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Discussions on Nuclear Waste

A Survey on Public Participation, Decision-Making and Discussions in Eight Countries:
Belgium, Canada, France, Germany, Spain, Sweden, Switzerland, United Kingdom

Robert Jan van den Berg
Herman Damveld

January 2000

Herman Damveld has been working on nuclear energy since 1976. He developed an interest in the subject when there were plans for the storage of nuclear waste in the northern Dutch salt domes, and plans for a nuclear power plant at the Eemshaven, near the Waddensea. Since the early ‘80s, he has given many lectures on these subjects, under a Broad Societal Discussion on nuclear energy. In recent years, he has worked as an independent researcher and publicist, and has written a number of books about nuclear energy, the disaster at the Chernobyl nuclear power plant (on request of Greenpeace), and the storage of nuclear waste. Hundreds of his articles have been published in weekly magazines and regional newspapers. Previous to this study, he wrote on request of the Dutch Commission for Radioactive Waste Disposal (CORA) a report on the social and ethical aspects of the retrievable storage of nuclear waste.

Robert Jan van den Berg is an employee of the Laka Foundation, the documentation and research centre on nuclear energy. Laka maintains an extensive archive on nuclear energy and related matters. Laka gives information and advise to media, scholars, individuals, etc. In cooperation with his colleagues, Van den Berg has, among others, published articles on the greenhouse effect and on nuclear energy, the airplane crash on Amsterdam’s Bijlmer district, the dismantling of a research complex in Amsterdam, and the dismantling of nuclear weapons. He co-operated with Damveld in the study on ethics and retrievability.

CONTENTS

INTRODUCTION

The storage of radioactive waste is a problem. The question is how government and society can arrive at solutions. It is therefore of importance to know how other countries deal with this problem of radioactive waste. The Dutch Commission for the Disposal of Radioactive Waste (CORA) asked us to make a concise survey of one or two discussion in Western countries about the aboveground or underground storage of nuclear waste, mainly concerning the last 10 years. This to learn more about experiences in public participation abroad. CORA started its research program on retrievability a few years ago. This study presents an overview of lessons learned from decision-making processes in eight countries. It will be of use for a next phase of nuclear waste research in The Netherlands, which will likely start in 2001.

In the process of selecting countries, we took into account the developments we had been aware of to a certain degree, because of our earlier study on ethical and social aspects of retrievable waste storage. Second criteria was to select these countries from which we expected to collect relevant and easy accessible information. Because of the available time we limited the amount of countries to eight--Belgium, Canada, France, Germany, Spain, Sweden, Switzerland and the United Kingdom. Concerning Spain, this is a brief chapter since, during this study, the development of a new discussion procedure was halted unexpectedly by the Spanish Senate.
Given the mandate of the study, this report deals with discussions about the storage or disposal of nuclear waste. An analysis of technical concepts, for instance about the pros and cons of reprocessing, will not be found in this report.

For each country we have a corresponding structure. We start with the status of the nuclear power program. Then we deal briefly with radioactive waste production, the categories of radioactive waste, the amounts produced or are to be produced, where it is presently stored and who is responsible for the storage. It is followed by one or two cases.
For each country, we tried to find information contacts, representing both environmental organisations as well as governmental authorities dealing with nuclear waste issues. Unfortunately, those contacts were not found in all countries. The draft texts were submitted to the contacts for a check on the correct presentation and interpretation of the information. The responsibility for the conclusions, however, remain solely with the authors.

Although the objective was to make a survey country by country, we compared the outcomes in the light of a number of themes and derived eight points for attention. A thorough comparison would have required more time than had been available for this report. Reports and studies dated later than July 1999 were not used for this study.

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January 2000

1. SUMMARY, CONCLUSIONS AND POINTS FOR ATTENTION

SUMMARY AND CONCLUSIONS FOR EACH COUNTRY

In the following table, we first summarize a number of data by country: the number of operating nuclear power reactors, their capacities, the present amount of nuclear waste stored/disposed of, and the future amount to be stored/disposed of.

Table: central data

Country	Reactors	Capacity (Gwe)	Present waste (m^3)	Future waste (m^3)
Belgium	7	5.7	13,715	70,500
Canada	21	10.0	985,000	± 79,200 MT SF*
France	55	59.0	635,816	1,006,410
Germany	19	22.0	158,800	412,000
Spain	9	7.1	21,000 + 1,800 MT SF	200,200 + 6,750 MT SF
Sweden	12	10.0	27,442 + 2,395 MT SF	252,000 + 7,380 MT SF
Switzerland	5	3.0	10,000	102,500
U.K.	35	12.8	1,060,000	3,080,000

* MT SF = metric tons of spent fuel, no volumes were specified. For Canada, the future amount of other waste is unknown to the authors.

BELGIUM

Summary

Since its founding in 1980, the NIRAS--Belgium's National Institute for Radioactive Waste and Enriched Fissile Material-has managed all the radioactive waste that has been produced in Belgian territory.
In Mol, an underground laboratory was realised in clay. When it was set up, it did not face large public resistance. It is the only laboratory in thr world with such a size. Extensions are being made in the PRACLAY (clay disposal) project. With this project, NIRAS has to prove that an infrastructure for a geological disposal of vitrified waste can be built, operated and sealed in a safe way. The NIRAS points out that there was an absence of public protests towards the research character of the project, and states that the laboratory cannot be converted into a final disposal unit. The research character is the reason that Greenpeace did not resist, although Greenpeace considers PRACLAY to be a step too far and thinks the project is the realisation phase "under the guise of research". Both Greenpeace and the NIRAS expect that a decision on storage will indeed lead to protests.
Public discussions about nuclear waste were on low- or inter-mediate-level waste with short half-life (Category A). In 1994, NIRAS mentioned 98 possible locations in 47 municipalities. In 1997, an additional 25 military bases, not anymore in use as such, were added. The proposals led to mass protests. In all these, the fact that different factors determine whether waste is Category A waste or not played a role.
After the protests, the government reviewed its policy. The research is now limited to the existing nuclear zones in Doel, Tihange, Mol, Dessel and Fleurus, or to municipalities that volunteer. The government will not conduct a broad consultation with the population.
A new element is the partnership, consisting of local governments, local organisations, and the local nuclear operators, as well as the NIRAS. The idea behind this is that the storage can fit in a broader project, so that the total effect is to be perceived by the local community as positive. These partnerships still have to be formed.

Conclusions

1. Until now there has never been a discussion about the total nuclear waste policy, and there is no expectation that it is being planned.
2. The definition of the different categories of waste is unclear and difficult to explain. This has not supported the gaining of public acceptance.
3. The idea of local partnerships still has to be worked out. In practice it has to be shown whether the idea is realistic.

CANADA

Summary

Public review of the concept of the Atomic Energy of Canada Ltd. (AECL) for nuclear waste disposal already started in the late 1980s. An independent panel was set up to examine the criteria for safety and acceptability and to make a proposal for future steps to be taken by the government.
Nuclear energy was outside the Panel's mandate and therefore some environmental groups refused to participate, others only had minor difficulties with the decision not to discuss nuclear energy. The government promised to conduct a parallel review of more broad energy issues, but never realised it, also not after several requests from the Panel. The review got broad input, with anti-nuclear groups actively participating. Some provinces, however, did not want to get involved as they refused to accept a disposal facility in their territory at all.
The Panel concluded that safety is an important, but only one part, of acceptability, as both safety and acceptability are "relative, value-laden and subject to different interpretations". Because of the relation between nuclear waste and future generations, an ethical and social framework is considered necessary. The Panel concluded that technical safety had been demonstrated "on balance", but not from a social perspective. Reasons for this conclusion were: the long-term danger of the waste and the needed cautious approach; scientific uncertainties in relation to the long-time frame; and public concern more about possible severe consequences than about the small probabilities. Concerning acceptability, the Panel concluded that the AECL's concept did not have the broad public support that is required. It recognised that the lack of a clear policy on the future of nuclear energy made it difficult for the public to develop trust. Other reasons for it were: too little Aboriginal cultural input; no other alternatives to choose from; and a level of distrust in the AECL.
The Panel further recommended the creation of a Nuclear Fuel Waste Management Agency (NFWMA) "at arm's length" from the industry to make "a fresh start" and build trust. In a four-step approach of a) set-up, b) concept acceptance, c) project acceptance and d) realisation, the NFWMA should try to solve the issues that were recognised by the Panel and finally realise a disposal or storage site. This can also be a long-term aboveground storage when this is what the public prefers.

In its Government of Canada Response to the Panel's final report, it was announced that the creation and activities of the new agency is to be executed by the nuclear industry itself, which is contrary to the Panel's advise to put it "at arm's length" from the industry. It is, however, in accordance with the 1996 Radioactive Waste Policy Framework, that prescribed that the nuclear industry is responsible for managing and organising the nuclear waste problem. The government "expects" that the new agency will take into account the conclusions and recommendations of the Panel in the future.
More distrust arose when the government wrote in its response to the Panel that the steps taken to resolve the waste problem would support the further use of nuclear energy.

Conclusions

1. An independent panel, with an open mind and no biases, conclusions, will gain more trust and participation than a government-conducted review, as government will always take into account the goals it wants to reach.
2. Although it took as long as 10 years to review a disposal concept, it had not gained enough public acceptability for the concept to be realised.
3. The decision not to place the new agency "at arm's length" of the industry has created a distance to environmental groups and will certainly not contribute to public trust.
4. The panel concluded that future expectations for nuclear energy are of influence on public trust for waste management, but the issue was actually outside the panel's mandate. The government, in its response, stated that trust in waste management was necessary for the future of nuclear energy. To connect these two now, where the government had forbidden the panel from dealing with this relationship, is astonishing.

FRANCE

Summary

France has an extensive nuclear program, which includes enrichment and reprocessing for foreign customers. Initially, like many other countries, it considered the option of final deep disposal as a solution for the high-level long-lived waste problem. Protest against four test drilling sites, in the late 1980s, forced the

government to temporarily stop those drillings and develop a new policy.
The Nuclear Waste Law of 1991 regulated the new policy. Research has to concentrate on transmutation, retrievability and long-term aboveground storage. In the year 2006, an overall assessment is to be discussed in Parliament, after which a final strategy has to be adopted. For an easier acceptance of a test site, the government introduced the concept of the laboratories: No waste can legally be stored in such laboratories. However, there is always a possibility to adopt a new law that would permit the conversion of a laboratory into a disposal site.
In 1993, MP Bataille acted as a negotiator to look for a site in interested *departements* (in France, a departement is a prefecture). A total of 30 showed initial interest, but of these, only 10 could meet geological criteria. He finally selected four departements to continue in the site selection. Others were dropped due to their own withdrawal or because there was too little departement council support.
In his final report, Bataille emphasized the importance of guarantees for retrievability and a dialogue. Critics, however, criticized his mission as not open enough and too short. They feared the conversion of a laboratory into a repository. They said the population was not consulted directly and sufficiently as required by law.

After having selected four sites, the process of public inquiries and council votes started. Here again, opponents considered the process as not open enough, and more, as an "alibi" to fulfill legal requirements. Too little possibilities were said to be present to have a real discussion. The amount of written objections in the Meuse departement reached 6,500.
Council votes varied in the municipal, departemental or regional outcomes. But all the four departement councils voted in favour of a laboratory. The possibility to receive financial compensation played a role in this. Council votes have no real meaning, as these can be overruled by the national government.
In 1997, a governmental decision on the laboratories was postponed for a year due to the upcoming elections. During that year, the National Evaluation Commission (CNE) advised on the issue of retrievability, and recommended the storage of only transuranic wastes in a deep disposal and high-level fuel and reprocessing wastes in a subsurface facility for possible retrieval.
In the December 1998 governmental decision, Gard and Vienne were dropped as sites because of geological reasons. It followed CNE's recommendations of the two-way approach for different high-level wastes.
The site located at the border of the Meuse and Haute-Marne departements was the only one left at the moment. Because of this, opposition is now growing. A granite formation site is now being sought in Brittany and Massif Central mountains. Both laboratories still have to be constructed, researched and evaluated before Parliament can make decisions in 2006 as required by law.

Conclusions
1. In Bataille’s mission, the real decisions about cooperation were actually being made by the departement council and Bataille. Opposition remained after his mission. Critics said the population was not consulted directly and sufficiently as required by law. So it cannot be said that a departement council, unanimously or almost unanimously in favour of a laboratory, gives a realistic reflection of the public's opinion within the departement itself.
2. The amount of written objections indicates a lack of public acceptance for a laboratory in Meuse/Haute-Marne. A lack of time as the date of 2006 nears might be among other reasons that no real acceptance has been obtained in the inquiry.
3. The presence of a Green minister in the cabinet could eventually lead to more political problems and delays in further decision-making, either by her standpoint on nuclear energy or because of the possibility of resignation due to pressure from within her party.
4. It will be next to impossible to find a second laboratory site, consult the population, construct the laboratory, and research and evaluate it all before 2006. This can already be a concern for the Meuse/Haute-Marne site as construction still has to begin. It is doubted whether thorough conclusions on the safety of the sites can be made before 2006.

GERMANY

Summary
In February 1977, Gorleben was chosen as a possible site for nuclear waste disposal and as a location for a reprocessing plant. How did this come about? In 1973, the search for a suitable disposal site began. Twenty-four salt domes in the state of Niedersachsen were checked on a number of criteria. These criteria were published in 1977 when Gorleben had already been selected. These were general criteria, like a sufficient

volume of the salt dome, homogeneity of the salt, the top of the salt dome should be at least 200 metres below ground level, etc.
On the basis of these criteria, the salt domes at Wahn, Lichtenhorst and Weesen-Lutterloh were selected. Gorleben was not part of this selection because of its position near the border of the former German Democratic Republic (GDR). But in February 1977, Gorleben was decided upon. The then prime minister of Niedersachsen, E. Albrecht (CDU), brought up two political arguments:
--the region of Lüchow-Dannenberg where Gorleben is situated as an economically weak area;
--the expected public support.
This public support, however, proved to be non-existent. On 12 March 1977, a protest rally was held with 100,000 participants. This was the first of a long series of protest actions and discussions.
The doubts about Gorleben had an effect on the coalition agreement between the SPD and the Green Party of the Schröder government on 20 October 1998. In this coalition agreement, the government announced it wanted the research at Gorleben to be terminated because of the existing doubts about this salt dome, and that other locations should be looked into. A selection should then be made on the basis of a comparison of various locations. In July 1999, this policy was not executed yet, the research in Gorleben was not halted yet as well.
The term consensus talks is an invitation to study precisely how agreement can be reached, the more so as the storage of nuclear waste--besides nuclear energy--played an important role. Further study, however, shows that a clear description of the goal of the consensus talks is lacking. The first discussion rounds concerned the consensus between political parties. At that, it was not made clear whether consensus between a number of Parliament representing parties would be sufficient to speak about public acceptance.
The consensus talks of the present government are between the governmental parties and the electric utilities. Implicitly, this means another definition of consensus. It also appeared that the government did not want to have an open mind, but as a precondition, aimed for an immediate ban on reprocessing. In February 1999, a difference of opinion arose on the remaining life span of the nuclear power reactors. The government assumed 30 to 35 years. The electric utilities reckoned with a 40- year life span at full workload; since a nuclear power station on average reaches an 80% workload, the real life span would be 50 years, resulting in the first nuclear power station being closed down after 2020. In June, a difference arose between the government parties themselves on the remaining life span. Minister Müller wanted a total life span to be pegged at 35 years, but the Greens did not agree and wanted at least one nuclear power reactor to be closed within the present governing period. The SPD and Greens, however, agreed to try to reach an agreement before 30 September.

Conclusions
1. The discussion about the disposal at Gorleben was tough from the beginning. This was mainly the result of a lack of openness in decision-making. The criteria for the selection of Gorleben were not made public. Afterwards, criteria were mentioned, but it was not clear why Gorleben was the only one that would fit these criteria. For the people, this resulted in the idea that the criteria had been adjusted to the findings of research in the salt dome of Gorleben. Briefly stated, an unclear decision-making.
2. The consensus talks at a political level have reached little, apart from a lot of media attention. This was caused by the fact that the government had no clear idea on what issues consensus should be reached. The government parties appeared to be divided among themselves and the electric utilities disagreed with the government.

SPAIN

Summary
As in other countries, plans for an underground storage or research program has faced public opposition in Spain. Siting work by ENRESA--Spain's National Authority for Radioactive Waste SA--stopped in 1996 after this opposition. Although research continues with already known geological data, no site drillings are to take place before 2010. By that year the Senate has to decide on a final disposal strategy.
Government licensed the building of a spent-fuel storage facility at the Trillo nuclear power plant. Environmental groups fear that this storage might become a national storage facility.
An inquiry commission was set up to give guidelines in the development of a new policy that could overcome public opposition. But after having written a draft report, the final outcome was unsuccessful. The report was not adopted in the Senate due to what appears to be political reasons.

Conclusions
1. As it remains unclear what the exact reasons were to reject the report, it looks more that the waste issue is so controversial that political parties have difficulties in dealing with it.
2. The realisation of an interim storage at Trillo, firstly meant for the station itself but with a possibility of expansion, can result in decisions being easily postponed in the future.
3. The political hesitations and the practice of postponing has not brought and will not bring an acceptable solution any closer.

SWEDEN

Summary
Sweden has 12 nuclear power reactors and has a policy of a nuclear phase-out, although there are no deadlines. Low- and intermediate-level wastes from the nuclear program are stored at the final disposal site, the Central Final Repository (SFR) in Forsmark, located below the bottom of the Baltic Sea. High-level waste, spent fuel, is stored at the interim near-surface Central Interim Storage Facility (CLAB) in Oskarshamn.
The Swedish Nuclear Fuel and Waste Management Company (SKB), responsible for waste management, developed the KBS-3 concept for the final disposal of spent fuel in an underground repository. First construction work for a repository should start around 2010 and should include a limited possibility of retrievability. Only after the first five-year demonstration period can the canisters be retrieved.
After the earlier failure to find a suitable site, SKB introduced the concept of voluntariness. It invited municipalities to show interest in conducting a feasibility study. SKB wanted to conduct at least five feasibility studies, after which it will select two sites for test drillings, to start from 2002. Around 2010, an underground repository should be constructed at one site. Up until now, eight municipalities have shown interest, either by volunteering themselves or after an invitation from SKB. In two of these sites, Malå and Storuman, referendums were held and both voted against the plans. Now, feasibility studies have been completed or are underway at six other sites (Nyköpping, Östhammar, Oskarshamn, Tierp, Hultsfred and Älvkarleby), all of them having nuclear activities in their own municipality or in a neighbouring municipality. Possibly, Nynäshamn will be a candidate soon as well. All of these still have the opportunity to withdraw. Environmental groups have warned that the system of volunteering has the risk that not the safest site is selected, but one where there is an overall acceptance from a social point of view.
In 1996, a National Co-ordinator for Nuclear Waste Disposal was appointed to co-ordinate the information flow between the different authorities and municipalities. Apart from being an information source for interested municipalities, he set up a National Environmental Impact Assessment (EIA) Forum. This forum, which does not include representatives from environmental organisations, should discuss the contents of the EIA that is necessary for constructing the underground repository.

Conclusions
1. Retrievability (still) plays a minor role in the KBS-3 concept as it is only guaranteed for five years. It might be more difficult to gain public acceptance for the KBS-3 concept as environmental groups and the public often emphasize the importance of controllability and accessibility.
2. Environmental groups have criticized the idea of voluntariness. And indeed it can be questioned whether the safest site is found in the underground of a "nuclear municipality" or some other volunteer. Another risk is the hurry with which SKB wants to proceed.
3. The exclusion of environmental groups, upon the behest of the concerned municipalities, in the National EIA Forum can later lead to new conflicts, when the EIA procedure really starts.

SWITZERLAND

Summary
In 1972, the federal government and the operators of nuclear power reactors founded the Nagra--the National Company for the Storage of Radioactive Waste--in which the operators have a share of 95%.
In 1978, the Nagra started by choosing locations for low- and intermediate-level wastes. In 1981, Nagra

chose 20 from a list of initially 100 locations to conduct further research. Evaluation of these locations gave three preferred locations: Bois de la Glaive, Oberbauenstock and Piz Pian Grand. In 1987, the Nagra added to the list the location Wellenberg near the municipality of Wolfenschiessen in the canton Nidwalden. Wellenberg was not on the initial list of 100 locations. Niederbauern, which is close to Wellenberg, was on the list.
The research at the different locations faced resistance and could sometimes begin only after a lot of delays. This resulted in the fact that the Nagra only choose Wellenberg as number one, and this was as late as 1993. The storage plan was rejected in a referendum. If the storage would have been controllable and retrievable, the majority might probably have voted in favour.
The continuation of nuclear energy was a big obstacle to reaching consensus among different parties on the issue of management and storage of nuclear waste. Although the use of nuclear energy was not included in the mandate of the working group "Energie-Dialog Entsorgung" (Energy-Dialogue Disposal), the working group could not avoid this issue and it was put on the agenda. No consensus could be reached and this had an effect on all the discussions.
On the question of giving content to the responsibilities for future generations, the points of view also differed. From this responsibility, the operators and the Nagra choose for final disposal. The environmental organisations stated that retrievable and controllable storage gives the best options of handling to future generations. These organisations want this storage method to be worked out further.

Conclusions
1. The Nagra choose the location Wellenberg for the storage of low- and intermediate-level waste. Wellenberg was not on the initial list of 100 locations. It is remarkable that a choice was made for a location that was initially not considered.
2. The Nagra sticks to Wellenberg, regardless of the outcome of the referendum. With a new storage concept, that includes elements of retrievability, the politicians are trying to hold a new referendum. The politically different opinions will not be solved with this. A new referendum on Wellenberg will increase the present conflict.
3. The discussion about storage of nuclear waste in Switzerland is overshadowed by disagreements about the future of nuclear energy. Discussions about nuclear waste are difficult without clearness on the future of nuclear energy.

UNITED KINGDOM

Summary
The United Kingdom has an extensive nuclear energy program that started in the 1950s. It includes enrichment, fuel fabrication and reprocessing. There are no plans for building new nuclear power reactors. Since the 1970s, studies have been conducted on the possibility to realise a deep disposal site. The test drillings that were undertaken faced opposition. Apart from some drillings to high level waste disposal, most of the attention was given to finding a site for low-level and/or intermediate-level waste disposal. In the late 1980s, Nirex (Nuclear Industry Radioactive Waste Management Executive) had, from a (not public) list of 500, selected 11 sites. Later, Sellafield was added with the idea that a "nuclear culture" might lead to an easier acceptance. Data on how Sellafield was considered to be suitable for a Rock Characterization Facility (RCF), an underground laboratory, were kept secret and local communities were not informed about the selection process.
In March 1997, the plans for the RCF at Sellafield were rejected by the Secretary of State of the Environment. The effects of the aboveground works and the uncertainties from a geological and hydrological perspective were too high. It was also doubted whether the RCF itself would have negatively influenced the safety of a repository.

With no prospects of a disposal site, the UK needed a change of its waste policy. A House of Lords Committee started an inquiry as a first step. The inquiry was more directed to high-level waste. The House of Lords concluded that one or more underground repositories were necessary within the next 50 years. Environmental organisations protested that there was no discussion possible about a long-term aboveground storage. They consider the 50-year goal too hasty since a 1995 White Paper, a parliament policy paper, earlier had spoken about "no fixed deadlines".
The Lords Committee concluded that the earlier strategy of decide-announce-defend had failed and that

public acceptance is necessary to realise plans, but that it would be difficult to achieve. In order to ease that process, it proposed offering compensation for a hosting community. Environmental groups considered this as a too-much-goal-driven process with the use of compensation to "buy" acceptance.
The Lords Committee recommended the creation of two new bodies. The first would be known as the Nuclear Waste Management Commission (NWMC) to oversee national policy. As a first task, it should conduct consultations on the Green Paper on waste policy, to be expected at the end of 1999. Environmental organisations, however, think the NWMC itself should be subject of the consultations.
A second body, the Radioactive Waste Disposal Company (RWDC), should be responsible for site selection and construction. The Lords Committee mentioned the possibility of voluntariness. But this voluntariness has the limitation that once a community has agreed, it can no longer withdraw, according to the Lords' proposal. According to the Lords Committee, a site-specific inquiry should be limited to site-relevant issues, as broader aspects would have been part of the Green Paper consultation.

