Radiation Protection Institute, SKI, which is nowadays a part of SSM. The report was referred to consideration on a broad basis. A large number of parties, including The Swedish NGO Office for Nuclear Waste Review, MKG, submitted reports. SKI summarised and reported this feedback together with its own reports about the FUD-report to the Government in June 2008. The Swedish National Council for Nuclear Waste, the state's authority for nuclear waste issues, submitted a separate report to the Government in June 2008. The Industry, SKB, was given opportunity to report on these documents, and thereafter have the SSM and the Swedish National Council for Nuclear Waste responded to industry's reports. All these communications can be found on MKG's website.

The Government will, probably before the end of 2008, decide whether the industry's research program fulfils the demands according to the Law of nuclear technology. This triennial decision is the Government's opportunity to intervene in the nuclear waste process by means of specifying conditions for the decision.

The industry's FUD-report was presented in the beginning of October 2007. An information meeting for the parties involved in the consideration process was arranged by SKI in Stockholm the 26th of October 2007. The deadline for reports to SKI was the 15th of March 2008. This consideration process was open not only the instances normally involved in the consideration but to anyone, including the public. More information of how to respond to considerations is found on the homepage of the Government Offices of Sweden. The Swedish Society for Nature Conservation and MKG submitted

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a common report to the FUD-07 in April 2008. This report contains substantial criticism of the ongoing process for handling nuclear waste, and the organisations propose a number of conditions for the Government to include in its coming decision on FUD-07. A large number of authorities, organisations, and other parties have also submitted reports, and these can be found on MKG's homepage.

The SKI's report usually reaches the Government at the end of March the year after the industry presents its FUD-report. Most often the Government reaches its decision in December the same year, or in the beginning of the next year. The decision on FUD-07 could thus be expected in December 2008, but SKI requested and was granted a respite for submitting its FUD review until the 30th of June 2008. The main reason stated was an extensive workload due to the SR-Can security analysis. The Government decision might therefore be delayed, but present indications suggest that it can be expected before Christmas as usual.

One of the most important reports that SKI has to deal with historically is the one submitted by the nuclear waste department of the Swedish Radiation Protection Institute, SSI. SKI and SSI was merged into the new authority SSM on the 1st of July 2008. Ann-Louise Eksborg is director-general of SSM and responsible for the merge. This timing had the consequence that SKI alone formally submitted the reports on FUD-07 to the Government. When SKI was granted respite for submitting its FUD-reports the merge was planned to the 1st of April. According to the original plan SSI should first submit its reports to SKI, and both nuclear waste departments of former SKI and SSI would together submit their reports to the Government. The delayed merge implies that both former authorities are in fact responsible for the reports that were submitted by SKI alone. SSI's and SKI's reports can both be found on MKG's homepage as well as the reports by Swedish National Council for Nuclear Waste.

MKG will in October 2008 supplement its previously submitted reports from March 2008 to the Ministry of the Environment and the Government on the FUD-07 in response to the reports from the industry, authorities, and other parties.

The Government's decision on FUD-07 is expected in December 2008.

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