A second event in the process of restructuring government's policy was the Consensus Conference in May 1999. A randomly selected Citizen's Panel had to study literature and hear witnesses to form an opinion on nuclear waste policy. In a two-day session, hearings with 32 witness were held. It was perceived that there was an imbalance between pro- and anti-nuclear witnesses and visitors.
The panel rejected the idea of deep disposal because of the risks of leakages. Secondly, it concluded that the waste MUST remain accessible and monitorable, and thus retrievable. Because of the risks of human intervention and climate change, a storage should be placed below the earth's surface.
Much attention was given to the technology of transmutation, and the panel was strongly convinced that in future this would be feasible. Transmutation played an important role in the panel's motivation to keep the waste accessible in a near-surface storage as an "interim solution".
Although the outcome of the Consensus Conference is not binding, it is said that such conferences are of influence on policy making. Responsible Minister Meacher of Environment expressed his reservations about subsurface storage due to the longevity of some wastes. Nirex used the words "retrievable deep disposal" as another possibility.

Conclusions
1. The secrecy about the list of 500 and the criteria upon which Sellafield was chosen did not contribute to public confidence, and is still of influence on the public's trust.
2. On the basis of the negative outcome of the question whether Sellafield would be safe, it can be concluded that it was wrong to add Sellafield, on "nuclear culture" grounds, to the list of 11 sites that were derived from comparing geological information.
3. If the government will adopt the Lords Committee conclusion to proceed with constructing a deep disposal within 50 years, new conflicts with environmental organisations can be expected.
4. The Lords Committee mentioned the possibility of voluntariness, but once a municipality has shown interest, it can no longer withdraw, according to the proposal. This will not attract communities to volunteer.
5. The Lords' proposal to limit site-specific inquiries to only site-specific issues, as broad issues are discussed in the Green Paper consultation, can lead to conflicts.
6. Concerning the Consensus Conference, it can be asked whether a randomly selected panel of just 15 other individuals would have come to the same conclusions.
7. The panel’s favour for a near-surface storage was not worked out, i.e., at what depth and how to realise it from a technical perspective. Therefore it looks as if the panel tried to combine the idea of supposed isolation at great depth and easy retrievability of an aboveground storage.
8. Transmutation played an important role in the panel's choices, but the real technical feasibility and problems were not discussed profoundly.
9. It is doubtful if the government will take over the favoured near-surface storage. It is possible that retrievable deep disposal will be the concept to be introduced, instead of working out for the UK the new concept of near-surface storage.

POINTS FOR ATTENTION DERIVED FROM A COUNTRY-BY-COUNTRY COMPARISON

We have compared the information presented in the country reports in the light of a number of themes, and have come to eight points for attention.

A. Relation with general discussion about nuclear energy

In the UK, a Consensus Conference was organised about nuclear waste, where the Citizen's Panel recommended that there be no increase in the nuclear energy capacity. In Germany, Environmental Minister Jürgen Trittin mentioned the end of nuclear energy as a condition for public acceptance for a solution of the nuclear waste problem. In Switzerland, disagreements about the use of nuclear energy was such an important obstacle that the dialogue about storage of nuclear waste among different public groups did not lead to a consensus of opinion. In Canada, nuclear energy also played a role in the nuclear waste discussion. The independent panel on nuclear waste recommended, upon the demand of participants, that there be more public discussion on nuclear energy. The government, however, refused to set up such a discussion. For many groups, this government position was no obstruction for participation. Although the government failed to organise the desired discussion about nuclear energy, the government itself did connect nuclear waste and nuclear energy. In its response to the panel's report, the government stated that working on a disposal site for nuclear waste is of importance for the building of new nuclear power reactors.

Environmental organisations in many countries state that ending nuclear energy, either immediately or within the foreseeable future, is a necessary condition for a discussion about how to handle the nuclear waste that was inevitably produced.

Point for attention A: Nuclear energy is an important source of nuclear waste. Therefore, it is obvious that the issue of nuclear energy will play a role in each discussion about the storage of nuclear waste.

B. Retain to a once announced storage location (decide, announce, defend)

Up to the present, we find the traditional decision-making method of "decide, announce and defend" in Belgium, Germany, Spain, Switzerland and the UK. An example of it is the plan for disposal in the salt dome in Gorleben. The salt dome was selected in 1977, the decision was consequently announced, and the decision was defended afterwards. From the very beginning, this gave rise to differences of opinion that carried over into the coalition agreement of the present government for a moratorium on research at Gorleben. The criteria for selecting Gorleben had not been published but criteria had been established which Gorleben could fulfill. That fits in with the concept of defending a decision once it is taken.

The mentioned traditional decision-making method was also used in Belgium (a list of 98 locations followed by a list of 25 military locations). As a reaction to the massive protests, the lists of locations were withdrawn and a new procedure was developed.

In the UK, the location of Sellafield was just added to an earlier list of potential locations and chosen as the future research location. In a similar way, in Switzerland a potential location was selected and proposed as disposal site.

The plan to study 30 regions in Spain for the disposal of nuclear waste faced so much resistance that the Senate decided to set up an inquiry commission. That commission had to develop a procedure that would be acceptable. It resulted in so much political conflict of opinion that the commission was dissolved before a final report was ready.

Contrary to the abovementioned examples, where locations had been decided upon, announced and defended afterwards, many countries are looking for another strategy to finding a location. The French MP Bataille succeeded in a mediation mission to find four departements where the councils agreed to look for a location on its territory for an underground laboratory. In Sweden, after earlier protests against test drillings, the choice was made in a voluntary approach. Until now, this has led to eight interested municipalities. In Canada, the procedure has been independent of any concrete location.

Point for attention B: The traditional policy of announcing locations for nuclear waste storage and the consequent defence of these did not result in public acceptance. Therefore, a move towards other approaches can be observed in many countries. However, any change of policy should not be welcomed as a postponement for difficult decisions.

C. Strive for consensus

The German government chose for consensus talks as a way out. That might look like an attractive idea. But it appears that there exists no clear vision on who, with whom and in which way consensus shall be reached about what issues. The recent consensus talks are at present in an impasse. The discussion in Canada under the supervision of an independent panel was indeed well organised and well considered. This discussion did lead to results. It was a discussion independent from a location, where no location was chosen and possibilities existed for alternative concepts like aboveground storage. A Consensus Conference in the UK with a clearly described procedure also led to results. Switzerland is a country that is dedicated to consensus.

However, it was not able to reach consensus on the storage of nuclear waste because of the different opinions that existed about nuclear energy.
Point for attention C: Attempts to reach consensus on nuclear waste are only useful if, in advance, it has an open mind and has no biases. A discussion independent of locations, where minds are still open, gives more prospects for results.

D. To store nuclear waste at existing nuclear locations
The procedure in Belgium has now been limited to existing nuclear facility locations. The idea behind this is that public acceptance can be found at the existing nuclear locations because one is used to nuclear energy. The same approach has also been used in Sweden, where the municipalities of nuclear locations applied for feasibility studies. In the UK, Sellafield was selected as a potential location. This limitation to nuclear locations can raise a certain level of distrust. It is questioned whether exactly below the existing nuclear installation is coincidentally where the most suitable disposal site can be found. For Sellafield, indeed, it appears that this location was unsuitable.
Point for attention D: The limitation of possible locations to existing nuclear installations can give the impression that potential public acceptance for a disposal site prevails over safety issues.

E. Voluntariness and compensation
The local population in a Belgian community rejected in a referendum the voluntary application of a municipal council. Then Belgium chose the procedure of a local partnership at existing nuclear locations. Forms have to be given for this. It is yet unclear whether this partnership will be established. Some nuclear locations do not want a partnership. Partnership means that next to a nuclear waste storage, another project should be realised for the local population, so that the overall effect is considered as positive. The partnership is directed towards the provision of an advantage for the current generation.
The UK investigated the possibility of voluntariness and compensation. The proposal of a House of Lords committee is that once volunteered, a municipality can no longer withdraw in the future.
In France, the protests against the announced disposal of nuclear waste reached such a level that the government decided to switch to a new procedure. Three locations had been found for the construction of an underground laboratory. Volunteer departements were found and the departement councils agreed. The possibility to receive financial compensation was a factor that played a role in this. One location remains--Bure in Meuse. Despite the financial compensation offered, the protests are growing: a majority in the departement council may agree, it can be questioned strongly if this also applies to the people of the departement itself.
Point for attention E: In the countries we studied, nowhere was there a disposal site for nuclear waste duly agreed upon that was based on a voluntary basis. The instrument of financial compensation did not create sufficient public acceptance among the people.

F. Retrievability
In several countries, for instance in France, Sweden, Switzerland and recently the UK, retrievability played an increasingly growing role. In Switzerland, retrievability seemed to give prospects in a referendum for agreement on a disposal site. Further analysis, however, showed that in Switzerland it concerned a not-thoroughly-elaborated concept that required further study.
Sweden only took into account a limited period of retrievability during the demonstration phase of five years. In the UK, the House of Lords committee recommended retrievability without giving specifications. France assumes that a retrievable storage of high-level wastes--aboveground or near the surface--is for at least tens of years. French law only allows for licenses for retrievable storage, but new laws can be made for unlimited periods. Canada's policy is that this generation has to construct a disposal site where future generations can make decisions about its closure.
Point for attention F: Retrievable storage is mentioned in more and more countries, but the concept is insufficiently thought out and worked out. Sometimes it is unclear whether retrievability has the aim to validate calculation models, the possibility to re-use materials, or to meet a public wish to control a storage and make repairs possible and so the realisation of public acceptance.

G. Guidance by an independent panel

The discussion in Canada had been guided by a commission independent of the interests of the nuclear industry and environmental organisations. That gained enough trust that many groups wanted to participate. Canada was the only country which succeeded in organising a discussion with such dimensions. However, the government handed over to the nuclear industry the next phase. This directly led to protests from environmental organisations.

The Consensus Conference in the UK also had been guided by an independent Citizen's Panel. For this case, however, it had been a one-off meeting. We see that the House of Lords' is proposing the establishment of a new commission NWMC that should oversee the UK's new policy on nuclear waste. Environmental groups attach much value to the independence of such a commission.

Point for attention G: Actually, it was only in Canada that we observed a discussion guided by an independent panel which held hearings for a long period of time. Though we derive the conclusion that the guidance of a discussion by an independent commission is a qualitative requirement and of great importance to gain the trust and participation of the population.

H. Organising a referendum

In Belgium, Sweden and Switzerland, referendums were held for the establishment of a storage for nuclear waste. With this, the people were consulted and asked for their opinion. In all cases, the proposals for a storage site were rejected.

Point for attention H: In the countries that we studied, local or regional referendums led to the rejection of a proposed storage.

2. BELGIUM

KEY FACTS

Nuclear Power: 7 nuclear power reactors; 5.7 Gwe; 54% Gen. Cap.; plans for new NPP abandoned in 1988.
Waste (present): Category A (short half-life low and intermediate level) – 10,000 m^3 (NPP 74%, research and medical 11%, fuel cycle 3%, "pasiva" [liabilities] 10%, Belgoprocess 2%); Category B (long half-life low and intermediate level) – 3,500 m^3 (mainly reprocessing Eurochemic); Category C (long-lived HLW) – 215 m^3 (200 m^3 VHLW Eurochemic); Totally 13,715 m^3. Central storage in Mol-Dessel.
Waste (future, cumulative): Category A – 60,000 m^3; Category B – 8,000 m^3; Category C – 2,500 m^3; Totally 70,500 m^3; surface disposal site for Category A searched; deep disposal of Category C planned.
Waste authorities: Nationale Instelling voor Radioactief Afval en Verrijkte Splijtstoffen (NIRAS); Belgoprocess (NIRAS subsidiary, operates the Mol storage).
Retrievability: not foreseen.
Dialogues (among others): although public doubts were present about the Mol laboratory, no legal objections were made; Category A waste surface disposal site being sought, local referendum rejected military site Beauraing with 94%; possible locations limited to "nuclear zones" Doel, Tihange, Mol, Dessel, Fleurus or volunteering municipality; local partnerships planned: siting placed in broader project to gain positive effect for community.
Key issues: no public discussion on total waste policy organised or planned; different categories of waste confusing to public, did not support public acceptance; local partnership still to be worked out, has to prove itself.

Introduction

Belgium is the only country in the world that has an underground laboratory in clay, in Mol, for the research on the final disposal of highly radioactive waste. Therefore, we go more deeply into the choice for Mol. Also, there is an ongoing discussion about a local partnership for the storage of low-level radioactive waste. That is the second subject of this chapter.
In this chapter, information can be found from the NIRAS, the "Nationale Instelling voor Radioactief Afval en Verrijkte Splijtstoffen" (National Institution for Radioactive Waste and Enriched Fissile Material), and from Greenpeace. Conversations were made with Evelyn Hooft of the communications division of NIRAS and with Jan vande Putte of Greenpeace. They also commented on a draft version of this chapter.

1. NUCLEAR POWER PROGRAM

In Belgium, seven pressurised water reactors are in operation: four at Doel and three at Tihange. The oldest nuclear power reactor is Doel-1 which came into operation in 1974; Tihange-3 is the latest (in operation since mid-1985).[1]
The share of nuclear energy in the electricity supply is 54% and its generating capacity is 5.7 GWe. France has a share of 67% in Tihange-1 and Belgium has a share of 25% in the French nuclear power reactors at Chooz, at the Belgium-France border. In 1988, the Belgian government abandoned plans to build an eighth nuclear power reactor in Belgium.[2]
The "Studiecentrum voor Kernenergie" (Research Center for Nuclear Energy, SCK-CEN) is located in Mol. Three research reactors were built there--BR1 (1954), BR2 (1963) and BR3 (1962). Of these, BR1 and BR2 are still in operation. Between 1966 and 1974, the reprocessing plant Eurochemic at Mol had been in operation, among others for the reprocessing of spent fuel from the Dutch nuclear power reactor Dodewaard. In nearby Dessel are located the manufacturers of reactor fuel Belgonucleaire (MOX-fuel) and FBFC International, "Franco-Belge de Fabrication de Combustibles International" (France-Belgium for the Manufacture of Fuel International) that manufactures uranium fuel and assembles the MOX fuel elements. Dessel also houses Belgoprocess, a subsidiary company of NIRAS, which is the central interim storage for all nuclear wastes. It also operates waste conditioning installations.
The first big action against nuclear energy was organised in June 1979 at Doel [3] when all the above mentioned nuclear installations were already in operation or were under construction.

2. PRODUCERS OF RADIOACTIVE WASTE

The nuclear power reactors at Doel and Tihange are the main producers of radioactive waste. The manufacturers of nuclear fuel SCK-CEN and the "Instituut voor Radio-elementen" (Institute for Radio-Elements, IRE) in Fleurus are considered to be moderate producers. There is also waste from reprocessing of spent fuel elements abroad and from dismantling of nuclear installations, for intance, from the past radium manufacturer at Olen.[4] There is also radioactive waste from medical applications, industry and research. About 70% of the volume of nuclear waste comes from the nuclear industry and another 10% from nuclear energy research. The other 20% is from the IRE, the Euratom-Institute for Reference Materials and Measurement (IRMM) and from applications in industry and hospitals.[5] Further specifications are not made. Thus it is unknown which part is waste from hospitals.

3. CATEGORIES OF RADIOACTIVE WASTE

The NIRAS distinguishes three categories of radioactive waste:[6]
- Category A: low- and intermediate-level waste with a short half-life.
This category includes low- and intermediate-level waste with a half-life of less than 30 years. This waste comes from nuclear power reactors and installations that manufacture or use radioactive elements, such as filters and gloves. According to NIRAS, this waste may contain radionuclides with a long half-life, but only if the radiation dose is so low that there is no danger whatsoever.
- Category B: low- and intermediate-level waste with long half-time.
This is waste that is contaminated with radioactive elements with a long half-time, in amounts that are that big that it cannot be classified in Category A. This waste mainly comes from the manufacturing of fuel elements and reprocessing.
- Category C: high- and very high-level waste.
This category includes radioactive material with short or long half-life that produces a lot of heat. This is waste from reprocessing of spent fuel elements or the used fuel itself, if not reprocessed.

4. AMOUNTS OF RADIOACTIVE WASTE

4.1 Present amounts

Of Category A waste, 15,000 m^3 had been dumped in the ocean.[7] The NIRAS also managed about 10,000 m^3 up to the end of 1997, that came for 74% from the nuclear power reactors at Doel and Tihange, 3% from the fuel cycle, 11% from research and medical science, 10% from nuclear "passiva" (liabilities, for instance, Eurochemic) and 2% from the production of Belgoprocess.[8] Yearly, an amount of 500 to 600 m^3 is additionally produced.
At the end of 1997, the NIRAS managed about 3,500 m^3 waste of Category B. This waste mainly came from the closed reprocessing plant Eurochemic.
The amount of Category C is 215 m^3, of which 200 m^3 is vitrified waste from Eurochemic.[9]
The abovementioned consider amounts that are managed by the NIRAS. These differ from the amounts produced in the past. For instance, spent fuel elements are not managed by the NIRAS and are thus not included in the figures abovementioned. There are no figures available on the totally produced amounts in the three different categories.

4.2 Future amounts

The NIRAS calculated how much radioactive waste would arise until the year 2050. This calculation is based on the fact that the present seven nuclear power reactors would remain in operation as long as their economical/technical lifetime will allow. The NIRAS also assumes that the industry and medical science would keep using radioactive materials.
With this presupposition, the amount of waste to be managed until 2050 is:
Category A: 60,000 m^3;
Category B: 8,000 m^3;
Category C: 2,500 m^3.

There had been a discussion about these amounts. In April 1994, the NIRAS published a report on the aboveground storage of Category A waste. In the report the conclusion was made that "in a safe way, it was technically possible to dispose of--at the surface--at least 60% of the low- and intermediate-level waste produced in Belgium".[10] The question arose about the disposition of the other 40%. Evelyn Hooft of

NIRAS commented on this: "These 40% could not be disposed of at the surface. I want to nuance this figure as follows. The amount of waste that eventually can de disposed of in a surface disposal site is, for an unchanged disposal concept, defined by two factors: firstly, the radiological properties of the waste itself and secondly the properties of the disposal site. The figure of 40% was the result of an illustrative calculation on a typical and representative waste amount and on a disposal site with 'moderate' properties. If another disposal site would be considered, another distribution than 40% - 60% will probably be determined. A better characterization of the waste will also change this distribution." [11][12]
Where the NIRAS in 1994 used a prediction of 100,000 m^3 Category A waste, in 1997 this figure was reduced to 60,000 m^3. Hooft said: "In reactions it looked like the NIRAS would let waste disappear, but that is untrue of course. Initially we used conservative estimations of the amounts. But the incoming amounts decreased as a consequence of a number of technical improvements, among which is an optimalisation of the management of operational waste (sorting at the source) and the use of new conditioning technics (among others, super compaction). Besides, the estimations on the volume of waste coming from dismantling were revised downwards with more than 30,000 m^3, because of improved dismantling techniques that produce less waste." [13][14]

5. WHERE IS IT STORED?
The three categories of wastes are now stored at Belgoprocess, a subsidiary company of the NIRAS, in Mol-Dessel. For low-level waste, there exist two buildings (building 150: 97% of the storage capacity is used; and building 151: 57% of storage capacity used). There is a building for intermediate-level waste, whose capacity has been used for 80% and a building for high-level waste (building 129, 91% full). Totally, till the end of 1997, 13,691 m^3 had been stored in 40,650 barrels.[15] Next to building 129 is building 136, where 600 m^3 of vitrified high-level waste and 1,000 m^3 of high- and intermediate-level waste can be stored.[16]

6. RESPONSIBILITIES
The NIRAS is responsible for managing the radioactive waste. It is under the supervision of the Minister of Energy. The NIRAS is a public institution that was, by law of 8 August 1980, charged with the management of radioactive waste produced in Belgian territory. With this, the collection and management of radioactive waste was centralised.
As the NIRAS says, it manages "the radioactive waste in a way that it is of no danger for the population and the living environment". The NIRAS also searches "intensively for a solution which makes it possible to isolate the radioactive waste definitely from the biosphere so that there is also no danger to future generations". The NIRAS wants to dispose of the waste "without imposing excessive burdens upon future generations".
The costs of the management of the waste are paid by the producers of the waste. These producers also make provisions to cover future costs. This money is yearly paid to a fund managed by the NIRAS.
However, Greenpeace Belgium doubts whether this fund can provide the necessary money: too little has been reserved for the storage of nuclear fuel, and there is a defective control on the way of putting money aside.[17]

7. RESEARCH LABORATORY AT MOL
In 1974, when the first Belgian nuclear power reactor became operational, the SCK/CEN in Mol started a research program on the final disposal of high-level radioactive waste with long half-life. In cooperation with the Belgium Geological Survey it was studied which geological formations would be suitable.
According to the NIRAS, the following requirements were made for a geological formation:
--situated in an area least subjected to earthquake;
--the formation should be homogeneous and should possess properties to limit the migration of radioactive elements;
--the formation should have a small permeability and/or porosity and be sufficiently deep and vast;
--the formation should be stable.
According to these criteria, granite, salt formations, clay and slate could be considered.[18]

Belgium has no salt formations and granite is at too great a depth. Regarding slate, the NIRAS remarks that there is a lot of data on low-depth layers available, "but in many cases they had not been researched on great depth". This is contrary to slightly hardened rock like the "Boom Clay". These could be "better identified and

characterised". The Boom Clay reaches some hundreds of square kilometers below the "Kempen" and is about 200 metres thick. This formation was selected for the studies.[19]
After the choice for a formation, the next question is which location would be the most suitable. The NIRAS states: "Apart from its instrinsic qualities, the Boom Clay layer has the advantage of being located under the nuclear site of Mol-Dessel. The choice for this clay layer was also influenced by a number of non-geological factors, like the availability of the terrain, the presence of personnel and multi-disciplinary laboratories and the outlook to have available a local solution for eventual disposal of reprocessing waste from the Eurochemic plant". The NIRAS adds: "Taking into account all these aspects, the clay option was considered as the best choice for Belgium although there was a serious disadvantage at that time, which is the lack of experience in digging and building of extensive constructions in a clay layer at a depth of over two hundred metres".[20]

Between 1980 and 1984, a research laboratory was built in clay at a depth of 230 metres. The initial design consisted of a shaft and a gallery at 230 metres and of 26 meters in length and a useful diameter of 3.5 metres. In 1987, a new gallery was constructed with a length of 67 metres. The laboratory was named HADES (High Activity Disposal Experimental Site).[21]
In 1995, a second phase of research started: the PRACLAY project (preliminary demonstration test for clay disposal of highly radioactive waste). With this project, the NIRAS had to prove that the infrastructure of a geological disposal of high-active, heat-producing, vitrified waste can be built, operated and sealed in a safe way. The NIRAS also has to prove that the cost-price should be acceptable. Therefore, the geological disposal will be demonstrated full-sized. The law on mining did not allow the construction of PRACLAY from the HADES laboratory. So a second shaft has to be constructed, from which a connection gallery of 80 metres with HADES. That can be finished in 2003. The heat-production of the high-level waste determines the behaviour of clay. To study this, heat production is simulated with electric resistors between 2004 and 2007. After a cooling-down period of two years, the used instruments will be removed. In 2010, the project is to be finished.[22] According to present plans, final disposal will start in 2035 in a new storage mine to be constructed--which does not have to be at Mol--and the last canister should go underground around 2070/2080.[23]

From available literature, it seems that no formal objections were made against the choice for clay or the construction of the laboratory. In 1980, the "Verenigde Aktiegroepen voor Kernstop" (Organised Action Groups for a Nuclear Ban, VAKS) doubted the stability of clay layers[24]. In 1981, the "Stroomgroep Stop Kernenergie" (Energy Group to Stop Nuclear Energy) wrote that clay could not stop all radioactive elements and that clay contains corroding elements. They pleaded to stop waste production and asked for an independent research on the best way to limit the potential damage from radioactive waste[25]. These doubts however did not result in delaying the construction of the HADES laboratory. The construction of PRACLAY started three years later than planned,[26] but that had to do with the realisation of new organisational structures and not because of protests. There had been procedures for public input, but no objections were brought in.

What does the NIRAS think about the absence of protests? "On one hand it has to do with the situation in the early 1970s, when people thought different about nuclear waste. On the other hand, it was always said that it concerned tens of years of research and that no decisions would be made. We emphasize that the laboratory is not meant to really build a disposal facility, for this, among others, the entrance shafts are too narrow."[27]
Greenpeace also did not organise actions nor bring in formal objections against the underground laboratories, said Jan vande Putte, the nuclear energy campaigner of Greenpeace Belgium. On itself he does not object to research, but he considers PRACLAY to be a step too far: "We have serious objections against the PRACLAY project because it is not a fundamental research. It is the realisation phase under the hat of research." Therefore, Greenpeace will indeed get involved with the case in the near future.[28]

8. LOW-LEVEL WASTE AND PARTNERSHIP

8.1 From above ...

The NIRAS was founded in 1980. Since 1982, when "sea disposal at great depth of conditioned low-level waste"[29] (the dumping in the Atlantic Ocean) was stopped, the NIRAS has studied the possibility of storage on land. It concerns Category A waste.
At the end of the 1980s, the NIRAS recognised the next possibilities: final disposal in the Belgium-Limburg

coal mines, final disposal in the deep underground in clay and final disposal at the surface, in which the waste will be placed some metres below the earth's surface and covered by a protective construction, as in El Cabril (Spain) and l'Aube (France). Disposal in coal mines was called by the NIRAS as being "unacceptable": "The rock surrounding the galleries showed too much changes by the coal mining that could, in the long-term, lead to the danger of radioactive contamination of the groundwater of upper areas. The NIRAS questioned the disposal in clay. More insight should be available in corrosion capabilities of the waste in clay and the possible release of big amounts of gases that could result in the formation of fractures[30]. According to the NIRAS, it will therefore study concepts that will prevent the build-up of gases: "If Category A waste would be disposed of in one site together with Category B and C waste, it could be that special disposal installations have to be designed for this."[31]

The final disposal aboveground, at the earth's surface, became the "reference solution for the NIRAS"[32], which conducted from 1990 a four-year study on its technical feasibility.
In April 1994, the NIRAS published a study on the surface storage of Category A waste. In the report, 98 potentially suitable locations were mentioned in 47 municipalities[33].
In May 1994, Greenpeace released a report that pointed to the fact that there is a lack of a systematic study on different disposal possibilities. Also social, economic and ethical studies were postponed until a later stage. Greenpeace also remarked that the criteria, on the basis of which the 98 locations were chosen, were vague. For instance, the criterion of sufficiently homogeneous clay of sufficient thickness, what is meant by sufficient? The report also shows that the locations of Doel, Tihange and Mol cannot meet the criteria[34].
The scientific advisory commission that researched the proceedings on request of the NIRAS recommended that human-scientific and social aspects be taken into account. A special governmental working group had the opinion that NIRAS should have more contacts with citizens: "It is a bad case that until now NIRAS only reacts to an invitation for debate. The result is that no remarks were made on the positive consequences of a disposal, for instance employment," said Robert Leclère of this working group, in March 1995[35].

In a reaction, the NIRAS stated that there had been studies on the social consequences of surface disposal of nuclear waste: "That report was never made public, because the government wanted alternatives for surface disposal as well and we did not want to give the impression with the publication of this report to continue only with surface disposal."[36]
Greenpeace stated that in 1995, test drillings would be conducted at some locations. The population can only react after the selection of one site. "The risk is high that decisions will be taken without a broad social and political debate. Thus it is of big importance that citizens and politicians from all the municipalities should react forcefully before it is too late," wrote Greenpeace in an action paper[37].
The call from Greenpeace had effect. Several municipalities exempted a municipal official from daily work to collect data and coordinate the resistance[38]. Several demonstrations took place, organised by local groups and with the participation of the municipalities[39]. The NIRAS report resulted everywhere in resolutions in municipal councils in which the storage was rejected[40].
Freddy Decamps, director-general of the NIRAS, stated in May 1995 that at the end of that year, a choice would be made for 10 to 15 locations for test drillings. In the next phase, he said, two or three locations would remain, and in 1997, the political decision should be made unless the government would ask the NIRAS to stop with the plans.[41]

8.2 ... through a military intermezzo ...
At the end of 1996, the NIRAS became a request from the Ministry of Economic Affairs--incited by the Ministry of Defence--of whether one of the 25 military bases would be suitable for the disposal of Category A waste. That work became public in early 1997[42] and again gave rise to unrest.
The advantage of military sites was that no change of a local development plan, with an included public input procedure, was to be required. Of course there would indeed be public input possible on the actual storage. Some politicians tried to win the municipal council by promising an investment of 100 to 300 million Belgian Francs (Dfl 5 to 15 million) for a science museum or an amusement park[43][44] .
The municipality of Beauraing, where the military base of Baronville is located, is a possible candidate for Category A waste. On 28 June 1998, a local referendum was held. To the citizens the question was presented whether they wanted a storage bedded into a broader project that would make possible the development of other activities like tourism or research. For this broader project, 1 billion Belgian Francs (Dfl 50 million) were to become available and employment should be expected for 150 persons. This could be read in a brochure disseminated house-to-house[45]. Apart from this brochure, the citizens were informed by information meetings, NIRAS came with an exhibition, and Greenpeace gave information but also

constructed an artificial pyramid with nuclear waste barrels. The outcome of the referendum, with a 67% turn-out, showed that 94% rejected the storage[46].
The NIRAS considered Baronville to be "a very unpleasant case. Local politicians supported the plan but action committees were formed. Thus the municipality decided to hold a referendum. We at the NIRAS did not want a plebiscite at that time because we had not yet finished our working program and we were studying the request of the government on the different alternatives and on issues concerning the acceptance by the public. We did not have a concrete project. In the framework of the plan for military domains of the Ministry of Defence, the NIRAS was mentioned and that thwarted our plan with the alternative policy options. First our report with policy options should have been released before we could eventually do something with Baronville"[47].
Greenpeace Belgium pointed to the fact that at a certain moment, the municipality aimed at a low turnout: "If the quotum would not be reached, then the outcome of a referendum would be invalid. The municipality itself then could take a decision. When it looked like that the people would say no, despite the compensation of over 1 billion Francs, the municipality started the strategy to discourage people to vote. But that strategy failed"[48].

8.3 ...towards partnership?
On 16 January 1998, the government decided to proceed with further work on "a final solution or a solution with definite, progressive, flexible and reversible destination"[49]. According to this decision, low- and intermediate-level waste can be stored either close to the earth's surface as well as in deep geologic clay formations[50]. With this, the government declared itself to be opposed to the option of long-term (interim) storage and followed this by what the NIRAS described as ethical basic principles: "On one hand, to act in a way that the conditions for the storage of waste on the long-term do not bear unacceptable risks for the health of future generations; and on the other hand, do not impose excessive technical and financial burdens on those generations". Long-term storage implicates that eventually a new building would be necessary for prolonged storage and "that all would implicate important postponed technical and financial efforts"[51].
The storage was for some decades which "guarantees in itself the reversibility of the decision-making process until the closure of the disposal site, i.e., until about 2060. Instead of taking an authoritative attitude, the government gave priority to support the debate, in a way that opinions gradually will converge to consensus". The NIRAS called this governmental decision "in every way an ethical standpoint"[52].
Greenpeace gave a contrary view, stating that now the option of "long-term aboveground storage" had been rejected. Greenpeace considered this to be ethically irresponsible because in an irreversible way the limitations of our present knowledge and insight are imposed upon future generations[53].

What ethical theory was behind the ethical standpoints taken? Vande Putte stated that the NIRAS used the word ethics to justify a proposed practice, but he gave no further explanation of the ethical theory used by Greenpeace[54]. NIRAS said thathere is "no own ethical theory. The NIRAS takes over the ethical principles as internationally developed by the International Atomic Energy Agency and the Nuclear Energy Agency"[55].
We refer to the following. We studied these principles in our report, "Nuclear waste and nuclear ethics". From our research, it turned out that these principles were not so much that ethical or a "sound ethical thought", but were sometimes controversial recommendations with political compromises. The question of moral justification of the nuclear waste production was insufficiently discussed.
Concerning research, the NIRAS was limited to the existing "nuclear zones" in Doel (nuclear power reactors), Mol (SCK/CEN), Dessel (manufacturing fuel elements), Fleurus (Institute for Radio elements), Tihange (nuclear power reactors) and to locations where local authorities showed interest[56]. Vande Putte called this a "pure political decision". According to him, "sociologists of the Universities of Antwerp and Liège have stated that at the nuclear zones a kind of habituation has been formed. One can either accept the nuclear risks, or one moves. Therefore, one can expect an acceptance at the existing nuclear zones. Although it could also indeed be possible that an additional waste storage results in a bad reputation for the community and that houses will decrease in value. With this, public acceptance can appear to be low"[57].
Mol-Dessel, Tihange and Doel, which were dropped in 1994, were now on the list. The NIRAS clarified this by referring to the fact that deep disposal was called a possibility: "Apart from this, the surface storage concept was changed. In 1994, no control mechanism was foreseen. The new concept indeed takes into account monitoring during three hundred years. And we are studying how to do so. But I want to emphasize that it concerns a broad research, in which social aspects and acceptance have a very big role. It can happen that it appears that the nuclear zones will all be dropped."[58]

The NIRAS conducted deep test drillings at the locations[59]. Mol-Dessel and Doel were both candidates for surface disposal as well as deep disposal. In Tihange and Fleurus only surface disposal was studied. In March 1998, Decamps stated that NIRAS definitely shelved the studies on the 47 municipalities and 24 military training sites[60].
The government policy resulted in new orders to NIRAS. At the end of 2001, the NIRAS wants to propose new concrete designs, in which integration and partnership will be central. The NIRAS supported the new policy because "it had gradually realised during the last years that old procedures are not sufficient"[61].

The NIRAS hoped that "the local communities not only voluntarily but also actively participate in the work. Everyone can, yes or no, participate in the project, but the project will have good results if one feels really involved, not as observer, but as actor. (...) The disposal has to be integrated in a much broader whole, of which the general impact on the community is positive. Then the disposal is no longer a burden but it becomes a catalyst for the economic, cultural and social life". (...) "From the start to strive for a real partnership, instead of limiting oneself to a contradictory debate, means a renewal for the sector of the nuclear waste"[62].
NIRAS gives the following contents to the partnerships: "The partnership we propose on one hand includes representatives of concerned people who pay attention and, on the other hand, representatives of the NIRAS. (...) With the exeption of NIRAS, the possible partners have to live in the concerned municipality(ies)." Possible partners might be local governments, environmental, labour or socio-cultural organisations and the local nuclear operators. Individuals or companies can be supervisory members and participate in working groups[63].
The partnerships have to consist of four organs:
--The general meeting, in which all partners have a seat.
--The governing committee, which is appointed by the general meeting and consists of no more than six persons.
--The coordination for daily management, consisting of at least two persons.
--Working groups that give the project proposal concrete forms, work out possible options and ask advice from experts[64].

Every partnership will start with the collection of information. The partnership will be helped with this by the University Institute Antwerp (UIA), the Foundation University Luxembourg (FUL) and the NIRAS. Then the partnership will make a thorough study of the collected data and decides whether it is, or not, possible to work out one or more proposals for an integrated disposal project. After the study phase, "the partners will together discuss the different project proposals for disposal that had been worked out, before a candidate proposal is worked out more completely in the form of a maquette, so that the project is a visual proposal apart from the reports". The NIRAS would continuously evaluate the technical feasibility of the proposals[65].
The partnership has to be careful that "the proposed disposal project is integrated in a broader project that is supported by broad consensus and will be good for the municipality"[66].
The partnership is responsible for information to the population: "More special, the partnership will take care of contacts with media, with the broad public and with local organisations that are not directly involved as partners in conducting the project"[67].
Every partnership works out one or two concrete proposals. These proposals are reviewed by independent experts on safety, costs and expected social benefits. The purpose of the advice is to make a ranking list of projects. The NIRAS itself would be involved in the project and therefore not the designated authority to give advice. Hence, there would be the independent commission that, however, cannot dismiss proposals as such. The proposals and the advice are submitted to the government which would take a decision[68].

According to the NIRAS, "at the moment a kind of information round is taking place with possible target groups. We also want groups opposing the storage to join. All local actors are consulted and invited to cooperate. Tihange is not interested. The municipality Beveren, in which Doel is located, is waiting. Conversations are ongoing in Fleurus. In Mol and Dessel two partnerships will be formed, because in Dessel local authonomy plays an important role"[69].
A precondition in the discussions is that the existing storage capacity at Belgoprocess in Dessel is to be fully utilised around 2005: "By that time, the NIRAS has to prepare to bring into practice the policy for the long-term management as chosen by the government"[70]. The precondition, however, is "no urgent issue", says the NIRAS: "Actually, there is no urgency. Indeed in 2005 a decision is necessary, but that could also be an extension of the existing buildings."

Greenpeace has objections to the limitation to waste from category A: "A partnership for only this category is not accepted by people because this will not mean a real solution. In practice Category A is very diffuse. In the past, a part of A seemed to be in fact B. There was no effort towards a solution for B waste. Greenpeace wants an integrated solution. Its position is that there is nuclear waste, and although the nuclear power reactors are still in operation, it wants to take a responsible position on nuclear waste. There are indeed a lot of nuclear legacies in Belgium and Greenpeace does not want them to be spirited away, but handle them in an integrated way. That's why we consider the existing idea for partnership a waste of time"[71].
The plea for an integrated approach meets with a wide response from the NIRAS: "There has never been a real social debate on the global problem, not even on low-level and short-living waste. What we see now is that in the public opinion there are requests coming for a global approach"[72].

9. SUMMARY

The NIRAS has managed all the radioactive waste that has been produced on Belgian territory.
In Mol, an underground laboratory was realised in clay. When it was set up, it did not face large public resistance. It is the only laboratory in the world with such a size. Extensions are being made in the PRACLAY (clay disposal) project. With this project, the NIRAS has to prove that an infrastructure for a geological disposal of vitrified waste can be built, operated and sealed in a safe way. The NIRAS points out that there was an absence of protests towards the research character of the project, and states that the laboratory cannot be converted into a final disposal unit. The research character is the reason Greenpeace did not resist, although Greenpeace considers PRACLAY to be a step too far and thinks the project is the realisation phase "under the guise of research". Both Greenpeace and the NIRAS expect that a decision on storage will indeed lead to protests.
Public discussions about nuclear waste were on low- or intermediate-level waste with short half-life (Category A). In 1994, the NIRAS mentioned 98 possible locations in 47 municipalities. In 1997, an additional 25 military bases, not anymore in use as such, were added. The proposals led to mass protests. In these protests, the fact that different factors determine whether waste is Category A waste or not played a role.
After the protests, the government reviewed its policy. The research is now limited to the existing nuclear zones in Doel, Tihange, Mol, Dessel and Fleurus, or to municipalities that volunteer. The government will not conduct a broad consultation with the population.
A new element is the partnership, consisting of local governments, local organisations, and the local nuclear operators, as well as the NIRAS. The idea behind this is that the storage can fit in a broader project, so that the total effect is to be perceived by the local community as positive. These partnerships still have to be formed.

10. CONCLUSIONS

1. Until now there has never been a discussion about the total nuclear waste policy, and there is no expectation that it is being planned.
2. The definition of the different categories of waste is unclear and difficult to explain. This has not supported the gaining of public acceptance.
3. The idea of local partnerships still has to be worked out. In practice it has to be shown whether the idea is realistic.

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3. CANADA

KEY FACTS

Nuclear Power: 21 nuclear power reactors; 29.3 Gwe; 16% Gen. Cap.
Waste (present): historical waste (producers no longer exist) – 800,000 m^3; ongoing waste (producers still exist) – 180,000 m^3; spent fuel – 5,000 m^3; most historical waste stored at two locations in Ontario; Ontario reactors' waste stored at Bruce NPP; spent fuel stored on-site NPP.
Waste (future, cumulative): spent fuel – 79,200 MT; Canadian shield considered for HLW disposal; surface disposal site at Bruce planned, operational by 2015.
Waste authorities: Atomic Energy of Canada Ltd. (AECL), responsible for developing disposal concept.
Retrievability: this generation responsible for constructing disposal site, future generation can decide on closure date.
Dialogue (among others): public review of the AECL's concept started in the late 1980s by an independent panel; broad input from public and environmental organisations; nuclear energy was outside mandate and created conflict; conclusion Panel: technical safety proven "on balance", not from social perspective.
Key issues: independent Panel gained trust and broad input; no sufficient public acceptance for disposal option yet; government decision: new waste agency to be set up by nuclear industry, created distance to environmental groups and will not contribute to public trust; discussion influenced by nuclear energy issue.

Introduction

In the late 1980s, a public review was started on the concept of the Atomic Energy of Canada Ltd. (AECL) for a nuclear waste disposal on the Canadian shield, an area that covers the northern and eastern parts of the country. For this a panel of independent members was set up. In 1998 its final report was published, followed by a government response on it. In this chapter we concentrate on the panel's review and the government response.
For this chapter, the main documents were the panel's report, the government's response to it and material from environmental organisations that was brought into the review. Comments on the draft text were made by Ghislaine Kerry, information officer at the Canadian Environmental Assessment Agency that housed the secretariat of the panel. Although there had been contacts with an environmental organisation, no comments has been received, unfortunately.

1. NUCLEAR POWER PROGRAM

The nuclear power program started in the 1950s and in 1962, the first nuclear power reactor, the Nuclear Power Demonstration plant, was connected to the grid. In the next decades power stations, mostly with more than one reactor at each site, were built at Bruce, Darlington, Gentilly, Pickering, Point Leprau and Douglas Point[1].
Canada's 21 reactors generate about 16% of the country's electricity and its generating capacity is 29,3 GWe. Most of the reactors (19) are located in the province of Ontario, and one each in the provinces of Québec and New Brunswick. The reactors are of the CANDU design: Canadian Deuterium Reactor, in which natural uranium is used as fuel with heavy water as moderator. The nuclear electricity utilities are fully owned by the three provinces in which the reactors are operating[2].
In August 1997, Ontario Hydro shut down temporarily seven reactors, Bruce 1, 3 and 4, and Pickering 1-4, due to safety concerns. It is expected that it will take years to make a final decision on safety upgrading or definite shutdown and decomissioning[3]. Five other CANDU reactors were shut down definitely in the past[4].
Canada is the biggest uranium producer and exporter in the world. In 1997 it produced more than 12,000 MT (metric tons uranium equivalent) of uranium, about one third of the world’s production[5].

2. PRODUCERS OF RADIOACTIVE WASTE

Waste producers in Canada are the nuclear reactors, research institutes, radio-isotope production facilities (Canada is one of the world leaders on that market), the uranium mining industry and others. Concerning low-level waste, the Ontario reactors produce about 45% of these waste, AECL laboratories some 30% and uranium mining company Cameco 5%. The other reactors in Québec and New Brunswick and two fuel fabricators count for 3%. Radioisotope production and use produce 17% of annual low-level waste[6].

3. CATEGORIES OF RADIOACTIVE WASTE

For low-level radioactive waste, two categories are used: waste from ongoing production and so-called historical waste. Ongoing waste comes from nuclear reactors and is called reactor waste, and also from medical and industrial use.
The category historical waste is from producers that no longer exist, mainly from past radium industry, or that are not any more responsible for it. This waste consists mainly of process residues or contaminated soil. Its volume is about 90% of the other total low-level wastes[7].

4. AMOUNTS OF RADIOACTIVE WASTE

4.1 Present amounts

Until 1995, some 5,000 m^3 of spent fuel were stored. Ongoing low- and intermediate-level waste from all producers had cumulated to 180,000 m^3 in 1995[8]. Historical wastes would total a volume of about 800,000 m^3.[9]Uranium mining and milling waste volume till 1995 was 225 million MT. In volume, spent fuel is less than 1 percent of the cumulative amount, ongoing low-level waste is 10% and historical waste is 90%. Uranium mining and milling wastes are not included in this[10].

4.2 Future amounts

Yearly, an amount of a few hundred cubic meters of spent fuel are produced. Apart from the spent fuel from electricity production, smaller amounts of spent fuel are also produced in research and radioisotope-production reactors[11]. The AECL expects that a total of 3.3 million spent fuel elements (approx. 79,200 MT) finally have to be stored, under the condition that no expansion of reactors or capacity would take place. Due to the temporary shutdown of Bruce and Pickering this amount could be less.
In 1995, some 5,000 m^3 "ongoing" waste were produced[12].

5. WHERE IS IT STORED?

Spent fuel from the reactors is not reprocessed and is stored in water-filled pools or in dry concrete containers at the reactor sites[13].
Other reactor wastes from Ontario reactors are stored at a facility at the Bruce reactors site. There are plans to dispose of these wastes in a near-surface disposal, excavated in rock, in Bruce. Site selection should start in 2002 and operation by 2015. Waste from the Québec and New Brunswick reactors is stored there on-site[14].
Most of the historical waste was disposed of at two locations in Ontario, Port Hope and Port Granby. The waste from uranium mining is stored near the mines[15].

6. RESPONSIBILITIES

The Atomic Energy Control Board (AECB) is the federal authority responsible for regulation and licensing. It reports to the Parliament through the Ministry of Natural Resources, which is responsible for nuclear energy issues. The AECB was founded in 1946, together with the promulgation of the Atomic Energy Control Act. In 1996 a proposal was made to replace the Atomic Act by a new Nuclear Safety and Control Act. The AECB is to be replaced by a new body called the Canadian Nuclear Safety Commission (CNSC)[16].
AECL has developed a concept for a final disposal site for spent fuel.

There is still no special fund for managing nuclear waste costs. Up till now the electricity companies have a levy on the electricity price to cover costs. The money that has been collected was invested in normal utilities

operations. The utilities think that future income can provide enough means to pay for the future costs. For fuel fabrication, radioisotope production and nuclear research facilities, no provisions have yet been made. Uranium producers though have the obligation to provide financial assurances for future decomissioning activities[17].

7. THE NUCLEAR FUEL WASTE MANAGEMENT AND DISPOSAL CONCEPT ENVIRONMENTAL ASSESSMENT PANEL

In the early 1980s, the government decided that siting of a nuclear waste repository could only take place after a public consultation and governmental approval of a disposal concept. The consultation was conducted in a 10-year review by the "Nuclear Fuel Waste Management and Disposal Concept Environmental Assessment Panel", hereinafter called "the Panel".

7.1 History of the disposal concept

In 1975, the Ontario Royal Commission on Electrical Power Planning had a first kind of public review on the province's policy on nuclear waste. It was to conduct a five-year inquiry to finally address the issue of nuclear waste disposal. It advised a moratorium on building new nuclear capacity if the waste problem had not been solved by the year 1990. The commission also recommended a dialogue between proponents and opponents of nuclear energy[18].
In 1977, the Ministry of Energy, Mining and Resources established a group of experts to develop a long-term policy for waste management. In its final report, well known in Canada as the "Hare Report", named after its chairman, Kenneth Hare, the commission studied several options for spent nuclear fuel, including reprocessing, space disposal and geological disposal. The last one was favoured[19].
In 1978, the AECL was officially asked by the governments of Canada and Ontario[20] to develop a concept for deep geological disposal of nuclear waste. This was followed, in 1981, by the requirement that siting may take place only after public consultation and approval of the concept by government[21].
In the early 1980s, the AECL chose to start test drillings near the town of Massey and the Sagamok First Nation (Aboriginal) in the north of Ontario. This raised massive protests, and after a referendum in Massey, in which 88% of the people opposed the plans, the AECL withdrew. After similar protests in five other communities, the AECL decided not to proceed and to concentrate on "generic" research and the development of a "concept" for deep disposal[22].

The concept has been designed to store 10 million used fuel elements and its costs would be about Ca$ 10 billion (Dfl 14 billion). If no new reactors were to be built, only 3.3 million fuel elements have to be stored. The 10-million assumption was made on the possibility that new reactors would be planned to replace the older ones, or that existing capacity would grow 3% a year[23]. Critical groups, however, feared that the AECL has considered the possibility to import nuclear waste, in exchange for exporting CANDU reactors or Canadian uranium[24].
According to the ideas of the AECL's concept, this generation that benefited from nuclear energy, is responsible for designing and construction of the disposal site. The AECL's choice for definitive underground disposal is made to minimize the dependency on institutional controls. However, some kind of retrievability is foreseen as this generation would design and construct the repository, but the decision to finally close it is left to succeeding generations. The construction and operation phase is to take decades. The AECL fears that if this generation would not take any decision, for instance because of hope for another technological solution, succeeding generations would not do it as well[25].

7.2 Procedure

Panel's mission

The early history of the Panel actually started in 1989 after the 1988 announcement to review the AECL concept by the public[26].
The independent Panel was appointed on 4 October 1989. The eight members were a former deputy minister of environment, a consultant health physicist, the vice chairperson of the National Aboriginal Economic Development Board, a professor of the Department of Biology, a professor at the School for Engineering (Laurentian University), a member of Consensus (the Quebec Centre for Environmental and Social Mediation), the president of the Canadian Institute for Broadband and Information Network Technology (University of Regina) and the former president of the Canadian and World Councils of Churches[27].
The Panel had to:

- *"examine the criteria by which safety and acceptability of a concept for long-term waste management and disposal should be evaluated*" and secondly
- *"prepare a final report addressing whether AECL's concept is safe and acceptable or should be modified, and the future steps to be taken in managing nuclear fuel wastes in Canada*"[28].

The Panel's mission was clearly limited to spent fuel from Canadian reactors and did not include other wastes.

The Panel also established a Scientific Research Group (SRG), consisting of independent experts, to review the technical aspects of the AECL's concept. The SRG was established in 1990, and reported in October 1995 and September 1996[29].
In its first years the Panel developed guidelines for the Environmental Impact Statement (EIS), to be made by the AECL. During this time the Panel held public meetings in 14 communities.
In 1994, the AECL submitted the EIS for public review which lasted until August 1995. Written submissions were made to the Panel and the first SRG report was received.

Public Hearings
After this, the Panel concluded that sufficient information was available for the start of public hearings. The hearings lasted from March 1996 to March 1997. The public hearings were divided into three phases. Phase I focused on societal issues and future generations. It took three weeks, two of which were spent on specific topics and the remaining one with general sessions. The sessions started with general presentations followed by round-table discussions.
Phase II dealt with safety aspects of the concept. This lasted 12 days, of which 10 dealt with the post-closure safety aspects and the other two about the pre-closure time. This phase was prolonged as the AECL was referring to studies on the use of copper canisters, which the public was unaware of.
In phase III, people had the last opportunity to give their opinion. In this phase, the Panel visited a number of communities, in total 16, on the Canadian Shield, the area considered for a disposal site.
In the three phases a total of 531 speakers were heard, 536 written submissions were made and 108 other responses were received[30].

Funding
Funding of public initiatives was possible. The AECL was responsible for the provision of funds that was administered by an independent committee. Finally the limited amount of Ca$ 842,515 (Dfl 1,179,521) was spent during the whole process, from developing the guidelines for the EIS to the public hearings finally[31].

Nuclear Energy
Outside of the Panel's mandate was the issue of nuclear energy in general. This was for some groups reason not to be involved in the Panel's process, for instance Greenpeace Canada. Others also complained that it was difficult to deal with the waste issue in complete isolation of its broader context of production, when these two processes are connected. A third group had no problems with the limitation[32].
In a pre-hearing study by A. Wiles, upon request of the Panel, one group warned of the risk that excluding nuclear energy from the hearings would certainly not contribute to increased acceptance of waste disposal: "Citizens will very likely refuse to accept nuclear waste disposal when waste production issues are evaded in hearings such as these and remain beyond public control."[33]
At the start of the Panel's review, the government announced that it would conduct a parallel review in which the waste issue would be placed in the broader context. However, this process never started, although the Panel several times requested the government officially to do so[34]. On one hand, the reaction was that it is not a business of the federal government, as energy issues are a task of the provinces. But on the other hand, this broader review remained in consideration. The Panel recognised the government's support to nuclear energy[35].

Aboriginal Input
As potential locations for disposal are mostly inhabited by Aboriginal communities, the Panel tried to give extra attention to this group. The Panel itself included one member with Aboriginal background and, apart from the public hearings in Aboriginal communities, a special workshop was organised. In general, Aboriginal people felt that neither the AECL nor the Panel consulted them in a way that respected their culture, languages and consultative process. Because of time and language reasons, they had too little possibilities to study the concept. But it was argued that the concept of disposal would be in conflict with

Aboriginal principles of human's relations with Mother Earth and next generations. Because of a long history of bad experiences with the Canadian government, they feared the possibility that a volunteer process would be broken by the government. And last, people asked why communities that did not benefit from the production of waste should feel responsible for the disposal of it. During the process and especially at the last day of hearings, the Aboriginal participants requested a stop to the Panel's review process to receive time and resources to conduct its own consultation before the Panel would report to the government[36].
Contrary to this critical reaction, by 1994, the Meadow Lake Tribal Council, an Aboriginal community in the province of Saskachewan, showed interest in siting a disposal facility as a means to increase employment for their community. It conducted a feasibility study to examine the economic benefits of a waste disposal, including the import of fuel waste from the U.S.[37]. But Saskachewan's Prime Minister Romanow declared on January 13, 1997, that his province would not accept a disposal site. Due to growing protests from within the Meadow area, several First Nation communities declared themselves to be "nuclear-free zones"[38], the Tribal Council also finally declared not to accept a disposal. The Cree and Dene Aborignals expressed strong opposition to the disposal plans and accused the Canadian government and industry of "environmental racism" as their lands were destroyed by uranium mining and by a possible future waste burial[39].
A study by the Laurentian University, Sudbury, Ontario, among four northern communities, of which one was Aboriginal, showed little support for the plans to dispose of waste in the northern part of Ontario. A survey showed that only 10% was in favour and 73% against it. Opposition in the Aboriginal community was stronger than elsewhere. The university found the following relevant factors that were of influence: trust in nuclear regulators, faith in science and technology, and expected net costs. No indication was found that financially insecure people would be more in favour than secure individuals[40].

Environmental Groups

In the process, several environmental and nuclear energy critical groups were involved. They took part, for instance, in the hearings or issued their visions on paper or on internet. Also, messages were sent around, for instance, in magazines or through e-mail, to individuals to participate, with telephone numbers of the Panel, data and addresses of the hearings[41].
Among others, Northwatch, a regional coalition of environmental and citizen organisations that operate in the northeastern Ontario, actively participated in the Panel's process and issued information packages and also held its own workshops for communities and First Nations[42]. Although it had limited possibilities for paying, it sought independent experts for the hearing sessions on themes like climate change, the copper canisters and biological monitoring[43].
In the weekend before the hearings of phase III, a "Global Citizens Forum on High Level Waste" was held in Saskatoon, where individuals and members from organisations met. A charter with a common statement was issued, with a clear aim towards a nuclear phaseout. It also stated: "As long as nuclear waste continues to be generated, any discussion of solutions to the problem of nuclear waste is premature and misleading." With this statement, the forum again emphasized the need for a general discussion on nuclear energy, which still had not been initiated[44]. The charter also asked for an independent waste management agency, contrary to the present situation where the nuclear industry depended on the use of nuclear energy and at the same time had to find a solution for its waste[45].
Greenpeace Canada felt no will to be involved in the Panel's hearings. It found it difficult to separate the concept and the siting issue. More principal, it doubted whether the public should feel responsible for the waste problem or to leave it totally to the producers. And they were critical of the limited Terms of Reference of the Panel that made it almost impossible to talk about nuclear energy in general[46].
Apart from scepticism about the limitations of the Panel's mission, others also had doubts about the status of the hearings. According to Environment North: "One other function of public participation in these hearings is to legitimize the entire assessment procedure, to place a stamp of democracy on a process which is not necessarily all that democratic"[47].

Provinces' input

According to Northwatch, four of the five provinces in which the review was conducted gave statements that reflect their sometimes quite negative approach to the plans for waste disposal. For instance, Saskatchewan's deputy minister stated that the province's policy could not support a waste disposal. The Manitoba province's High Level Radioactive Waste Act disallows the siting of a disposal and was not involved in the Panel's hearings. The Québec government already in the 1980s made clear to the federal government that it would not participate in the concept review process. And last, New Brunswick, which has one reactor, also did not want to be involved in the Panel's review. So, only Ontario seriously participated in the public review,

although Northwatch perceived little input from it, like documents, etc. As Ontario's Minister of Environment said: "Ontario has only held observer status rather than full involvement in the process as was envisioned in 1981. We share your concerns about the limitations of the federal environmental assessment process"[48].

Policy Framework for Radioactive Waste

During the Panel's hearings on July 10, 1996, a Policy Framework for Radioactive Waste was issued by the Ministry of Natural Resources. Its key elements were:

> - *"The federal government will ensure that radioactive waste disposal is carried out in a safe, environmentally sound, comprehensive, cost-effective and integrated manner."*
> - *"The federal government has the responsibility to develop policy, to regulate, and to oversee producers and owners to ensure that they comply with legal requirements and meet their funding and operational responsibilities in accordance with approved waste disposal plans."*
> - *"The waste producer and owners are responsible, in accordance with the principles of 'polluter pays', for the funding, organisation, management and operation of disposal and other facilities required for their wastes. This recognises that arrangements may be different for nuclear fuel wastes, low-level radioactive waste and uranium mine and mill tailings."[49]*

The release of the Policy Framework was at that time criticized by Northwatch as it was in the middle of the Panel's hearings. It was seen as an attempt by government and industry to make their own policy, before the Panel could make conclusions[50]. Later, we will see that the contents of this Framework indeed played an important role in government's response to the Panel's report.

7.3 Final Report

On 13 March 1998, the Panel presented its final report. According to the Terms of Reference the Panel had to define and evaluate criteria for safety and acceptability.

Criteria

In defining criteria for safety, the Panel recognised the different dimensions of safety, saying: *"in the broadest sense neither safety nor acceptability is an absolute or measurable construct. Both are relative, value-laden and subject to differing interpretations by different people*". Therefore the Panel concluded that safety is an important, but only one part, of acceptability.

As the nuclear waste problem has a close relation to the issue of the welfare of future generations and environment, the Panel secondly concluded that an ethical and social framework was necessary to find acceptable solutions.

The Panel recognised the difficulties in finding an acceptable solution and referred to the international situation, where actually no country had found social consensus for a high-level waste disposal site. The Panel concluded that broad public support was necessary in order to reach an acceptable concept for disposal.

The Panel mentioned six conditions for acceptability: *broad public support*; *technically and socially safe*; *developed within social and ethical framework*; *support of Aboriginal people*; *selected after comparison with risks, costs and benefits of other options*; and *managed by a stable and trustworthy proponent and regulator*.

Aside from the conditions of making the concept acceptable, the Panel formulated seven conditions which the concept should meet to be considerd safe: *determination to meet regulatory requirements*; *based on thorough and participatory scenario analysis*; *the use of realistic data and models*; *sound science*; *flexibility*; *flexibility*; and *integration of peer review and international experience*.

The conditions for acceptability and safety are more comprehensively worked out in the Panel's Final Report. For those interested we refer to this report[51].

Criteria from a technical perspective

In its report, the Panel first examined the conditions for safety, from a technical perspective. The Panel thinks that, with the concept now being available, it could meet the *regulatory requirements*. But during the review, concerns were made by participants about, for instance, the long-term safety of backfill material, the availability of low-permeable rock and corrosion rates.

During the review it became clear that, concerning the *scenario analysis* criterion, the public was more concerned about the high consequences of extreme events than on its low probability. The Panel believed that "on balance" the concept was based on sufficiently complete scenario analyses, but also recognised that there was no widespread consensus about probabilities and (worst-case) consequences. It concluded that the concept was not based on *thorough and participatory scenario analyses*.

To answer the question of using *correct data and models,* it was a problem that no site-specific design was

available. The SRG concluded that the AECL's models had a number of shortcomings, especially the conceptual model of the geosphere. The Panel recognised that uncertainties always would remain in modelling, but thought that, on balance, the models used for this concept were sufficiently developed. However, the Panel urged the AECL to critically review and update its models, including more external input than before.
Concerning *sound science*, the Panel stated: "We are satisfied that the proposed technologies are realistic from a scientific and engineering viewpoint, yet have challenges that must be overcome." With this it referred to the modelling work.
The concept of underground disposal should be *flexible* as the exact underground situation was not known. In constructing the repository, eventual changes of the design might be needed. According to the Panel, the AECL had made several variants.
To be *feasible* on the first place, there should be suitable sites for a disposal. As the AECL's concept was said to be flexible in design, the Panel concluded that somewhere a site could be found, although its feasibility had yet to be demonstrated. The Panel was not convinced that enough funds were set aside to mention the concept being feasible.
Finally, concerning *peer review and international experience*, the Panel agreed that this criterion had been met.
So, from the technical perspective the Panel concluded that the concept was "on balance" proven to be safe[52].

Criteria from a social perspective
From the social perspective, however, the Panel concluded that safety "has not been adequately demonstrated for a conceptual stage of development". The Panel had three reasons to doubt the social safety of the concept. First, the Panel pointed to the long-term danger of nuclear waste, for hundred thousands of years, and therefore needed a very cautious approach. Second, it referred to the scientific uncertainties in relation to the long- time frame for which calculations must be made. And third, the public tended to be more concerned about possible severe consequences than about the low probability of these scenarios.
The Panel examined the criteria for safety from a social perspective. The Panel doubted whether the criterion of *determination to meet regulatory requirements* could be met.
The reason therefore was that within the scientific community, opinions were divided on the issue of determination. For instance, the SRG doubted the reliability of predictions for post-closure consequences. The Panel concluded that the concept methodologies "have not yet gained sufficient recognition as valid and firm tools to enable the public to gain confidence in the safety of the disposal concept".
For the criterion of *thorough and participatory scenario analyses*, the Panel recognised shortcomings. The AECL failed to address scenarios that were brought in by the public, like the consequences of cumulative minor accidents or major unforeseen events. Also, too little public input was made in developing the possible scenarios.
For the use of *realistic data and models*, the Panel stated that they are insufficiently developed.
From a technical point, safety should be based on *sound physical science*. From the social perspective the concept should also be based on sound social science and the input of Aboriginal knowledge. The AECL calculations for future consequences only count for fatal cancers and serious genetic defects, whereas the Panel chose for "a very broad review of all the possible implications". For instance it mentioned the consequences of great social turmoil and opposition. A more "sustained and comprehensive use of social sciences" was considered as necessary.
As the AECL's concept was based on passive safety, it did not consider the possibilities of early warning systems to be built in the disposal site, as it might compromise the passive safety features. Many participants, however, strongly believed that long-term institutional controls, imperfect as they may be, are a sign of responsible management. Therefore, from the point of *flexibility*, the Panel advised to study the possibilities of early detection systems more closely, built-in or near the disposal site.
To be *feasible* there should not only be a technically suitable site, there should also be perspectives in the area of decision-making "from a social perspective". "...The AECL failed to demonstrate that it had developed an adequate decision-making strategy for successfully selecting a safe site in a cost-effective way". For the Panel it was not clear enough how to proceed with the site search in future.
Concerning *peer review and international experience*, the Panel recognised a lack of input from social and ethical scientists and also too little information about the siting processes in other countries[53].

Acceptability
After having evaluated the technical and social aspects of safety, the Panel studied the criteria for acceptability. *Broad public support* was absolutely necessary for making decisions on the waste management. The Panel concluded that the AECL's concept missed this broad support. Although the AECL did attempt to inform the public, it was unclear how widespread this information was understood and what kind of support it got. The Panel recognised that it was difficult to know exactly the extent of support or opposition to the concept, but thought there is still too much opposition: "We judge, however, that significant numbers of the public are currently sufficiently opposed to the AECL concept that it would be ill advised to proceed with it now."
To be acceptable, the concept should be *safe from a technical and social perspective*. As noted earlier, the safety from a technical perspective was "on balance" demonstrated, but not proven from the social side.
In its work, the AECL addressed a number of *social and ethical* issues, more than usually is found in technical proposals. One of the discussions from a social and ethical perspective was the need and timing of disposal. Against the reasoning of the AECL for direct disposal, participants mentioned the lack of confidence in technical solutions for a long-term, the trust in present aboveground storage to gain time, the lack of built-in monitoring and the denied future generation's right to choose. Besides, the impossibility to discuss the future of nuclear energy and its relation to waste production was found unethical by participants. The Panel said: "These may be out of the mandate, but they cannot be ignored when looking at acceptability." Participants also felt a lack of balanced input from social and ethical sciences into the EIS. The Panel concluded that the development of the concept had not taken place in a comprehensive social and ethical framework.
As mentioned earlier, Aboriginal participants were mistrustful in the process. They felt a lack of respect for their culture and consultation methods and they were not sufficiently able to make their judgments of the concept because of lack of time. So, the criterion of *Aboriginal support* could not be met.
In 1992, the Panel asked the AECL to study the *alternative options* to the concept. However, little information was received on this issue during the hearings. To be acceptable, the public should have the opportunity to choose among several options[54]. Where the AECL clearly has chosen to construct an underground repository by the present generation to d+ecrease the dependency on institutional controls, others however argued in the hearings that aboveground storage would be better and safer. For instance it was said that "relying on undemonstrated technology to achieve passive safety for many thousands of years was less acceptable than the assumption of societal breakdown and the loss of institutional controls". Also, the argument was made that a visible aboveground storage would remind people of its potential dangers, and thus ensure institutional controls[55].
The Panel recognised that to gain public acceptance, it was important to have a *stable and trustworthy proponent and regulator*. Although the AECL developed the concept, it also made clear that it had no primary, or maybe any, responsibilities for nuclear waste management in the future. Thus, there was no stable proponent. The Panel doubted the public's degree of trust in the AECL. It was accused of a lack of openness and transparency, insensitivity to the public and a lack of public participation. A conflict of interest was recognised, that is, that the AECL studied the solutions of the nuclear waste problem possibly as a means of ensuring CANDU reactor sales. The regulator, the AECB, was criticized by participants because of its slowness in adopting changes based on international standards, and the lack of public participation in setting standards. Finally, the Panel stated: "The absence of clear policy statements by the governments with respect to the future of nuclear energy in Canada makes it more difficult for the public to develop trust in a proponent and regulator."
The Panel's conclusion for overall acceptability was: "As it stands, the AECL concept for deep geological disposal has not been demonstrated to have broad public support. The concept in its current form does not have the required level of acceptability to be adopted as Canada's approach for managing nuclear fuel wastes."[56]

7.4 Future Steps
One of the tasks of the Panel was to advise the government how to proceed with its waste policy. The Panel recommended a four-step approach: phase-I set-up, phase-II concept acceptance, phase-III project acceptance, and phase-IV implementation.
Phase-I: Set-up
In the set-up phase-I, which would take about a year, the government should make a policy statement on the long-term management of nuclear waste and also develop an Aboriginal participation process. In this phase, a Nuclear Fuel Waste Management Agency (NFWMA) should be created and a review of regulatory

documents should take place.
Although Aboriginal people are possibly the most affected by the concept, their involvement in the process was presently too low. A participation process should be developed in which they themselves have a strong role: "Aboriginal people should design and execute the process so that it will be appropriate to their value systems and decision-making processes."
Seeing the lack of confidence in the present policy, the Panel advised that there be "a fresh start" by creating a new agency "at arm's length from the producers and current owners of the wastes".
The NFWMA initially has to: encourage and facilitate Aboriginal participation; develop a plan for public participation; study different options for management; develop an ethical and social assessment framework; develop technical considerations; present a comparison of the options and follow social and technical developments in other countries.
Its board of directors should be appointed by the federal government and should reflect broad interest groups, like federal and provincial governments, electricity utilities, engineering, science and social science. The staff should include the scientific-technical disciplines as well as the socio-economic ones.
The NFWMA should be financed by contributions of waste producers and owners, and not by general taxes. The money must be kept in a segregated fund and independently managed. The fund should cover all the costs to be made for participation, research, siting, compensation, etc.
The Panel recommended to set up an advisory council with broad representation: engineering, science, health and social sciences, Aboriginal, workers, environmental and non-governmental organisations, ethical and religious groups, affected communities and international bodies. Members should be nominated by professional and other organisations and appointed to the council by the government.
As it is possible that conflicts would arise between the NFWMA and other parties, like potential communities, an independent authority should be created to receive complains, mediate and possibly solve the problems.
The Panel advised to create an oversight mechanism that should contribute to confidence building. This included roles for the successor of the AECB, the federal government, the Ministries of Environment and Health, among others. An annual report should be sent to the Parliament for review.
Besides the creation of the NFWMA, the regulatory documents of the AECB should be subject of public review. As the Panel stated: "Taking into account the importance of a trustworthy regulator in gaining acceptability, we recommend that the AECB design and implement a more effective process for consulting the public during the formulation of regulatory standards, and that it undertake a public review of all relevant regulatory documents based on this process and of the new Nuclear Safety and Control Act."
Special attention is to be given to the discussion about "worst-case scenarios". The Panel recommended that the scenarios be defined and analysed, with input from the public[57].

Phase II: Concept Acceptance

The phase of concept acceptance has the goal to determine which option of waste management is most acceptable to the public. These options vary from the original AECL concept to long-term aboveground storage. In this phase, the NFWMA has to develop a public participation plan. According to the Panel, an early and thorough participation plan was absolutely necessary to gain acceptance. As history of participation faced distrust in nuclear industry and regulators, the creation of a new NFWMA could change this situation.
One of the tasks would be to develop a measurement method to study public opinion, which could vary from opinion polls, expert panels to referendums. In that way, public preferences for the different options should be determined.
The participation plan should lead to an appropriate level of public knowledge; building trust and confidence in the NFWMA and achieve informed and collective acceptance. One step was to develop a clear time-frame for decision-making.
Other conditions for the plan should be: information must be accessible for the public; clear information about uncertainties; there should be a good two-way communication; a funding program must be developed to give people access to different science disciplines; a professional communication plan must be developed and regional and local media should be involved in the process.
Special attention should be given to the option of retrievability, to improve security and gain public confidence, and to give freedom of choice to future generations.
The development of a social and ethical framework had to address the following issues: rights and responsibilities among generations; responsibilities to environment and ecosystems; societal versus individual rights; the minority issue; acceptable risks; retrievability, etc[58].

Phase III: Project Acceptance

After having determined the preferences for options of the general public, the next phase is more directed to

a potential host community, and others affected, where the preferred option should be realised. For this phase, the Panel again underlined the importance of public input.
A willingness of a community to cooperate in site investigation should not be interpreted as a final commitment to construct a repository. At all times, the community should have the opportunity to withdraw from the process. Communities must be compensated for their willingness to cooperate. All the safety criteria must remain intact. A site that may have public acceptance, but cannot meet the safety criteria, must not be allowed. Enough time should be taken to make a thorough decision, for instance ways have to be found to include minority opinions. In this phase the NFWMA has to pay for all the costs the community makes to consult experts, to set up a community liaison group, etc.
The NFWMA also has to develop site selection criteria that includes aspects like geology, land use, social areas, nature protection, transportation, etc.
When a volunteer community has been found, the NFWMA forms a Siting Task Force (STF) to negotiate with the community. From the community itself a Community Liaison Group (CLG) is formed, representing its different sectors, and it will act as a contact point for public and advisor to the municipal council. Finally, before realising an underground research program to study the suitability of the site, binding agreements between the NFWMA and the community must be made.
Lastly, in phase-III, an environmental assessment should be conducted and hearings be held to be sure of public support[59]. The last phase (IV) is the factual realisation of the disposal site[60].

7.5 Government Response

On 3 December 1998, the Ministry of Natural Resources made public the official "Government of Canada Response"[61] to the Panel's conclusions. Central starting point in government's conclusions is the Policy Framework for Radioactive Waste. In its first chapter it is repeated that the government "*has the responsibility to develop policy, to regulate, and to oversee producers and owners to ensure that they comply with legal requirements and meet their funding and operational responsibilities*" and that the waste producers and owners "*are responsible for funding, organisation, management and operation of disposal and other facilities required for their waste*"[62]. This starting point led to the following reaction on the Panel's recommendations.
On the Panel's request to issue a policy statement, the government announced to work out within 12 months a more detailed plan for the creation of a waste management agency and the establishment of a fund and a system of reporting to government and public participation.
The government agreed with the recommendation to create an Aboriginal participation process that is set up by themselves. However, the response mentioned "to the extent possible".
Concerning the creation of a Nuclear Fuel Waste Management Agency the government disagreed with the Panel's advice. Although the government recognised the importance of such an agency, it did not agree with the recommendation to put it "at arm's length from the utilities". In the response, the government refers to the 1996 Policy Framework that left the "management" of nuclear fuel wastes to its producers and owners. The creation of the NFWMA is thus the task and responsibility of the waste producers and owners. It is also their task to establish the demanded segregated fund to cover future waste costs.
Where the Panel had advised the establishment of a NFWMA's board of directors reflecting broad interest and appointed by government, the government considered the responsibility of appointing the board to be for the waste producers, referring again to the 1996 Policy Framework "management" principle. The composition and appointment of the Advisory Council members also was considered to be a task of the NFWMA itself, but the government "expects" that it would represent a "broad range of interest", as it recommended.
The Panel had asked the government to establish an oversight mechanism for the work of the NFWMA, including a public review. The response announced a less than 12-month period to study the options for this, in order to establish the fund, on the relation between the government and the agency and the review method (see page 43).
The response agreed with the Panel's advice to review the AECB regulatory documents. Such a revision was already foreseen by the AECB as it has to conduct its documents to public review every seven years.
The government expected the agency to set up a public participation plan that should lead to providing information, develop trust, confidence and acceptance. The development of an ethical and social framework should be set up by NFWMA and include different issues and input from several groups in society.
The government wanted the NFWMA to study the different options and aspects related to these, possibility for Canada's waste management, for instance, long-term aboveground storage. Where the Panel had asked to seriously consider the public's preferred choice, the response gave no clear answer when it states that future decision would be taken after having received from NFWMA a final report with the approach it wants. In

this report the shortcomings, identified by the SRG, should also be addressed[63].
The government response was not welcomed all too positively by environmental groups. Where Northwatch was reasonably content with the Panels report: "While we did not support all aspects of the Panel report [...] we accepted it, overall, as a thoughtful and responsible conclusion to the 10-year review, and one which set out a reasonable process for the next several years"[64], it disagreed with the response of government to it: "There's no explanation of why it took the government ten months to ignore the key findings of the hearing panel which reviewed the AECL's burial option, but that's what they have done." The group accused the government of having published the response initially only on internet for a number of people, and in a format that was difficult to handle (.pdf-file).
Four points of critics were: the advice not to create a fully independent waste agency, the development of the ethical and social framework with limited public input, a lack of an agency's multiple oversight mechanism and the choice to "build acceptability within the *proposed* siting territories" instead of first building general public acceptance[65]. But most astonishing to Northwatch was the following phrase in the response: "Taking steps to resolve the nuclear fuel waste issue would further support nuclear energy, and particularly the CANDU option, as a sustainable supply option for electricity."[66] Where on one hand the issue of nuclear energy in general was excluded from the review, the government itself in its response emphasized the importance of it[67]. Similar comment was given by other groups, like the Inter-Church Uranium Committee[68].
On the aspect of oversight mechanism, including the establishment of a fund, the reporting relation with government and way of funding research, the Ministry of Resources held early 1999 consultations in seven cities[69]. Public input could be sent till the end of February 1999. The Minister of Natural Resources is to report to the cabinet by December 1999[70]. In written comments by environmental groups, there was still the aim to develop a more democratic process in which the waste producers and owners have limited control over the agency and the fund to be established. There was also criticism on this latest consultation process, that is, that only a limited number of people received invitations or that such invitations came too late. The ministry told others that only written comments were welcome, when actually hearing sessions were planned[71][72][73].

8. SUMMARY

Public review of the concept of AECL for nuclear waste disposal already started in the late 1980s. An independent panel was set up to examine the criteria for safety and acceptability and to make a proposal for future steps to be taken by the government.
Nuclear energy was outside the Panel's mandate and therefore some environmental groups refused to participate, others only had minor difficulties with the decision not to discuss nuclear energy. The government promised to conduct a parallel review of more broad energy issues, but never realised it, also not after several requests from the Panel. The review got broad input, with anti-nuclear groups actively participating. Some provinces, however, did not want to get involved as they refused to accept a disposal facility in their territory at all.
The Panel concluded that safety is an important, but only one part, of acceptability, as both safety and acceptability are "relative, value-laden and subject to different interpretations". Because of the relation between nuclear waste and future generations, an ethical and social framework is considered necessary. The Panel concluded that technical safety had been demonstrated "on balance", but not from a social perspective. Reasons for this conclusion were: the long-term danger of the waste and the needed cautious approach; scientific uncertainties in relation to the long-time frame; and public concern more about possible severe consequences than about the small probabilities. Concerning acceptability, the Panel concluded that the AECL's concept did not have the broad public support that is required. It recognised that the lack of a clear policy on the future of nuclear energy made it difficult for the public to develop trust. Other reasons for it were: too little Aboriginal cultural input; no other alternatives to choose from; and a level of distrust in the AECL.
The Panel further recommended the creation of a Nuclear Fuel Waste Management Agency "at arm's length" from the industry to make "a fresh start" and build trust. In a four-step approach of a) set-up, b) concept acceptance, c) project acceptance and d) realisation, the NFWMA should try to solve the issues that were recognised by the Panel and finally realise a disposal or storage site. This can also be a long-term aboveground storage when this is what the public prefers.
In its Government of Canada Response to the Panel's final report, it was announced that the creation and activities of the new Agency are to be executed by the nuclear industry itself, which is contrary to the Panel's advice to put it "at arm's length" from the industry. It is, however, in accordance with the 1996 Radioactive

Waste Policy Framework that prescribed that the nuclear industry is responsible for managing and organising the nuclear waste problem. The government "expects" that the new agency will take into account the conclusions and recommendations of the Panel in the future.
More distrust arose when the government wrote in its response to the Panel that the steps taken to resolve the waste problem would support the further use of nuclear energy.

9. CONCLUSIONS

1. An independent panel, with an open mind and no biases, conclusions, will gain more trust and participation than a government- conducted review, as government would always take into account the goals it wants to reach.
2. Although it took as long as 10 years to review a disposal concept, it had not gained enough public acceptability for the concept to be realised.
3. The decision not to place the new agency "at arm's length" of the industry has created a distance to environmental groups and will certainly not contribute to public trust.
4. The Panel concluded that future expectations for nuclear energy are of influence on public trust for waste management, but the issue was actually outside the Panel's mandate. The government, in its response, stated that trust in waste management was necessary for the future of nuclear energy. To connect these two now, where the government had forbidden Panel from dealing with this relationship, is astonishing.

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20- An explanation of the political structure is beyond our project goals.
21- Panel Report, p. 4.
22- "Northern Ontario targeted for nuclear waste burial", Northwatch, November 1996.
23- Panel Report, p. 12.
24- Panel Report, p. 81.
25- Panel Report, p.13.
26- Panel Report, p. 1.
27- Panel Report, Appendix B, p. 86-87, during the ten-year review the chairmanship changed as well as three Panel members.
28- Panel Report, Appendix A, Terms of Reference, p. 84-85.
29- Most of the members were professors in the fields of geology, hydrology, biology or engineering.
30- Panel Report, p. 6-8.
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32- Panel Report, p. 20.

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4. FRANCE

KEY FACTS

Nuclear Power: 55 nuclear power reactors; 59.0 Gwe; 77% Gen. Cap.; 1994 – EdF decided not to order new capacity before 2000.
Waste (present): short-lived L/ILW – 526,000 m^3 disposed at La Manche (1969-1994) and 82,000 m^3 at l'Aube (1994-); Category B from reprocessing - 16,316 m^3; HLW – 1,500 m^3 stored spent fuel at reprocessing plants; Total: 635,816 m^3.
Waste (future, cumulative): L/ILW – 952,000 m^3; Category B - 49,390 m^3; HLW (C) - 5,020 m^3; Total: 1,006,410 m^3.
Waste authorities: Agence nationale pour la gestion des déchets radioactifs (ANDRA), research and waste management; Commission National d'Évaluation (CNE), advisory commission.
Retrievability: 1991 Law only allows for disposal for limited periods, future law should provide for unlimited periods.
Dialogues (among others): Bataille mission to find hosting departements, critic on public input; public inquiries in four departements, considered not open enough and "alibi" function; Meuse/Haute-Marne site only one left, consultation to find second site to be started.
Key issues: population not sufficiently consulted; amount of objections indicate too little acceptance; Green minister in cabinet can lead to more delays; legal deadline of 2006 will not be met?

Introduction

France is a country with an extensive nuclear energy program, including all steps of the nuclear cycle. For its high-level long-lived waste, it is searching for an underground disposal site. After resistance against test drillings in the late 1980s, waste policy was changed with the introduction of a new law and the main goal was now the construction of an underground research laboratory as a first step. The search for a potential site is the main theme of this chapter. It will concentrate on the Meuse/Haute-Marne site, the only candidate site available at the moment.

Information for this chapter was received through the ANDRA, the "Agence nationale pour la gestion des déchets radioactifs" (National Agency for the Management of Radioactive Wastes), an interview with representatives of the "Collectif Meuse contre l'enfouissement des déchets nucléaires" (CDR 55, Collective Meuse against Nuclear Waste Burial), and from other sources, mainly English articles from the magazines *Nuclear Fuel* and *Nucleonics Week*. Comments on a draft text were received from ANDRA, by Isabelle Forest, Thomas Busuttil and Armand Aboaf, director of the International Division. From the environmental groups, comments were received from Jean Franville and John Neelsen of CDR 55 and from Jean-Yvon Landrac, charged with international contacts for "Réseau Sortir du nucléaire".

1. NUCLEAR POWER PROGRAM

The French nuclear program started in the 1940s in order to create a nuclear weapons capability, and its first reactors were built for weapons plutonium production. The nuclear industry developed significantly during the 1950s when plans were made for domestic, commercial, nuclear power stations. First, nine gas-cooled graphite reactors were built. In the 1970s, the French adopted the US light-water technology. In 1994, Électricité de France (EdF) announced that it will not order any new nuclear power plants before the end of the century due to the oversized generating system[1]**.** As of February 1999, 55 nuclear power reactors were in operation in France, all pressurized-water reactors except for one[2]. Three more reactors, at Chooz and Civaux, went critical but are not yet in commercial operation[3]. About 77% of France's electricity production comes from nuclear power, whereas 15% of the generated electricity is exported[4]. Total generating capacity is 59 Gwe.[5] In the past, 12 nuclear power reactors had been shut down permanently[6].

Founded in 1976, Cogema (Compagnie Générale des Matières Nucléaires) is a state-owned company. It is one of the world's main suppliers of uranium, and the only company that offers every single stage of the nuclear fuel process. Mining is one of its major activities and it has uranium mines all around the world. Cogema also offers fuel reprocessing in its reprocessing plants in La Hague and Marcoule and operates the enrichment plant in Pierrelatte. The nearby enrichment plant of Tricastin is larger and is operated by Eurodif, in which Cogema has the majority share[7].

In the past, more than 200 uranium mines were in operation in France, also for weapons production, and covered up to 57% of domestic use. Due to the discoveries of gigantic uranium deposits in Canada and Australia, the French uranium mines were closed[8].

2. PRODUCERS OF RADIOACTIVE WASTE

There are three main producers of nuclear waste in France. EdF operates the nuclear power plants, where operational waste and spent fuel arises. The spent fuel from power reactors is, after a cooling period, transported to La Hague for reprocessing. The second producer is the Commissariat à l'Énergie Atomique (CEA), which is responsible for nuclear reactor and fuel research, and for the military nuclear program. Cogema operates fuel and reprocessing plants[9].

3. CATEGORIES OF RADIOACTIVE WASTE

Within the first Category A, which is low-level waste with little activity or short lifetime, a subdivision is made for waste with short half-life (<30 years) and long half-life (>30 years).
Type B wastes contain higher activity levels or certain specific radionuclides and mostly are reprocessing wastes that are not heat-generating, and contain transuranic elements. Type C wastes is the vitrified reprocessing waste or spent fuel[10].

4. AMOUNTS OF RADIOACTIVE WASTE

4.1 Present amounts

Short-lived low- and medium-level waste is disposed of at the surface disposal facility at Aube. Most of this waste comes from power plants (44%) and reprocessing (32%). Only 2.2% comes from non-nuclear sources, like hospitals or universities. A yearly "income" of about 13,700 m^3 is foreseen. In Aube, 82,000 m^3 have been disposed of. Earlier, the La Manche surface disposal was used for this purpose. A total of 526,000 m^3 had been disposed of in La Manche[11]. Category B waste, at the reprocessing plants La Hague and Marcoule, had a volume of at least 16,316 m^3[12].
Till the end of 1994 an amount of 1,500 m^3 of Category C have been stored, mainly in the form of spent fuel[13]. Mining wastes, which are stored at 15 sites, total 45 million MT[14].

4.2 Future amounts

Until 2020 a cumulative amount of 952,000 m^3 low- and intermediate-level waste is foreseen (including presently disposed volume), that is to be disposed of at a surface disposal facility[15].
Assuming that France will continue with reprocessing, until 2020, a cumulative amount of 5,020 m^3 of vitrified waste (Category C) are expected for disposal. For Category B, it will be 49,390 m^3 until 2020. For all categories the total amount of waste to be stored or disposed of is 1,006,410 m^3. Due to the future dismantling of nuclear installations, an amount of 1.6 million tons of low-level waste will be produced[16].

5. WHERE IS IT STORED?

In 1969, the La Manche disposal site was opened near the La Hague reprocessing plant. Till 1994 waste was received and disposed of. The site is now covered and is to be in a surveillance period for 300 years[17]. The final sealing of the site was criticized because of measured tritium and plutonium leakages in its surroundings[18].
Till 1996 an amount of 82,000 m^3 low-level waste had been disposed of at the Aube disposal site. This site was opened in 1992 and has a capacity of 1 million m^3. Medium-level, long-lived wastes are stored at the production sites, because there is no central disposal or storage site for it. High-level reprocessing waste is vitrified and stored at the two reprocessing plants[19]. A total capacity of 3,850 m^3 is available[20].

6. RESPONSIBILITIES

ANDRA was founded in 1979 as part of the CEA. In 1991, with the adoption of a Nuclear Waste Act, it became a "public, industrial and commercial establishment", independent from waste generators. ANDRA has three main missions, laid down in the Nuclear Waste Act: to manage nuclear waste, to research deep disposal and to make an inventory of all French wastes.
The Directorate for the Safety of Nuclear Installations (DSIN) is responsible for licensing and regulating nuclear issues. It operates under the Ministries of Industry and Environment. It is advised by the Institute for Protection and Nuclear Safety at the CEA. Supervisor of radioactivity releases and radiation levels around nuclear installations is the Office for Protection against Ionizing Radiation (OPRI), under the Ministry of Health[21].
In 1991, the National Evaluation Commission (Commission Nationale d'Évaluation or CNE) was established by the Nuclear Waste Act. Its task is to review yearly the progress of three research objectives: partitioning and transmutation of actinides, geological disposal, and long-term storage of high-level wastes[22].

7. THE SITING OF UNDERGROUND LABORATORIES

7.1 History

On 9 February 1990, Prime Minister Rocard announced a moratorium, at least for 12 months, on test drillings that were undertaken at four potential laboratory sites. He took this decision after having had a meeting with politicians and local opponents from the Maine-et-Loire *departement* (French for prefecture)[23], where a candidate site was located in Serge/Bourg d'Ire. Also in the three other candidate sites, public protests arose against the plans. After the beginning of the tests under police protection and a demonstration with 15,000 participants in January, ANDRA decided to stop drilling. At that time, selection of one site for a laboratory as early as 1991 was still expected.
Also at that time, four potential sites were identified by ANDRA: Segre/Bourg d'Ire (Main-et-Loire), St. Julien-sur-Reyssouze (Ain), Neuvy-Bouin (Deux-Sèvres) and Montcornet-Sissonnes in the departement of Aisne. It was impossible for ANDRA to start up a dialogue in the first three departements, as people simply refused to talk with ANDRA. In the Aisne departement, however, local officials cooperated in ANDRA's work and test drillings took place[24].
Rocard asked a specially created advisory body, the College for the Prevention of Risks, how to proceed with its waste policy. This body advised the government to resume work at the four sites as quickly as possible to prevent a further fall-back in the international waste scene[25]. Studies were also conducted by the Parliamentary Office for the Assessment of Science and Technology Options and by the Ministry of Industry[26].
The Parliamentary Office released its report in December 1990. Its rapporteur, Christian Bataille, MP for the Socialist Party, announced that a new search round would start with 28[27] potential candidate sites. He recommended the creation of at least two underground laboratories, in which no nuclear waste would be disposed of. ANDRA's work should be more independent, and for that reason the organisation should be removed from under the CEA. According to the report, research on actinide separation and transmutation had to increase to reduce nuclear waste's toxicity. To implement all the recommendations, Bataille suggested the creation of a special law on nuclear waste policy. In his opinion, ANDRA should drop two of the earlier candidate sites (Maine-et-Loire and Deux-Sèvres) because of "the antagonism previous ANDRA work has created there"[28]. According to Bataille, the earlier years were characterized by secrecy and "the 1990s must mark the end of the cult of secrecy in nuclear affairs. [] The future of nuclear energy in our country depends on our capacity to develop democracy"[29].

7.2 The Nuclear Waste Law of 1991

On 30 December 1991, the proposed new law was adopted, officially called the "Law No. 91-1381 of 30 December 1991, on Radioactive Waste Management Research". It deals with the management of long-lived, high-level wastes and sets out the governmental policy for the next 15 years, till 2006. In that year, the government has to present an overall assessment of research and a new draft law on future waste management, to be adopted by the Parliament.
The law has a three-way approach to waste management: research on partitioning and transmutation; evaluation of retrievable versus non-retrievable options for disposal in the deep underground; and studies on conditioning of waste and long-term aboveground storage.
The law is meant as a legal instrument for the creation of underground research laboratories, where studies will be conducted in potential host formations, at least at two locations. It clearly prohibits the actual storage of nuclear waste in these laboratories. For this, a new law has to be adopted after 2006. Each laboratory

would cost more than FF 1.5 billion (Dfl 0.5 billion). A real repository would cost more than FF 10 billion (Dfl 3.3 billion).
On the subject of public involvement, the law states in Article 6: *"Locally elected officials and the population of the affected site shall be involved* [in French, the word "concertation" is used] *pursuant to the provisions of a relevant decree before any preliminary site investigation for a proposed underground laboratory shall begin"*.

For the next phase of constructing a laboratory, a license is needed, to be granted by the Conseil d'État (Council of State). Article 8 regulates public involvement for such a license *"pursuant to an environmental impact assessment and the opinions of the affected municipal, general and regional councils, and following a public hearing* [enquête publique]".
For communities interested in hosting a laboratory, and those within a circle of 10 kilometers, the law mentions the possibility for financial compensation to "benefit and facilitate the construction and operation of each laboratory". A yearly amount of FF 60 million (Dfl 20 million) would be available for a hosting community.
In each hosting community a Local Information and Oversight Committee should be created with, among others, members of government, officials from local communities, laboratory representatives and environmental protection organisations. The committee should meet at least two times a year and evaluate the research going on.
Concerning the storage of foreign nuclear waste on French territory, the law prohibits the disposal of these wastes in France and also states that temporary storage of foreign reprocessing wastes shall not exceed the time necessary for it (to cool down).
For the future underground disposal of nuclear waste, the law laid down that only licenses may be given for limited periods of storage. In that, it looks that retrievability is the only allowed storage method in French law. But the option of definite disposal is not excluded as the Law mentions the possibility to adopt new laws regulating disposal for unlimited periods[30]**.**

7.3 Bataille's mission
Not included in the law, but adopted by the government, was the initiative to appoint a national negotiator for nuclear waste. In August 1993, Bataille was officially installed for this job[31]**.** He had to search for a departement that wanted to host an underground laboratory.
In preparation for his visits, an information package was sent to the concerned local authorities and organisations. It contained general information about the mission, waste in France, the history of waste policy, legislative frameworks, the laboratory program, costs, and an explanation of the "negotiating method" (open information and cooperative decision-making)[32].
An example of the social unrest that arose after showing interest was the village of Chatain in Vienne. It was heavily divided between proponents and opponents. Mr. Faudry, the mayor, decided to organise a referendum against the advice of the departement's prefect, who said that it would be illegal and that no public funds would be available. The mayor thus paid for the costs and the referendum resulted in a 60% vote in favour of the laboratory, which would bring more employment in the village. Protest became sometimes violent and two weeks after the referendum, Faudry committed suicide[33].

In its final report of December 1993, Bataille recognised four main issues for which he made recommendations. First, in his view there was a shortage of reliable and good information. He referred to the 1991 law to start a Local Information and Oversight Committee when a laboratory site was confirmed and suggested to install information committees already in an earlier phase. A proposed study should give insight into the effect of a laboratory or repository on the tourist and economic image of a departement. After having recognised four potential departements, the time necessary for conducting geological research can be used to start a dialogue with the people.
During the research phase it should be clear that retrievability will be guaranteed. Another guarantee had to be given to the departement that a laboratory would be dismantled, when no repository will be constructed.
Third, Bataille pleaded for a better coordination between ministries, governmental authorities and departements. In continuing the search for a site, Bataille recommended a follow-up to his mediation mission, for instance by creating local mediators at possible sites.
Last, he proposed to supply a yearly amount of FF 5 million (Dfl 1.7 million) to communities that possibly wanted to host a laboratory. This is a fund prior to the FF 60 million (Dfl 20 million) that would be available when agreements were to be signed to really host a laboratory[34].

The scenario that a laboratory will be converted into an actual repository was for groups like Les Verts (the political party Greens) reason to strongly criticize Bataille's recommendations. The Greens observed a lack of real guarantees that a laboratory would not be converted. Bataille was not able to answer the question why an underground laboratory was necessary to study the properties of clay or granite whereas experiments with "samples of radioactive" material, as would be allowed, can also be done in a surface facility. Critical groups feared that an underground laboratory will absolutely be converted into a repository. Besides, a discussion about laboratories could be better placed in a broader framework, the total discussion about energy policy[35].
During his mission, a total of 30 departements or communities showed interest. Favourable geological conditions could be found in 10 of these. Bataille visited eight departements, of which two withdrew due to local opposition or because of upcoming elections. The earlier-mentioned four candidate sites where test drillings were undertaken until 1990 were not visited by Bataille[36].
Bataille thus identified six possible departements that wanted to cooperate, and continued in the process of site selection.
Critics however had doubts on the geological safety at a number of the sites and were cautious about their candidacy. One of the visited departements was Gard, in southern France, where the Marcoule nuclear research centre is located. Here, France's first plutonium production reactors were built, a reprocessing plant is present as well as the breeder reactor Phenix. The underground is connected near the deformation of the Alps and knows an increased level of seismicity. The formation to be investigated is clay.
The Marne and Haute-Marne departements have underground clay formations that would be suitable, although a site had to be found at a depth of less than 550 meters and a clay thickness of at least 100 meters. The Meuse departement is neighbouring the Marne and Haute-Marne and its clay formation continues in the Haute-Marne departement. The departement of Meurthe-et-Moselle also contains clay formations at two locations in the north and south. The south of Vienne departement is the one with a granite formation.
Of these six departements, Bataille chose four to continue with, because of broad council support: "Nevertheless, candidacy for the installation of underground laboratories, formulated in a unanimous--or practically unanimous--manner by the Assemblies in four of the departements confers valuable qualities of engagement and particular commitment in each of these requests"[37[. For instance, the departement of Meuse unanimously agreed with the plans for a laboratory. It was promised that the departement's agreement would not be a positive vote for a repository. But the decision was made exactly at the same day when a meeting was held on the (positive) economic benefits. This caused scepticism among opponents[38].

7.4 Four candidate sites selected

On 6 January 1994, the government decided to go ahead with geological research at the four departements that were favoured by Bataille: Gard, Vienne, Meuse and Haute-Marne. ANDRA got permission to conduct a detailed geological investigation at more than seven locations within these four departements. With this permit, there came an end to a moratorium for drilling of four years[39].
In December 1997, the Conseil d'État rejected a complaint that was laid down in 1994 on the mission of Bataille and the license ANDRA got to conduct preliminary site investigations. The complaint was submitted by residents of Meuse and Vienne and concerned Article 6 of the 1991 Law. That article laid down that "*locally elected officials and the population of the affected site shall be involved [] before any preliminary site investigation [] shall begin*". The plaintiffs from Meuse argued that the meeting with Bataille only took two hours. The first was used for broadly outlining the waste issue and the second was only used by Bataille to give his own view, according to the complainers. They stated that there had never been a real involvement of the affected population, as required by law.
According to the Conseil d'État, Bataille had met with elected officials, union representatives and others. As the departement council agreed with the project, the Conseil d'État considered it as a representation of the population in it. The followed publicity would have given enough possibilities to express the necessary public opinion expected by law[40]. But others say that the meetings were not open to the public and only some environmental organisations were concerted. They went to the European Court of Human Rights for a judgment on the question of whether a consultation of the departement council could be seen as as a consultation of the whole population[41]. The law requires a **"concertation"** with elected officials **and** the affected population. With the decision, the Conseil d'État did not follow the advice of the so-called government commissioner, who agreed with the plaintiffs[42].
In May 1994, the prefect of Vienne gave permission to start the research. Around this time, information committees were founded in Haute-Marne, Gard and Vienne. Reason for the quick start was also said to be the government's announcement for a FF 1 million (Dfl 0.33 million) for its committee work[43].

The "hearings" in Bar-le-Duc (chief town of Meuse) were considered not open enough, according to representatives of the CDR 55. Some members of organisations were invited, after they had requested it themselves, to sit at a round-table discussion, that was chaired by the prefect of the departement Meuse. Others had to take place in the back of the room and were not allowed to ask verbal questions. They could only write questions down, and the prefect decided whether or not to answer these.
The opponent groups experienced the meetings in Bar-le-Duc as a kind of "alibi affair". This was reason for the CDR 55 to retire for lack of a real discussion.
According to the opposition, the meetings were too formal: they were in government buildings, the discussions were too academic and one had to write in to participate at the round-table discussion[44].
There was criticism that ANDRA had a huge budget to inform people and sponsor communities, whereas opponents lacked funds made available by government[45]. Moreover, CDR 55 complained that there were little possibilities to consult independent experts. The incidental moments they were allowed to get the testimony of their own experts were experienced more as a kind of "showcase for democracy"[46].
CNE's first annual report, published in July 1995, warned that ANDRA still needed a lot of work to do before a site can be chosen in 1998, as projected. It urged EdF and Cogema to make clear the exact expected amounts of high-level reprocessing waste and eventual not to be reprocessed spent fuel for direct disposal. The commission asked to quickly develop new concepts of long-term storage of high-level waste, as it was one of the 1991 law's research objectives. Finally, CNE noticed a shortage of studies on socio-political aspects of waste management[47]. Also in its third annual report, CNE urged EdF, ANDRA, CEA and Cogema to cooperate more closely, as otherwise the legal deadline of 2006 will be missed[48].

During its research, ANDRA identified three locations in the four departements: the Gard site, located near the Marcoule research centre; a granite formation, located at La Chapelle-Baton (Vienne); the third formation was a clay one located at Bure, Meuse, near the border of Haute-Marne, hereafter to be referred to as the Meuse/Haute-Marne site"[49].
But with the CNE's second annual review, published July 1996, it became clear that only the Meuse/Haute-Marne site's suitability was said to be "satisfactory". Geological uncertainties made the Gard and Vienne sites too unsuitable for approval. Gard was considered unsuitable due to tectonic activities. At the Vienne site, two aquifers were identified and the permeability of the granite was too high, and too many fractures existed[50]. In its third report, the doubts about Vienne were reiterated and recommendations were made to look for another site. The Gard site was considered more suitable than in CNE's second review[51].

Enquête publique
In February 1997, the first public inquiries took place. These were required by Article 8 of the 1991 law before a construction license can be granted. Although there was little time left to meet scheduled dates, ANDRA had to comply with the law, held the public inquiry and asked for a new vote from the municipal, district, departement and regional councils concerned. Otherwise the construction license could be annulled. First inquiry hearings started February 3 in the Vienne and neighbouring Charente departement, followed on February 17 in the Gard and neighbouring Vaucluse departement. The inquiry in Meuse and Haute-Marne started on 3 March. All the three inquiries took two to two and a half months[52].
In the Meuse inquiry, some 6,500 written submissions were made, opposing the siting. Some 10,000 arguments were mentioned concerning a perceived lack of participation (4,800), bribery because of financial compensations made (2,000), or an insufficient environmental impact assessment process (over 4,000)[53].
After the inquiry period, the commissions had to report their findings. The first report came from the Gard commission in June 1997. It was in favour of the project, although more in-depth studies on seismic activities were recommended[54]. The Vienne and Meuse/Haute-Marne reports were published September 1997.

Council votes
During or after the inquiry, the departement council had the possibility to vote on further proceedings. The French government was not obliged to follow a council vote nor an advice of the inquiry commission. In fact, it was not even obliged to follow a decision by the Conseil d'État, when this would give a negative decision on a license application. But the officials expected that the government would take into account the different opinions during the inquiry.
Just before the inquiry started in Gard, the municipal council of Chuslan, on whose territory the laboratory would be built, voted 10:5 against the project. The vote had no legal influence on the process as the licenses should be given by the departement prefect, who represented the national government. The negative opinion of the council was determined by the fear that local wines, like the Cotes-du-Rhône and Chateauneuf-du-

Pape, might face a negative image in case a nuclear waste disposal site were located in the area[55].
During 1997, more council votes were made. After the Chuslan municipal council voted against the project in Gard, the regional councils of Languedoc-Roussillon where the departement of Gard is located also voted 45:9 against, and neighbouring Provence-Alpes-Cotes-d'Azur also voted 72:8. While the Languedoc-Roussillon regional council voted 45:9 against, its own departement council of Gard voted 25:13 in favour of the laboratory[56]. Seven out of 27 municipalities around the site voted against[57].
The Poitou-Charentes regional council followed its own Vienne departement by voting also in favour of the Vienne site.
And the regional council of Champagne-Ardennes, where the departement of Haute-Marne is located, voted in favour of the proposed Bure (Meuse/Haute-Marne) site[58]. When the regional council of Lorainne, where the departement of Meuse is located, met in October 1997, a majority voted against the plans. The vote, however, had no legal power as the official deadline had already elapsed[59].
The Meuse departement did not vote officially on the siting. Earlier, in the meetings with Bataille the council unanimously voted in favour of a laboratory. But when more information from ANDRA became available, they were less positive when they read about a "pre-study for disposal" and the discussion about retrievability in the case of Meuse/Haute-Marne. Where they first thought only to have agreed with general research, they now feared that the process for a disposal had begun. For instance, the mayor of Verdun, member of the Meuse council, now opposed the plans and spoke at a demonstration in Verdun, attended by some 5,000 demonstrators in March 1999[60].

7.5 Government decision

It was initially foreseen that the government would decide on licensing the laboratories by the end of 1997. In September of that year, however, it unexpectedly announced a postponement of the decision by a year[61], after the regional and cantonal elections (critics call this the "Not In My Election Year" effect [NIMEY effect]).
Parallel to this postponement, the CNE advised on the issue of retrievability in its third annual report of September 1997. The use of overpacks were considered to be necessary to guarantee the technical possibility of retrievability. The CNE suggested a period of "trial" after the last waste container was placed and before the mine was sealed. The CNE stated that a possibility for retrieval might not be used as an excuse to choose a poor geologic site[62]. According to Chairman Tissot, the retrievability concept was a result of the discussion between scientists, on one hand, and politics/society, on the other[63]. Groups like the nationally organised elected officials against underground laboratories, however, think that retrievability "is a snare". They rather prefer the storage of waste at the production sites[64].
In June 1998, the CNE submitted a special report on retrievability. According to this new document, the CNE recommended that only non-heat-generating transuranic (TRU) wastes be stored in a deep repository, with a retrievability period of three centuries. Heat-generating high-level wastes, either vitrified reprocessing waste or spent fuel, should be stored in a subsurface repository (tunnels dug in a mountain site), retrievable for potential recovery of useful isotopes. Concerning the volume, the transuranic wastes that are produced in reprocessing are much larger in quantities. The argument, to keep the potential useful high-level waste easily accessible, faced critical reactions by laboratory opponents. They think it was "a ploy to obtain acceptance" and that once a deep disposal for TRU is available, the high-level wastes will also be placed there[65]. On the other hand, there were also less negative reactions, stating that the idea to keep high-level wastes accessible and monitored corresponds with their arguments against deep disposal[66].
On 9 December 1998, the French government formulated its position on the laboratory issue and waste management. Surprisingly, the proposed Gard and Vienne sites were discarded. Both sites were considered to be unsuitable because of geologic reasons. As it was still intended to create two laboratories in two different types of formations, another granite site had to be sought next to the Bure (Meuse/Haute-Marne) clay location.

The government asked the CEA to design a subsurface facility for "certain" wastes, possibly to be realised at the Marcoule (Gard) location.
The government did not really make clear whether it will follow the advice of the CNE to dispose of only TRU wastes in a deep repository. It looked that besides deep-laboratory research, parallel research will take place on subsurface storage. The government will make final choices possibly after having studied the results of it. On the other hand, the government decided to store high-level wastes for at least 70 years in a surface or subsurface facility to cool down. Long-lived radioactive waste, like TRU waste, was considered to be disposed of in medium term in a definitive deep disposal. In this, it appeared to follow the CNE recommendations. It was defined that disposal should be "reversible", but no clear period was determined.

Apart from the decision on laboratory siting, the government also decided to create a new independent nuclear safety regulatory authority. An overall economic evaluation of energy policy, including the reprocessing discussion, had to be made by a three-man committee.
Bataille reacted critically to the government decision, and he spoke about "half a measure" and "ignoring" the law's demands. He considered the Gard site suitable enough, and feared a lack of time to search for a new site, create a laboratory and having it evaluated by 2006[67].
As Minister of Environment Dominique Voynet was a member of the Green Party, she got a lot of criticism for her cooperation on the decision to go ahead with the laboratory siting. The Lorainne branch of the Greens earlier had asked Voynet to resign when a positive decision on the Meuse/Haute-Marne site would be taken[68].
At a national Greens conference, however, a motion that asked Voynet not to sign the final permit for a laboratory was rejected. The party considered Voynet's role and influence in the cabinet of more importance[69].

In January 1999, a decree concerning licensing the construction of the Meuse/Haute-Marne laboratory was submitted to the Conseil d'État for review[70]. By July 1999, the Conseil d'État had okayed and passed it to the ministers to sign. In August 1999, Voynet signed the degree inspite of resistance within the Green Party. But she did this only when the government made retrievability an integral part of future repository policy. At that moment, a second decree was also approved. It laid down the organisation and financing of the Local Information and Oversight Commission[71]. ANDRA expected to create by the end of 1999 the first buildings, followed in mid-2000 by the construction of access shafts[72].
Opposition in Meuse remains, and as the Bure site is the only existent one in France at the moment, it will possibly grow as people fear that the site will be chosen because another one has failed. On Sunday, 21 March 1999, some 5,000 people mainly from the Meuse departement, including some 100 from German cities bordering the French territory, took part in a demonstration named "La Marche pour la Vie" in the Meuse city Verdun. It was organised by several organisations, for instance the Elected Officials in Meuse Against Radioactive Waste Burial and Greenpeace. The Green Party did not officially support the demonstration, but did so financially[73].
The German regional council of Saarland, led by Social Democrats, and its opposition parties of the Greens and Christian Democrats protested against the French plans. In a letter to the Saarland council, German Environment Minister Trittin made clear he also disapproved of the plans. The Saarland council considered clay formations unsuitable for waste disposal, and that only granite would be safe. As the disposal can have consequences for neighbouring Germany, Trittin asked France to "inform and consult" the German government, in accordance with European regulations[74].
The date of 2006 was nearing relatively quickly, and a second site still had to be found. ANDRA is now looking at sites in "about 20 granitic zones" in Brittany and the Massif Central mountains. It hopes to have found a suitable site by the end of 2002. A "consultation mission" should be organised to be conducted by three people and comparable to the earlier mission of Bataille[75]. It is doubted whether Parliament will take a decision on waste management in 2006. Some expect that by that time there would be too little information to choose a final option for waste storage and expect a delay for three to four years. As Bettina Laville, environment and regional advisor to PM Jospin, said: "You can consider that in 2006, they will opt to give themselves more time and reprogram the decision to 2009 or 2010"[76].

8. SUMMARY

France has an extensive nuclear program, which includes enrichment and reprocessing for foreign customers. Initially, like many other countries, it considered the option of final deep disposal as a solution for the high-level long-lived waste problem. Protest against four test drilling sites, in the late 1980s, forced the government to temporarily stop those drillings and develop a new policy.
The Nuclear Waste Law of 1991 regulated the new policy. Research had to concentrate on transmutation, retrievability and long-term aboveground storage. In the year 2006, an overall assessment is to be discussed in Parliament, after which a final strategy has to be adopted. For an easier acceptance of a test site, the government introduced the concept of the laboratories: No waste can legally be stored in such laboratories. However, there is always a possibility to adopt a new law that would permit the conversion of a laboratory into a disposal site.
In 1993, MP Bataille acted as a negotiator to look for a site in interested departements. A total of 30 showed initial interest, but of these, only 10 could meet geological criteria. He finally selected four departements to

continue in the site selection. Others were dropped due to their own withdrawal or because there was too little departement council support. In his final report, Bataille emphasized the importance of guarantees for retrievability and a dialogue. Critics, however, criticized his mission as not open enough and too short. They feared the conversion of a laboratory into a repository. They said the population was not consulted directly and sufficiently as required by law.
After having selected four sites, the process of public inquiries and council votes started. Here again, opponents considered the process as not open enough, and more, as an "alibi" to fulfill legal requirements. Too little possibilities were said to be present to have a real discussion. The amount of written objections in the Meuse departement reached 6,500.
Council votes varied in the municipal, departemental or regional outcomes. But all the four departement councils voted in favour of a laboratory. The possibility to receive financial compensation played a role in this. Council votes had no real meaning, as these can be overruled by the national government.
In 1997, a governmental decision on the laboratories was postponed for a year due to the upcoming elections. During that year, the CNE advised on the issue of retrievability, and recommended the storage of only transuranic wastes in a deep disposal and high-level fuel and reprocessing wastes in a subsurface facility for possible retrieval.
In the December 1998 governmental decision, Gard and Vienne were dropped as sites because of geological reasons. It followed CNE's recommendations of the two-way approach for different high-level wastes.
The site located at the border of the Meuse and Haute-Marne departements was the only one left at the moment. Because of this, opposition is now growing. A granite formation site is now being sought in Brittany and Massif Central mountains. Both laboratories still have to be constructed, researched and evaluated before Parliament can make decisions in 2006 as required by law.

9. CONCLUSIONS

1. In Bataille's mission the real decisions about cooperation were actually being made by the departement council and Bataille. Opposition remained after his mission. Critics said the population was not consulted directly and sufficiently as required by law. So it cannot be said that a departement council, unanimously or almost unanimously in favour of a laboratory, gives a realistic reflection of the public's opinion within the departement itself.
2. The amount of written objections indicates lack of public acceptance for a laboratory in Meuse/Haute-Marne. A lack of time as the date of 2006 nears might be among other reasons that no real acceptance has been obtained in the inquiry.
3. The presence of a Green minister in the cabinet could eventually lead to more political problems and delays in further decision-making, either by her standpoint on nuclear energy or because of the possibility of resignation due to pressure from within her party.
4. It will be next to impossible to find a second laboratory site, consult the population, construct the laboratory, and research and evaluate it all before 2006. This can already be a concern for the Meuse/Haute-Marne site as construction still has to begin. It is doubted whether thorough conclusions on the safety of the sites can be made before 2006.

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5. GERMANY

KEY FACTS

Nuclear Power: 19 nuclear power reactors; 22.0 Gwe; 28.3% Gen. Cap.; no new capacity planned.
Waste (present): Category 1 (heat-generating) - 469 m^3 HLW unprocessed and 1,900 m^3 processed (Hamm-reactor 65.3%, reprocessing 16.4%, research 8.1%, industry 8.0%, temporary storage states 2.2%); Category 2 unprocessed (not heat-generating) - 30,100 m^3 (NPP 47.5%, nuclear industry 22%, nuclear research 16.3%, temporary storage states 6.1%, other 8.1%); Category 2 processed and packed - 60,800 m^3 (NPP 28.5%, nuclear research 46.2%, reprocessing 18.1%, industry 3.8%, temporary storage states 3.3%, other 0.2%); Category 2 half-products - 2,860 m^3; Total at present – 96,800 m^3 in storage and 62,000 m^3 disposed of at Asse/Morsleben mines; spent fuel stored at NPP, reprocessing plants UK/France or central storages Ahaus and Gorleben. L/ILW at NPP, research institutes, industry or temporary storage states.
Waste (future, cumulative): 412,000 m^3 (depending on future nuclear energy).
Waste authorities: Gesellschaft für Nuklear-Service mbH (GNS) builds and runs central storage facilities; government is responsible for disposal through the Bundesamt für Strahlenschutz (BfS).
Retrievability: not foreseen.
Dialogues (among others): in Gorleben case only public input in legal licensing procedure; consensus talks initially between political parties; presently between governing parties and electricity utilities.
Key issues: criteria for selecting Gorleben were unclear to the public and was perceived as adjusted to research findings; no clear ideas of the goals of consensus talks, government parties were divided and there was disagreement from the utilities.

Introduction

We will take up two points from the discussion in Germany on the handling of nuclear waste. Firstly, the discussion about why the Gorleben salt dome was chosen as a repository, as the management of this site is an important example to Holland as well. Secondly, we will pay attention to the recent nuclear energy consensus talks between the government and the electricity companies in which nuclear waste figures prominently.

The first part of this chapter is based on a survey report of the Gruppe Ökologie (Ecology Group), added with information from the Bundesamt für Strahlenschutz (Federal Office for Radiation Protection). For the second part, a big amount of articles in newspapers and press releases are used. The text was commented upon by Jürgen Kreusch of the Gruppe Ökologie, Detlef Appel of Pangeo - geoscientific office, Wolfgang Ehmke of the Bürgerinitiative Umweltschutz Lüchow-Dannenberg (Citizens Initiative Environmental Protection) and Manfred Petroll, until recently employed at the Deutsche Atomforum (German Atomic Forum), who had little time to comment due to circumstances.

1. NUCLEAR POWER PROGRAM

In 1957 the collective nuclear industry in West Germany presented a plan--the "Eltviller Program"--for the development of five types of reactor. Since this would not lead to the development of competing reactors, the reactor builders Siemens and AEG joined forces with American companies. Siemens and AEG founded the "Kraftwerk Union" and built 19 nuclear power stations in Germany with a combined capacity of 22,000 megawatt. The first KWU reactor was in Stade (operational in 1972), while Neckar-2 would be the 19th nuclear power station in 1989[1]**.** These power stations provide one-third of the required electricity[2]. By court ruling the license for Mühlheim-Kärlich was withdrawn. No nuclear power stations are under construction at the moment. Germany also has uranium enrichment plants in Gronau and a fuel element plant in Lingen. Sixteen nuclear power stations with a combined capacity of 4,000 megawatt--the products of the first nuclear programs-- have been closed permanently, as well as nine research reactors and a fuel element plant in Hanau[3].

2. PRODUCERS OF RADIOACTIVE WASTE

The industrial processes in both nuclear power stations and research reactors result in the production of waste by-products, apart from the spent fuel elements. Up until now the fuel elements were reprocessed, producing a large quantity of radioactive waste.
Uranium enrichment and the production of fuel elements also produce radioactive waste as well as various other industries, as do medical research and applications of radioactive materials.
Every two years the Bundesamt für Strahlenschutz (BfS) publishes a number of surveys on the amount of radioactive waste in Germany[4] in which seven sources of radioactive waste are distinguished:
1. reprocessing;
2. nuclear power stations;
3. temporary storage depots in the federal states (Landessammelstellen);
4. nuclear energy research institutions;
5. nuclear technical industries (e.g., fuel element production);
6. dismantling;
7. other.

The temporary storage depots in the federal states are assembly points for the radioactive waste from hospitals, universities, non-nuclear energy research institutions and industry. At present, there are 12 of these centres where radioactive waste is stored pending final disposal. The BfS has no data on, for instance, the contribution of hospitals to the total amount of radioactive waste[5].
In its surveys, the BfS does not take into account depleted uranium or the radioactive waste production resulting from uranium mining[6]. According to Wolfgang Neumann of the Gruppe Ökologie in Hannover, 500 million tons of radioactive by-products of the uranium mining in the Wismut mines in former East Germany have not yet been classified. This also goes for depleted uranium, which is a by-product of uranium enrichment. According to Neumann, depleted uranium can be seen as a residual product and it is therefore not included in the total amount of waste[7].

3. CATEGORIES OF RADIOACTIVE WASTE

Until a few years back radioactive waste in Germany was classified under three headings: low-level, medium-level and high-level radioactive. For this classification the concentration of radioactivity was the norm.
With a view towards underground storage, the BfS now classifies radioactive waste according to the amount of heat it generates. There are two headings:
1. heat-generating radioactive waste (e.g., nuclear fission waste);
2. radioactive waste with a low level of heat-generation (e.g., industrial residual products from nuclear power stations).
Category 1 waste comprises a) unprocessed waste and b) processed and packaged waste. Category 2 comprises a) unprocessed waste, b) half-products and processed and packaged waste[8].

4. AMOUNTS OF RADIOACTIVE WASTE

4.1 Present amounts

Category 1
Thus far, Germany has 469 m^3 unprocessed heat-generating nuclear waste from reprocessing and power plants, for which no precise location can be given. In addition to this, there is 1,900 m^3 of processed and packaged heat-generating waste. The origins are: production process nuclear power stations (especially spent fuel high-temperature reactor THTR-Hamm-Uentropp) 65.3%; reprocessing spent fuel elements 16.4%; nuclear research centres 8.1%; industry 8%; and temporary storage depots in the federal states 2.2%.

Category 2
There is 30,100 m^3 of unprocessed residual waste, produced by: nuclear power stations 47.5%; nuclear technical industry 22%; nuclear research centres 16.3%; temporary storage depots federal states 6.1%; and other 8.1%.
The volume of half-products is 2,860 m^3, produced by: nuclear power stations 68.2%; nuclear technical industry 15.9%; temporary storage depots federal states 6.5% and other 9.4%.
The amount of processed and packaged waste with a low level of heat-generation is 60,800 m^3 produced by:

nuclear research centres 46.2%; nuclear power stations 28.5%; reprocessing 18.1%; industry 3.8%; temporary storage depots federal states 3.3%; and other 0.2%.

Total amount
The total amount of radioactive waste of categories 1 and 2 comes to 96,800 m^3. This is radioactive waste in temporary storage. Since the 1970s, a further amount of 62,000 m^3 has been finally disposed of in the of Asse and Morsleben salt domes. This brings the total amount of radioactive waste produced in Germany to date to 160,000 m^3[9]**.** The exact storage locations are not known.

4.2 Future amounts
If the nuclear power stations reach their intended life span of 50 years the BfS calculates a total amount of 412,000 m^3 of radioactive waste which needs to be disposed of. If the use of nuclear energy will be abandoned in the near future 142,000 to 166,000 m^3 of nuclear waste will be produced on top of the existing 160,000 m^3. A further 66,000 m^3 is to be generated by the dismantling of nuclear power stations[10]**.**

5. WHERE IS IT STORED?

The heat-generating waste mostly consists of spent fuel elements and residual products after reprocessing. A small amount of the spent fuel elements has been reprocessed in the German reprocessing plant in Karlsruhe, but for most fuel elements there are reprocessing contracts with the plants in La Hague and Sellafield. All this radioactive waste is stored in temporary storage facilities aboveground. The BfS does not give a complete overview of which amount is stored where and confines itself to reporting that the utilisation of temporary storage capacity for heat-generating waste is of the same order as that for low-level heat-generation waste, which is about 40%, and will be sufficient till the year 2007[11]**.**
The Gruppe Ökologie in Hannover made an overview of the free temporary storage capacity for spent fuel elements. The storage capacity at the nuclear power stations is 6,562 MT and a license has been granted for central repositories at Gorleben (3,800 MT), Ahaus (3,960 MT) and Greifswald (620 MT)[12].
In mid-1999, the depot in Gorleben held five containers with 39 tonnes of spent fuel elements and three containers with vitrified high-level waste. For this depot a license has been granted for 150 containers with 20 to 28 drums each of nuclear fission waste from reprocessing plants[13]. The temporary storage depot in Gorleben can therefore house another 245 Castor containers. In Ahaus, 50 of the 420 places are taken by fuel pellets from the high-temperature reactor THTR. There are six Castor containers so there is space for 3,700 MT of spent fuel elements. The Gruppe Ökologie has ascertained that there is free storage capacity for a total of 13,000 MT of spent fuel elements. To date, 8,600 MT of spent fuel elements have been produced at the nuclear power stations in the course of their industrial processes. If the use of nuclear energy would be abandoned immediately, there would be enough temporary storage capacity, from a purely mathematical point of view, even if the reprocessing contracts would be cancelled and the spent fuel would be returned by France and England.
Plutonium is released in reprocessing. To date, 42 MT have been produced, 30 MT of which are stored in La Hague. Eight MT of plutonium have been turned into so-called mixed-oxide fuel elements and two MT have been supplied to breeder reactors. Some 2,4 MT of plutonium are stored in the plutonium-bunker in Hanau[14].
There is still no clarity on where the plutonium returned from abroad will be stored. Staff members of Karlsruhe research institutions have pointed out the dangers of plutonium. They stated that insofar as questions are rising concerning the distribution of nuclear weapons there is "no discernible difference" between plutonium originating in nuclear power stations and plutonium specifically made for nuclear weapons. For this reason they think it highly irresponsible that this issue is not taken up in the German discussion on nuclear energy[15].
With regard to nuclear waste with a low level of heat-generation, there are temporary storage facilities at nuclear power stations, nuclear research institutions, the nuclear technical industry and the temporary storage depots in the federal states. According to the BfS, these storage facilities are used to an average of 37%.

6. RESPONSIBILITIES

Building and running of temporary storage facilities are the responsibility of the producers of radioactive waste, in this case the electricity companies. The central storage depots are built and maintained by the

Gesellschaft für Nuklear-Service mbH (GNS, Company for Nuclear Service), a subsidiary company of the nuclear power station operating electric companies. GNS has its own subsidiary companies such as Brennelementlager Gorleben GmbH (Fuel storage Gorleben) and Brennelement-Zwischenlager Ahaus GmbH (Interim fuel storage Ahaus), taking care of storage at Gorleben and Ahaus.
The final disposal of nuclear waste is the government's responsibility. In order to give meaning to this task they established the BfS in Salzgitter. The BfS applies for planning permits to the federal state where the possible depot site is located. In actual practice, however, the BfS calls in another organisation altogether for the planning, building, and running of storage depots: the Deutsche Gesellschaft zum Bau und Betrieb von Endlagern für Abfallstoffe mbH (DBE, German Company for Building and Operation of Final Disposal of Waste) in Peine. The DBE was founded in 1979 by the GNS, the Industrie-verwaltungsgesellschaft AG (Industrial Management Company), Noell GmbH and Saarberg-Interplan GmbH. The electric companies are represented in the DBE through the GNS.

7. DISPOSAL IN GORLEBEN

In February 1977, Gorleben was designated as a possible site for nuclear waste disposal and as location for a reprocessing plant. How did this come about? Following is an attempt to reconstruct the events.

At the beginning of the 1960s, the Bundesanstalt für Bodenforschung (Federal Office for Earth Reseach, now the Bundesanstalt für Geowissenschaften und Rohstoffe, Federal Office for Geosciences and Resources, BGR) opted for final disposal of radioactive waste in a mine in a salt dome, working from the following starting-points: The waste should be stored in a mine especially dug for this purpose. All types of radioactive waste should be stored in this mine. Retrievability was not reckoned with; after disposal the mine should be sealed off immediately to prevent access by people or groundwater[16].
At the beginning of the 1970s, government policies were geared to the erection of the "Nukleare Entsorgungszentrum" (Nuclear Back-end Centre), consisting of a reprocessing plant, a fuel element packaging plant and a site for final disposal in salt. By the end of 1973, by government order the firm Kernbrennstoff-Wiederaufbereitungs-Gesellschaft (KEWA, Nuclear Fuel Reprocessing Company) started looking for a site for the "Entsorgungszentrum". In 1975 this led to the selection of three salt domes in Niedersachsen: Wahn, Lichtenhorst and Weesen-Lutterloh, on the advice of the geologist Professor Gerd Lüttig, chairman of the Energy Advice Committee of Niedersachsen. According to Lüttig, Gorleben did not fall in the most suitable category[17] [18] .
In December 1975, licenses for test drilling were applied for. This triggered off the founding of pressure groups. In the towns around the Wahn salt dome, in the Hümmling, south of Papenburg near Wippingen, many protestrallies were held. In June 1976, action groups occupied the drilling site at Lichtenhorst, north of Nienburg. Drilling at Weesen-Lutterloh, near Celle, in June 1976, also met with great resistance. The government subsequently decided to postpone all work at the three salt domes[19].
In February 1977, the government of Niedersachsen designated Gorleben as site for the "Entsorgunszentrum". The salt dome lies on the border with former East Germany between the towns of Gorleben and Rambow (in the former GDR). The salt dome is approximately 30 kilometres in length, 14 kilometres of which are on formerly West German soil. Because of this situation the Federal government had initial objections against Gorleben. The proximity of East Germany would render extensive research impossible. Nevertheless, in July 1977 the Federal government agreed to use the site at Gorleben. In May 1979 the government of Niedersachsen decided not to build a reprocessing plant but to go ahead with the erection of a temporary storage depot, a fuel element processing plant and a final disposal repository[20].

Which criteria led to the selection of Gorleben?
As stated earlier, in 1973 the search for a suitable disposal site began, 24 salt domes in the state of Niedersachsen were checked against a number of criteria. These criteria were published in 1977 when Gorleben had already been selected. These were general criteria like, for instance, a sufficient volume of the salt dome, homogeneity of the salt, the top of the salt dome should be at least 200 metres below ground level, etc[21][22] .
On the basis of these criteria the salt domes at Wahn, Lichtenhorst and Weesen-Lutterloh were selected. Gorleben was not part of this selection because of its position on the border with the former GDR. Although in February 1977 Gorleben was decided upon. After this, the Federal government presented four geological criteria that should have led to this decision by the Lower Saxony government[23]:
--no drilling may have been done in the salt dome;

--the salt dome must have ample dimensions and must contain large volumes of pure rock salt;
--the top of the salt dome may not be positioned lower than 400 metres below ground level and it may not cross groundwater streams;
--there may not be any depots of groundwater intended for future use in the vicinity[24].

The Gruppe Ökologie and the geologist Detlef Appel noted that these are very general criteria and it should not be excluded that other salt domes would meet these as well[25]. In that case, the salt dome at Gorleben should have other properties to justify its selection. The then prime minister of Niedersachsen, E. Albrecht (CDU), brought up two political arguments:
--the region of Lüchow-Dannenberg were Gorleben is situated as an economically weak area;
--the expected public support[26].

This public support, however, proved to be non-existent. On 12 March 1977, a protest rally was held with 100,000 participants. This was the first of a long series of protest actions and discussions. There were a lot of possibilities for public input at the start of the test drillings and at the construction of the shaft. Everytime, the draft licenses were made public, mostly during a period of two months. Objections brought in could be explained more closely at hearing sessions. A lot of use was made from these possibilities for public input, but the objections were dismissed up to the highestcourt as described in sources[27][28] . The government's reaction was the dissemination of information. The purpose of the activities first undertaken by the BfS (at that time still known as PTB, Physikalisch-Technisches Bundesanstalt--Physical-technical Federal Office) in 1978 was to create a climate of acceptance of this already selected location[29].
Gorleben repeatedly cropped up in the discussion. Those opposed to the repository used all available legal procedures to prevent licenses from being issued[30].

The Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) published two papers, in 1994 and 1995, on locations for the disposal of nuclear waste. These papers resulted from the coalition agreement between the governing parties CDU, CSU and FDP. In this agreement it was stated that if research into the disposal at Gorleben would yield a bad result, research into other locations should be undertaken immediately. To this end, the BGR had to draw up a list of other possible locations for disposal in salt or granite.
The BGR listed the qualifying and non-qualifying criteria. With regard to salt the BGR undertook a comparative study into 41 locations from which Gorleben was excluded. Four salt domes emerged from this: Wahn and Zwischenahn in Niedersachsen, Waddekath (Sachsen-Anhalt) and Gülte-Sumte (Mecklenburg-Vorpommern). The Gruppe Ökologie in a preliminary way applied the BGR's criteria to Gorleben: because this salt dome is not covered by a clay layer, among others, it seemed not to meet the BGR criteria and should not be considered to be a suitable location as they concluded[31]. In the region, this conclusion led to renewed discussions about the suitability of Gorleben. Some of the people were convinced that Gorleben would become a dumping place for nuclear waste. The people believed that if the nuclear waste would be in Gorleben, it would remain there. That is a reason for the protests against the transports to Gorleben. In March 1997, the employment of 30,000 policemen cost more than DM 111 million (Dfl 125 million), apart from the damage to roads and costs for the disruptions in train traffic[32][33] .

The doubts about Gorleben had an effect on the coalition agreement between the SPD and the Green Party of the Schröder government on 20 October 1998. In this coalition agreement, the government announced it wanted the research at Gorleben to be terminated because of the existing doubts about this salt dome, and that other locations should be looked into. A selection should then be made on the basis of a comparison of various locations[34]. On 10 February 1999, Environment Minister Jürgen Trittin announced that he wanted the research at Gorleben stopped this same year[35]. He further announced "to be willing to rectify the purely political instead of factually based decisions on Gorleben made by former Federal governments", as soon as it was clear how any compensation claims can be avoided[36]. The chairman of the Deutsche Gesellschaft zum Bau und Betrieb von Endlagern für Abfallstoffe mbH (DBE), Dr. Hans-Jürgen Krug, reacted immediately. He stated that up to February 1999, about DM 2,200 million (Dfl 2,500 million) had been spent on research, including the construction of shafts and galleries in the Gorleben salt dome. The DBE would lodge a compensation claim for these expenses[37].
According to the plan, the subterranean research is to be finished in the year 2003. At that time a decision should be taken about the suitability of Gorleben. Then a zoning plan should be drawn up: this would be finished in 2008. When objections against this would be rejected the first drum could be stored in 2013[38].
On 10 February, Trittin also announced the appointment of a new committee, consisting of 13 men, whose task would be to formulate new safety criteria for comparing various locations. It will take several years

before a new location can be selected, according to the minister[39]. The first committee meeting was on 26 February. The Environment Ministry's press release was entitled "Wissenschaftlergruppe zu Standortkriterien nimmt Arbeit auf" (Group of scientists on location criteria start work)[40]. However, the group's own name for itself was "Arbeitskreis zur Auswahl von Endlagerstandorten" (Working party for the selection of final disposal locations).
The working party's job description was vague. It was not clear if the selection of disposal site locations was the same as the drawing up of criteria. It will be interesting to see whether the results of the committee will be accepted by the public and will improve the acceptance of a final disposal site found by means of a new selection procedure and new criteria.

8. ENERGY CONSENSUS TALKS

In the 1980s, several nuclear energy projects came under attack: the fast breeder reactor in Kalkar, the construction of a reprocessing plant, the workings of a fuel element plant in Hanau and the exploitation of a High Temperature Reactor (THTR). In 1986, shortly after the accident in the nuclear power station in Chernobyl, the SPD decided to ban nuclear energy. Klaus Piltz, chairman of the board of the VEBA, stated at the end of 1992 and beginning of 1993 that the SPD policy had its effect on the granting of licenses and the monitoring in SPD-governed states. For the operators of nuclear power stations, the construction of new reactors "can therefore not be calculated and is economically unjustifiable", as he wrote. For this reason the "supporters of nuclear energy should also try to steer the nuclear energy controversy in an agreed direction to preclude any avoidable costs to the economy and to pave the way for a more commercial decision on the future use of nuclear energy"[41]**.** Piltz enumerated a number of building blocks for a consensus: the nuclear power stations will continue to be in operation for their anticipated technical-economical life span; the disposal at Morsleben will continue to be operated, the one in Konrad would be taken into operation; alternatives for Gorsleben will be looked for. Together with Gieske, chairman of the board of the RWE, Piltz sent on 23 November 1992, a letter to Federal Chancellor Helmut Kohl in which they conveyed their thoughts on a nuclear energy consensus. Consensus was here defined as consensus at a political level, not as a consensus with the public. Over time, several governments remained at this definition of consensus.

1993

The government adopted the electric companies' plans. The government interpreted consensus as political consensus. In 1993, this led to a plan drawn up by the Environment Minister and the Niedersachsen prime minister of the day, Klaus Töpfer and Schröder, respectively, with as main points:
--the remaining operational life span of nuclear power stations will not be subjected to a time limit;
--a moratorium until 2005 for the research at Gorleben and, in the meantime, a search for other locations (in Europe if need be);
--Morsleben will continue to be operated and Konrad will be taken in operation[42]**.**
The talks failed, especially because no consensus could be reached on the future of nuclear energy. Also, with the 1994 Bundestag elections approaching, the SPD could not afford to deviate from its decision to ban nuclear energy. Schröder was called back by his own party.

1995

In 1995, the Environment Ministry came with a new proposal for consensus talks. Regarding the disposal of nuclear waste, the ministry proposed to store spent fuel elements at the nuclear power station sites where possible. The ministry wanted to stick to Gorleben and will only agree to a moratorium when the disposal facility in Konrad will be operational. Disposal in Morsleben will continue till after the year 2000[43]**.**
This plan had been the subject of three meetings between the governing parties CDU, CSU and FDP, on one side, and the SPD, on the other side. In this second round of talks, consensus also meant consensus between those political parties represented in the Bundestag. These talks did not lead to any understanding since the parties could not agree on the future of nuclear energy in Germany[44].

1996-97

At the beginning of 1996, Wilfried Steuer, president of the "Deutsches Atomforum", expressed his concerns about the lack of understanding between the major political parties regarding the nuclear energy policy. For this reason the "Atomforum" was in favour of trying to reach at least a consensus on processing and disposal of nuclear waste, aside from the fundamental positions. A clear understanding was needed to operate the temporary storage facilities in Ahaus and Gorleben and the final disposal facilities in Gorleben, Morsleben

and Konrad, Steuer stated[45].
Environment Minister Angela Merkel offered Schröder a solution to come to an "Entsorgungskonsens" between the various political parties in the Bundestag. Schröder subsequently came with a proposal with as its main points:
--all radioactive waste should be stored in one location, to be decided upon by 2025;
--Konrad will be granted a license but this will not be used until the one disposal location was selected;
--Morsleben will be operational until after the year 2000;
--research into the suitability of the Gorleben salt dome for final disposal would be rounded off as soon as possible;
--decentralized storage of spent fuel elements with a temporary storage facility in Southern Germany[46].
An "Arbeitsgruppe für eine Verständigung" (Working Party for a Consensus), in which the various political parties were represented, started working from this proposal. This working party reached a compromise between Schröder's viewpoint and that of the CDU/CSU/FDP government. This compromise encountered resistance within the SPD. Both the Bundestag party and the party leaders cautiously distanced themselves from the compromise. They held their ground regarding the ban of nuclear energy[47]. One reason for this was the pending election in Niedersachsen in which the SPD wanted Schröder to secure an absolute majority in order for him to be up for the post of candidate for Federal chancellor. In this situation, an understanding between SPD and CDU/CSU was undesirable.

1998-99
The coalition agreement between the SPD and the Green Party, dated 20 October 1998, contained paragraph 3.2: "Stopping with nuclear energy" in which it was determined that irrevocable rules will be laid down for the ban of nuclear energy. The first step will be an amendment of the nuclear energy law in which reprocessing, among other things, would be banned. The second step entailed inciting the electric companies to enter into an agreement, by consensus if possible, about the steps necessary for the ban of nuclear energy, the disposal of nuclear waste and a new energy policy. Regarding disposal of nuclear waste, Konrad and Morsleben were disregarded and doubts were voiced about Gorleben. The government decides on decentralised temporary storage on the actual nuclear power station sites. The coalition agreement announced the fourth round of consensus talks.
While the first three discussion rounds consisted of talks among political parties, the coalition agreement now prescribed discussion with the electric companies. The government did not clarify this and also did not explain why, for instance, the unions and the environmentalists' organisations were not invited to take part. It was also not clear if the government attached any importance to a social consensus and, if so, which form this should take. Lastly, the government did not clarify if consensus talks served a purpose when statutory changes spelling the end of nuclear energy had been made beforehand. This lack of clarity led to a number of things happening, the main points of which follows.
Immediately upon his inauguration, Environment Minister Jürgen Trittin had drawn up an amendment of the nuclear energy law, which was not approved of by the minister for economic affairs, Müller, because reprocessing was outlawed immediately for one thing[48]. In December, Trittin was whistled back by Schröder, shortly after a meeting of Schröder with the chairmen of the boards of the RWE, VEBA, VIAG and Energie Baden-Württemberg on 14 December, a meeting Trittin was not invited to attend[49].
In December, Trittin decided to change the constitution of the Reactor Safety Committee (RSK) and the Radiation Protection Committee (RSK) so the members would not be all pro-nuclear energy. Schröder labelled this a high-handed action with which Trittin was endangering the coalition's survival[50][51] . The Green Party, however, put up a good fight. Gunda Röstel, spokesperson for the party leaders, stressed that the Greens would hold to the decision to ban nuclear energy and to end reprocessing, as stated in the promised amendment of the nuclear energy law[52]. Hereupon, Schröder and Trittin met in the end December in order to reconcile the open differences of opinion within the coalition[53].
At the beginning of January 1999, the government reached a compromise on reprocessing. Instead of an immediate ban, reprocessing should be forbidden only by the year 2000; this way, Schröder hoped to gain some time in which to negotiate with the operators of the reprocessing plants at La Hague and Sellafield[54][55] .
The amendment of the nuclear energy law, laid down by the government on 13 January, contained this compromise on reprocessing. Even if no decentralized storage sites were available, this might not be used as an argument for the closing down of nuclear power stations: this prevented an imminent closing down of the nuclear power station at Stade whose storage pools were nearly full. When the storage pools were full, the spent fuel elements should be transported to the central storage facilities at Ahaus and Gorleben. This

amendment was also less strict on the banning of nuclear energy. The government allowed research reactors as well as an extension of the enrichment plant at Gronau[56][57] .

The nuclear industry reacted furiously to the compromise on the amendment of the nuclear energy law. From both France and England the operators of the reprocessing plants threatened to send back the spent fuel elements and to lodge a complaint for damages of several thousand million[58][59] .
Dieter Harig of Preussenelektra, also spokesperson for the electric companies, stated that banning reprocessing was contrary to the agreement with Schröder on 14 December[60]. According to Harig, a consensus was of the utmost importance but could only be reached if all parties were prepared to accept that their truth was not the only one. He further stated that the government acted just like that. This put a burden on the consensus talks[61].
The director of VEW, Gert Maichel, appealed to the government not to encumber the consensus talks with unilateral decisions, like the ban on reprocessing[62]. RWE voiced the same sentiments[63]. Wilhelm Simson, chairman of the board of VIAG stated that reprocessing should be permitted for at least another five years or there will have to be a 100 Castor transports yearly[64]. The abovementioned people threaten not to take part in the consensus talks[65].
The prime ministers of Nordrhein-Westfalen, Wolfgang Clement, and Niedersachsen, Gerhard Glogowski (both SPD), announced they wanted to prevent any nuclear transports. They stated that they failed to see why they should again take massive police action against nuclear energy opponents[66]. The action groups in Gorleben supported this point of view. Their spokesperson, Wolfgang Ehmke, said they were willing to prevent the transports. It was true that Ehmke was in favour of banning reprocessing but this did not mean that nuclear transports were justified: he did not discriminate between the "good" atom as a result of banning nuclear energy and the "bad" atom as a result of continuing with nuclear energy[67]. He also stated that he failed to see why only the electric companies were invited to the consensus talks and not, for instance, the church and environmentalists' organisations. That was why environmentalists' organisations planned to campaign at the consensus talks in Bonn on 26 January[68] and also planned their own round of consensus talks with three unions (IG Bau, IG Metall and GdED)[69]. Greenpeace published a 10-point plan aimed at switching off the nuclear power stations in the year 2005 at the very latest[70].
Schröder then announced, on 20 January, he wanted to have a preliminary discussion with the electric companies by himself, without Trittin, to prevent the consensus talks from failing. He also announced that the amendment of the nuclear energy law would take another two months at the very least[71]. These remarks severely irritated the Greens[72].

The result of the consensus discussion on 26 January was that reprocessing will not be banned by the year 2000 but later. The exact time will be decided upon, for each nuclear power station separately, by a study group. The Schröder-government and the electric companies also concluded that further deliberations should be held on the exact time the nuclear power stations will1 be closed down; the next round of talks would be held on 9 March[73].
Harig of Preussenelektra stated that the normal life span of a nuclear power station was 40 years. The eldest German nuclear power station, Stade, had been operational for 27 years[74]. The first nuclear power station to be closed down, therefore, would be taken out of the network around 2010, if Harig had his way. Other energy industries reckon with a 40-year life span at full workload; since a nuclear power station on average reaches an 80% workload, the real life span would be 50 years, resulting in the first nuclear power station being closed down after 2020[75].
The consensus discussion did take place as the government turned its position, firstly by giving up the requirement to abandon reprocessing quickly and, secondly, not to require the forthcoming closure of nuclear power plants. According to commentators, for Schröder it only counted that there was consensus regardless of its contents. The Greens considered the results to be a defeat for their party, but did not consider it to have lasting consequences and called it a bitter result of a coalition in which compromises must be made[76][77] . With this, the Greens indicated that in this case, consensus meant agreement between Schröder and the electric utilities and not consensus between the governing parties.

In the following period, the discussion shifted from reprocessing to the moment of closure of the nuclear power reactors. To support the points of view of the electric utilities, the employees of the nuclear power plant Stade organised a demonstration on 4 February for the continuation of the reactor and labour. In this demonstration in Stade, 4,000 people participated[78]. The employees of the Obrigheim nuclear reactor (in operation since 1968) also were active: they stated that DM 700 million (Dfl 784 million) was invested in improvement of the safety and therefore no reason to close the reactor soon[79]. Schröder announced he

could not mention a date for phasing out nuclear energy[80], after which Trittin reacted with the announcement that certainly before 2002 the first reactor would be closed[81]. The works council of the nuclear reactors announced on 19 February to demonstrate on 9 March in Bonn for the preservation of nuclear energy.
On 23 February, the government then said it was willing to make a "total package" after talks with electric utilities, labour unions and environmental groups[82].
But a new conflict thwarted this plan. By the end of February, the government announced a new tax bill where it states that the electric utilities had to pay taxes on the funds they had made for the dismantling of nuclear installations and the storage of nuclear waste. The utilities reacted that this would mean an unacceptable assessment of DM 25 billion (Dfl 28 billion). They threatened to stop the consensus talks in the beginning of March[83]. Minister of Economic Affairs Müller announced on 8 March that he could only defend a tax amount of less than DM 10 billion (Dfl 11 billion)[84]. With this, he distanced himself from the tax plans of his government. But this was not enough to save the 9 March consensus round where the discussion was full of emotions and bitter disputes and where there was no final conclusion. It also was doubted whether further talks would take place. In Bonn, 30,000 people demonstrated for the continuation of their employment in the nuclear industry[85]. Afterwards on 11 March a conversation was arranged between Schröder and the labour unions. Points of views were exchanged and no decision was made. The government announced that it would take into account the aspect of employment in phasing out nuclear energy[86]. On 11 March, environmental organisations also proposed to Schröder to form two working groups: one for a new energy policy and one for phasing out nuclear energy[87].
On 10 April, the electric utilities declared they were willing to continue the consensus talks. From new calculations it would seem that the new tax law would result in an amount of DM 10 billion (Dfl 11 billion) to be paid, taking into account another calculation method[88]. On 15 April, Minister Müller of Economic Affairs repeated that he wanted to discuss together with the utilities the different opinions on the tax plans[89]. The planned discussion between the minister and the electric utilities on 16 April however, was cancelled some hours before because there remained questions on the taxes[90].

The theme of new nuclear transports also remained on the agenda. On 24 March, the utilities stated that they took account of new transports in the middle of 1999[91]. The environmental minister of Sachsen, Wolfgang Jüttner, called this a "high distrusting measure"[92]. On 8 April, Preussenelektra repeated that in the year 1999, transports from Stade should take place to avoid the closure of the plant[93]. Action groups announced on 11 April plans to blockade those transports. They considered the politics of the Red-Green coalition worse than the Kohl government because Kohl's view was to control nuclear energy, whereas although the Red-Green government, on one hand, said it was willing to stop nuclear energy, but, on the other hand, did everything possible to guarantee the continuation of nuclear reactors[94]. In the beginning of April, there were messages that new transports would take place from the reprocessing companies Cogema and BNFL to Germany[95]. On 18 April, Heinz Klinger, the coordinator for the consensus talks for the electric utilities, let it be known that a continuation of these talks was only useful when it could meet two conditions. Apart from the issue of the taxes, within a short period the new transports should be allowed. He stated that within a few weeks, new licenses for these transports will be sought and he hoped to receive an answer soon, otherwise not only Stade but also Philippsburg, Neckarwestheim and Biblis had to be closed[96].
After April, no decisions were made. In June, Minister of Economic Affairs Müller presented a concept agreement between the government and electric utilities. A conversation on 20 June between the government and the utilities, however, reached no agreement. An important difference of opinion was the question how long the nuclear power reactors could remain in operation[97]. This was followed by a difference on the remaining life span. Minister Müller wanted a total life span of 35 years, but the Greens could not agree with this[98]. On 7 July, Chancellor Schröder decided to set up a commission to formulate a common governmental standpoint by September on life span, reprocessing and the storage of nuclear waste. After that, the talks with the nuclear industry could proceed again[99]. The government planned for 30 September new talks with the electric utilities[100].
With this, the open differences of opinion within the government had not been solved. In mid-July, Minister Müller stated that a life span of 25 years was a compromise for the utilities. The SPD and Greens would have to admit that. Therefore the Greens should review their standpoint. He also pleaded for new nuclear transports, already in 1999. He considered the stand of the SPD to allow only transports that the utilities had made compromises, to be like a threat. According to Müller, the electricity producers had a right to conduct nuclear transports[101]. Environment Minister Trittin reacted with the statement that the first nuclear

reactors should be disconnected from the grid at the latest in 2002. Eventually there was no consensus. He also declared that a resumption of nuclear transports was out of the question[102].

How things went since the government had started, Environmental Minister Wolfgang Jüttner of Niedersachsen concluded that the electricity utilities had taken the reins. In his view, the federal government acted in a wrong way and was clumsy. Jüttner criticized the fact that a revision of the Atomic Law had not yet been made that would be necessary to prevent that he had to issue a license for the spent fuel conditioning facility in Gorleben[103]. On 19 April, Richard Meng of the *Frankfurter Rundschau* observed that an ultimatum had replaced the consensus, but that this attitude of the utilities was provoked by the earlier attitude of the government itself[104].

9. SUMMARY

In February 1977, Gorleben was chosen as a possible site for nuclear waste disposal and as a location for a reprocessing plant. How did this come about? In 1973, the search for a suitable disposal site began. Twenty-four salt domes in the state of Niedersachsen were checked on a number of criteria. These criteria were published in 1977 when Gorleben had already been selected. These were general criteria, like a sufficient volume of the salt dome, homogeneity of the salt, the top of the salt dome should be at least 200 metres below ground level, etc.
On the basis of these criteria, the salt domes at Wahn, Lichtenhorst and Weesen-Lutterloh were selected. Gorleben was not part of this selection because of its position near the border of the former GDR. But in February 1977, Gorleben was decided upon. The then prime minister of Niedersachsen, E. Albrecht (CDU), brought up two political arguments:
--the region of Lüchow-Dannenberg where Gorleben is situated as an economically weak area;
--the expected public support.

This public support, however, proved to be non-existent. On 12 March 1977, a protest rally was held with 100,000 participants. This was the first of a long series of protest actions and discussions. The doubts about Gorleben had an effect on the coalition agreement between the SPD and the Green Party of the Schröder government on 20 October 1998. In this coalition agreement, the government announced it wanted the research at Gorleben to be terminated because of the existing doubts about this salt dome, and that other locations should be looked into. A selection should then be made on the basis of a comparison of various locations. In July 1999, this policy was not executed yet, the research in Gorleben was not halted yet as well. The term consensus talks is an invitation to study precisely how agreement can be reached, the more so as the storage of nuclear waste--besides nuclear energy--played an important role. Further study, however, shows that a clear description of the goal of the consensus talks is lacking. The first discussion rounds concerned the consensus between political parties. At that, it was not made clear whether consensus between a number of Parliament representing parties would be sufficient to speak about public acceptance.

The consensus talks of the present government are between the governmental parties and the electric utilities. Implicitly, this means another definition of consensus. It also appeared that the government did not want to have an open mind, but as a precondition, aimed for an immediate ban on reprocessing. In February 1999, a difference of opinion arose on the remaining life span of the nuclear power reactors. The government assumed 30 to 35 years. The electric utilities reckoned with a 40-year life span at full workload; since a nuclear power station on average reaches an 80% workload, the real life span would be 50 years, resulting in the first nuclear power station being closed down after 2020. In June, a difference arose between the government parties themselves on the remaining life span. Minister Müller wanted a total life span to be pegged at 35 years, but the Greens did not agree and wanted at least one nuclear power reactor to be closed within the present governing period. The SPD and Greens, however, agreed to try to reach an agreement before 30 September.

10. CONCLUSIONS

1. The discussion about the disposal at Gorleben was tough from the beginning. This was mainly the result of a lack of openness in decision-making. The criteria for the selection of Gorleben were not made public. Afterwards, criteria were mentioned, but it was not clear why Gorleben was the only one that would fit these criteria. For the people, this resulted in the idea that the criteria had been adjusted to the findings of research

in the salt dome of Gorleben. Briefly stated, an unclear decision-making.
2. The consensus talks at a political level have reached little, apart from a lot of media attention. This was caused by the fact that the government had no clear idea on what issues consensus should be reached. The government parties appeared to be divided among themselves and the electric utilities disagreed with the government.

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Niedersachsen: Steyerberg
Nordrhein-Westfalen: Jülich
Rheinland-Pfalz: Birkenfeld
Saarland-Schwalbach: Elm
Sachsen: Rossendorf
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6. SPAIN

KEY FACTS

Nuclear Power: nine nuclear power reactors; 7.1 Gwe; 34% Gen. Cap.; No new nuclear capacity foreseen according to National Energy Plan 1991-2000.
Waste (present): 21,000 m^3 L/ILW; 1,800 MT spent fuel; Annual production L/ILW 1,200 m^3 and 160 MT spent fuel; L/ILW disposed at El Cabril surface disposal; spent fuel stored at reactor site.
Waste (future, cumulative): 200,000 m^3 L/ILW; 10,500 m^3 HLW (6,750 MT spent fuel and 200 m^3 VHLW); L/ILW until 2015 capacity at El Cabril; spent fuel at reactor site or possibly at Trillo interim storage facility; disposal strategy HLW yet unknown.
Waste authorities: Empresa Nacional de Residuos Radioactivos SA (ENRESA).
Retrievability: surveillance period at El Cabril of 300 years; strategy for HLW unknown.
Dialogues (among others): Senate Commission for Industry set up inquiry commission in 1996, report not adopted in Senate, broad support was lacking.
Key issues: politics appears to be imposing difficulties in dealing with the nuclear waste problem; interim storage at Trillo might postpone further decisions; with this, an acceptable solution is not near.

Introduction

After a presentation on the waste policy of Spain at a conference[1] and upon receiving information on an inquiry by the Spanish Senate, CORA requested us to include Spain to our list of countries to be studied. We agreed with the request but found some difficulties in describing the country. These difficulties deal in one part with a shortage of English material about Spain, and also the choice not to visit that country to have extensive interviews because of time and fund constraints. Therefore, this chapter will be shorter than the others. This is also because of the fact that the inquiry outcome was unsuccessful, its report was rejected by the Senate and the commission was disbanded.
For this chapter, the information was found in a number of documents, mainly from the OECD/NEA, the waste authority "Empresa Nacional de Residuos Radioactivos SA" (ENRESA), and the WISE News Communique. Telephone conversations were made with representatives from ENRESA. Unfortunately, no environmental organisation reacted to our requests for information. Their view is presented through the use of the WISE News Communique as a source. A draft version of the chapter was commented upon by Elena Vico and collegues at ENRESA.

1. NUCLEAR POWER PROGRAM

Spain's first nuclear reactor was opened in 1968. Aside from a now gas-graphite reactor which has been shut down, all the nine reactors are of the light-water design. Nuclear energy has a 34% share in total electricity production and a generating capacity of 7.1 GWe. Based on its National Energy Plan 1991-2000, no new nuclear capacity is foreseen[2].

2. PRODUCERS OF RADIOACTIVE WASTE

Main producers of nuclear waste are the nuclear power plants that are responsible for about 95% of the radioactive waste that would be produced in the coming decades. Other producers are, for instance, medical and industrial isotope users[3].

3. CATEGORIES OF RADIOACTIVE WASTE

Spain knows two categories of radioactive waste. The first one is low- and intermediate-level waste that has a low specific activity, short-lived beta and gamma emitters and a low concentration of long-lived alpha isotopes. The category high-level waste has a high specific activity, a higher concentration of long-lived isotopes or is heat generating[4].

4. AMOUNTS OF RADIOACTIVE WASTE

4.1 Present amounts

Till the end of 1995, 21,000 m^3 low- and medium-level waste and about 1,800 MT(U) of spent fuel were stored. Annual production of low/medium-level waste was 1,200 m^3 and 160 tU of spent fuel. Spent fuel of the closed Vandellós-1 was sent to the reprocessing plant La Hague in France. In 1983, however, the government decided to stop reprocessing. Vitrified high-level waste is to be returned to Spain in the future[5].

4.2 Future amounts

Based on a 40-year lifetime of nuclear reactors, a total of 200,000 m^3 of low- and intermediate-level waste has to be stored in the future. Main part of this are wastes that arise from dismantling (64%). Others are, for instance, operating wastes from reactors (23%) or other producers (5%). A total of 10,500 m^3 of high-level wastes have to be stored, being 6,750 MT of spent fuel and 200 m^3 vitrified reprocessing waste[6].

5. WHERE IS IT STORED?

Low- and intermediate-level waste is disposed of at the El Cabril surface disposal facility. This facility, located in the province of Córdoba at the location of an abandoned uranium mine, was opened in 1992 and can store waste till about 2015. The waste packages are stored inside big concrete containers of about 2 x 2 x 2 meters. The blocks are covered with protective structures and later covered with earth. A surveillance period for 300 years is foreseen[7].

Spent fuel is stored at the reactor sites. As there is no final storage yet, three options are open for interim storage. Reracking inside the reactor cooling pools will increase storage capacity. Other possibilities are the construction of on-site storage casks or a centralised interim facility[8]. According to ENRESA, reracking has been completed at all reactors and the storage casks are licensed to be used as further expansion capacity increases[9]. The construction of a centralized interim facility would not be really necessary till the year 2010. So, research is being conducted on this option, but no specific plans of a site have been made, says ENRESA[10].

However, environmental groups protested against a 1999 government decision to give the green light for a waste storage facility at the Trillo nuclear power station, which they feared would become the de facto centralized interim storage as mentioned. According to Ecologistas en Accion, the facility, which is said to be necessary as spent fuel pools in Trillo would be filled in 2003, would have a storage capacity that could store twice as much as the Trillo spent fuel produced and would be easily expandable. As the Trillo power station is owned by almost all the electric utilities, they fear the companies would "solve" the waste problem with this facility. The government decision overruled two earlier refusals by the city council and the Superior Court of Justice, because of "urgency or exceptional public interest"[11].

6. RESPONSIBILITIES

ENRESA is the organisation responsible for waste management. It is a state-owned company that was set up in 1984 to deal with all the aspects of waste management.

The Ministry of Industry and Energy is responsible for legislation and licensing, together with the Nuclear Safety Council (CSN). CSN was set up in 1980 and deals with nuclear safety and radiological protection and reports directly to the Senate[12].

7. SPAIN'S WASTE POLICY

Initially, ENRESA searched for favourable rock formations of salt, clay and crystalline. The research program started in 1987 and at that time a repository was expected to be realised by 2020. By end-1990, some 25,000 km^2 of possible regions were found. Finally, some 30 areas were identified for further research[13].

Although ENRESA had identified the favourable areas for further underground research, work was halted in 1996 due to public opposition. In 1995, it became known among environmental groups that ENRESA had plans for the construction of underground disposal sites and a list of possible locations was released. They accused ENRESA of not having informed the public and of having inspected possible sites. Big

demonstrations were organised, the first one in Belaleazar with 10,000 persons in 1996. The year after, some 15,000 demonstrated at Villanueva. It even grew to 20,000 in 1998 at Torrecampo[14]. And although decisions about underground disposal and test drillings were not to be taken before 2010, the protests have continued. Also in early 1999 a demonstration with thousands of participants was organised[15].
At the end of 1996, the Senate Commission for Industry established an inquiry commission to develop a new waste policy. It had to study the difficulties in finding a site for waste disposal and should include socio-political and public acceptance aspects. The commission's work was expected to result in guidelines for the government to develop a legal framework for siting. The commission also received contributions from groups and institutions. The commission also visited other countries for comparison.

In the process, the government decided in early 1998 not to make decisions about final disposal before the year 2010. By that time the Senate should have evaluated the research being conducted. It was also decided to conduct site drillings only after 2010 and that a voluntary process had to be "expected" before these could take place. More research should be done on partitioning and transmutation.
For ENRESA, the government decision meant that no test drilling work could be done. Studies do continue with the use of existing geological data[16].
By the end of 1998, the inquiry commission had come to conclusions and made recommendations to the government on how to proceed with the waste policy. But its report was not adopted at the April 1999 Senate plenary meeting and the commission was disbanded. Although it is not really clear what the exact reasons were for the rejection of the darft report, it appeared to be for political reasons. Where the commission had reached consensus about certain issues, in the Senate the report did not get the broad support that was wanted by the government.
The government wanted the broad support of the main political parties to accept it, but the Parti Popular and the Socialist Party voted against it. "It did not reflect their opinions," said an ENRESA spokeswomen, "and political parties do not want to talk about high-level waste"[17]. It remains unclear how the Spanish government would now proceed. It was expected that after an adoption of the inquiry report, new laws would be developed to give a legal framework for Spain's policy. New laws would be necessary for future siting activities[18].
ENRESA has been preparing a new General Radioactive Waste Plan. Although ENRESA has the obligation to submit yearly a proposal for a plan, the government has no obligation to approve it every year[19]. In July 1999, the cabinet agreed to approve the fifth plan. In this plan, the postponement until 2010 of decisions on deep disposal was included. Earlier plans fixed the decision for constructing an underground storage facility in 2000. According to Ecologistas en Accion, this delay has to do with upcoming general elections, public opposition and delays in international research and programs[20].

8. SUMMARY

As in other countries, plans for an underground storage or research program have faced public opposition in Spain. Siting work by ENRESA stopped in 1996 after this opposition. Although research continues with already known geological data, no site drillings are to take place before 2010. By that year the Senate has to decide on a final disposal strategy.
Government licensed the building of a spent fuel storage facility at the Trillo nuclear power plant. Environmental groups fear that this storage might become a national storage facility.
An inquiry commission was set up to give guidelines in the development of a new policy that could overcome public opposition. But after having written a draft report, the final outcome was unsuccessful. The report was not adopted in the Senate due to what appears to be political reasons.

9. CONCLUSIONS

1. As it remains unclear what the exact reasons were to reject the report, it looks more that the waste issue is so controversial that political parties have difficulties in dealing with it.
2. The realisation of an interim storage at Trillo, firstly meant for the station itself but with a possibility of expansion, can result in decisions being easily postponed in the future.
3. The political hesitations and the practice of postponing has not brought and will not bring an acceptable solution any closer.

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7. SWEDEN

KEY FACTS
Nuclear power: 12 nuclear power reactors; 10 GWe; 45% Gen. Cap.
Waste (present): 27,442 m^3 L/ILW stored at SFR Forsmark or surface disposal at Ringhals, Forsmark, Oskarshamn and Studsvik; 2,395 MT spent fuel stored at CLAB facility Oskarshamn.
Waste (future, cumulative): 252,000 m^3 L/ILW; 7,380 MT spent fuel.
Authorities: Swedish Nuclear Fuel and Waste Company (SKB); Swedish Nuclear Power Inspectorate (SKI); Swedish Institute for Radiation Protection (SSI); Swedish National Council for Nuclear Waste (KASAM); National Co-ordinator / Special Advisor for Nuclear Waste Disposal.
Retrievability: not included in SFR; five-year retrievability period planned for spent fuel disposal site.
Dialogues (among others): volunteering principle in site search; until now feasibility studies in eight municipalities; two withdrew after referendum; national co-ordinator co-ordinates information flow between municipalities and others; National Environmental Impact Assessment Forum, environmental groups excluded.
Key issues: lack of retrievability guarantees, less acceptance expected; risk that social acceptability dominates technical acceptability with voluntariness; exclusion of environmental groups in EIA Forum can lead to future conflicts.

Introduction

This chapter will give a description of the Swedish KBS-3 concept for nuclear waste disposal, the attempt to find a site for deep disposal, and the role of the National Co-ordinator for Nuclear Waste Disposal in this. A lot of material was received through Olof Söderberg, National Co-ordinator (the position has been changed to Special Advisor for Nuclear Waste Disposal). Information was also used from other studies on Sweden's waste policy. Unfortunately, environmental groups did not react to our requests. Their opinion, however, was found in articles, like a recent one in the *WISE News Communique* that gave a good insight into the position of environmental groups. Mr. Söderberg gave his comments on the draft text.

1. NUCLEAR POWER PROGRAM

In 1966, Sweden ordered its first nuclear power plant, a boiling water reactor, that was built at Oskarshamn. Plans for more reactors were made in the Swedish Parliament and 11 more reactors were ordered[1].
The 1973 oil crisis caused a turn in people's thinking on economic growth and environmental issues. Urbanization, large-scale production and high-technology faced sceptical reactions from parts of society. The Center Party favoured a new politics of small-scale production, environmental protection and regional balance and became the major opposition party in Parliament, in the 1973 elections gaining 25% of the votes. Nuclear power became one of the main issues of the party and a public debate was initiated on the ethical aspects of waste disposal and especially about the burdens on future generations[2].
When the Center Party won the 1976 elections, the nuclear energy discussion became more and more important in the new government of the Center Party, the Liberals and the Conservatives. Because of different points of view, several compromises were made. According to a December 1976 Stipulation Act, the operators of nuclear reactors were responsible for the "absolutely" safe handling and final disposal of nuclear waste. In 1978 a conflict arose when discussion took place on the first fueling of two reactors completed in that year. To save the cabinet, the Liberals and Conservatives agreed with the Center Party on a temporary refusal for loading as the utility did not succeed in showing a site for safe disposal of the waste. The ongoing disagreements led to the fall of the cabinet in the end of 1978[3].
After the 1979 Three Mile Island accident, the new cabinet, led by the Center Party, initiated a nationwide referendum, which the anti-nuclear movement had already asked for in 1973[4][5] . The outcome was that the 12 reactors could operate until 2010. The decision to phase out nuclear energy still stands, but the deadline of 2010 was dropped in an energy policy revision by Parliament in 1997[6].

At present, 12 reactors are still in operation--three pressurised- water reactors and nine boiling-water reactors. These reactors are located at four sites: Ringhals, Forsmark, Oskarshamn and Barsebäck. Total generating capacity is 10 GWe, and the share in electricity production is 45%[7]. The two reactors at Barsebäck have to close definitely in November 1999 and July 2001, respectively, as government decided in

1998. Owner Sydkraft AB started legal procedures against the decision. In June 1999, the Supreme Administrative Court backed the government's decision. Sydkraft also lodged a complaint with the European Commission. It has yet to make a decision[8].

2. PRODUCERS OF RADIOACTIVE WASTE

The 12 power reactors and a nuclear research center at Studsvik produce nuclear waste. Apart from this, hospitals, industry and other research facilities are responsible for a certain amount of waste yearly. In volume, it is less than the nuclear industry[9].

3. CATEGORIES OF RADIOACTIVE WASTE

Sweden knows a categorization that is used in almost all countries. High-level waste includes spent fuel and highly active reactor components[10]. Low-level and intermediate-level wastes come from reactor operation, decommissioning and research. The category very low-level wastes can also include reactor wastes. Wastes other than from the nuclear industry are managed separately and are either disposed of or incinerated[11].

4. AMOUNTS OF RADIOACTIVE WASTE

4.1 Present amounts

An amount of 9,000 m^3 of very low-level waste had been produced until the end of 1995.
Till the end of 1995, 2,960 m^3 of low-level and intermediate-level waste was produced by reactors annually, and disposed of at the Central Final Repository (SFR)[12]in Forsmark. The cumulative quantity of waste stored at SFR was 18,442 m^3.
For high-level waste, 196 MT of spent fuel is produced yearly. Till 1995 2,395 MT of spent fuel were stored at the near-surface Central Interim Storage Facility (CLAB) in Oskarshamn[13].
Hospitals, the pharmaceutical industry and research laboratories generate about 2,000 m^3 of low-level, solid waste annually. Partly, it is sent for surface disposal at Studsvik or to the SFR, but most of it is incinerated, after which the ashes are brought to SFR[14].

4.2 Future amounts

The production of radioactive waste from Sweden's energy program varies from highly radioactive spent fuel, operational low-level waste to decommissioning waste. The following table shows the amounts to be expected over the total lifetime of nuclear reactors[15].
Spent fuel HLW, long-lived 4,500 canisters (7,380 MT(U)[16])
Alfa contaminated waste
from research at Studsvik LLW/ILW, incl. long-lived 2,000 m^3
Core components and internals LW/ILW, some long-lived 10,000 m^3
Reactor waste LLW and ILW, short-lived 90,000 m^3
Decomissioning waste LLW and ILW, short-lived 150,000 m^3

5. WHERE IS IT STORED?

Since 1988, the SFR in Forsmark has been in operation for the disposal of low-level and intermediate-level wastes. It is meant as a final disposal site and is located 50 metres below the bottom of the Baltic Sea and has a total disposal capacity of 60,000 m^3. The site was chosen by SKB as it had good relations with local authority, where the three nuclear reactors are important employers. Besides, the construction of it was welcomed as the third reactor had just been completed at that time[17]. The choice for this site, however, was criticized by the People's Campaign Against Nuclear Power and Nuclear Weapons as it should be seen as a kind of sea-dumping of nuclear waste. The rock on top of the repository is not completely tight and there is a fracture zone in the access tunnels[18]. The most active waste (its activity is about 90% of the total to be disposed) is disposed of in a special silo that is to be backfilled with bentonite clay later. Other wastes are disposed of in excavated caverns. Finally, an amount of 10^{16} Beqcuerel is to have been disposed of at closure time[19]. The capacity of SFR is insufficient to dispose of the future amount of waste that will arise. An

enlargement of SFR is planned[20].
CLAB in Oskarshamn was opened in 1990 for the interim storage of spent fuel and highly active reactor core components. The installation is situated 50 metres below the surface and is excavated from rock[21]. In 1998 its allowed capacity was enlarged from 5,000 to 8,000 tonnes of spent fuel[22].

It is planned that a fuel encapsulation plant will be built at Oskarshamn to pack spent fuel in specially designed copper-cladded canisters for final disposal. The facility has to be ready when a disposal site is to be opened for storage. Since 1994, work has been done on an environmental impact assessment, including consultation of the Oskarshamn municipality[23].
As all nuclear units are located on the coast, almost all transports to the SFR and CLAB facility are conducted by a specially designed vessel, the *MS Sigyn*, built in 1982. Between 30 and 40 shipments are made every year from the power plants to the waste sites[24].
For very low-level waste, surface disposal facilities are located at the reactor sites of Ringhals, Oskarshamn, Forsmark and at the research center of Studsvik[25].

6. RESPONSIBILITIES

In 1980 the Swedish Nuclear Fuel and Waste Management Company (SKB) was founded. It is owned by the four nuclear utilities and has the task to develop a waste management strategy and a disposal site. It is supervised by the Swedish Nuclear Power Inspectorate (SKI); the Swedish Institute for Radiation Protection (SSI); and the Swedish National Council for Nuclear Waste (KASAM). The SKI and SSI report to the Ministry of Environment and are responsible for nuclear safety, waste management and radiation protection. KASAM was established in 1985 as an independent expert committee and advises the government and ministries on the waste issue[26].
Waste research and storage and disposal costs have to be covered by a Nuclear Waste Fund. All four nuclear power companies are responsible for the future costs of disposal of waste and the decommissioning of reactors. A levy between one and two öre (Dfl 0.0025-0.0050) on every produced kWh should, in combination with growth by interest, provide enough money for present and future costs. Besides, when the fund would seem insufficient, the companies are to be responsible for unforeseen costs[27].

7. THE KBS-3 SPENT FUEL DISPOSAL CONCEPT

A Government Commission of Inquiry looked in the mid-1970s at the possibilities for radioactive waste disposal. It concluded that Sweden should not rely on shallow land burial because of the small amount of suitable locations and bad experiences in the U.S. As Sweden had experience in building in crystalline rock, the group recommended the disposal of radioactive waste in rock caves[28].
The electric utilities started, after the 1976 Stipulation Act's publication, a research program on waste disposal, the Nuclear Fuel Safety Project (KBS). It was conducted by the Swedish Nuclear Fuel Supplies Ltd. (SKBF), the precursor of SKB. The Stipulation Act required an "absolutely safe disposal of HLW" as a condition for starting up nuclear reactors[29]. Until now, it had been the policy that the licenses to operate Swedish reactors be made conditional on positive reviews of the SKB's research and development (R&D) programme at three-year intervals. Anti-nuclear groups observed a certain risk in this connection: "What are the chances that a government would refuse to approve SKBs FUD [R&D] programme? Minimal. What politician with normal survival instincts would willingly take on the responsibility of cutting the country's electricity supply in half with the stroke of a pen?"[30]
A concept was developed on final storage and research was carried out on geological, hydrological and geochemical effects. After a cooling period of 30 years, the spent fuel would be packed in containers and placed 500 meters underground, technical and natural barriers should prevent the spread of radioactivity in groundwater for 200,000 years. The outcome led to critical reactions by experts and laymen, discussing the proofs and safety presented, as well as the concept of "acceptable risk"[31].

The KBS project was, at its start, divided into the sub-projects KBS-1 (1977) for the storage of vitrified high-level wastes from reprocessing, then still a practice, and KBS-2 (1978) for the storage and disposal of spent nuclear fuel. Due to the lack of governmental support for reprocessing more attention was paid to the KBS-2 project. The KBS-2 programme consisted of a sea-transport system, copper disposal canisters and disposal starting in 2020.

In 1983, a KBS-3 report was submitted following the KBS-2 principles: centralized storage of fuel for 40 years, the use of copper canisters for disposal and final disposal of waste in two separate repositories[32].
Critics asked for a review, including experts that were excluded between KBS-1 and -2 review. The energy minister however refused, stating that he was familiar with criticism on KBS-1 and -2[33].
The KBS-3 concept consisted of a repository 500 metres below the surface in bedrock. The spent fuel is contained in copper canisters and bentonite should surround the containers. Finally, the tunnels will also be backfilled.
In the first stage of a repository, around the year 2010, some 400 containers will be placed to demonstrate the suitability or unsuitability of the site. After this evaluation period of only five years, the containers can be retrieved if other methods for disposal are required or in individual cases because of safety reasons. For retrieval, methods have to be researched how to locate containers and freeing them from the bentonite backfill[34].
According to SKB's principles, the present generation is responsible for the management and disposal of nuclear waste. Therefore a disposal site should be developed within some decades to limit measures that would be required from future generations. Although SKB also takes into account the possibility for a future generation to modify the disposal concept when desired.

It is planned that this generation will build the repository and deposit the waste containers, but keep open the facility. A next generation then can choose to close the disposal, keep it open or retrieve the waste[35].
According to Greenpeace and other groups, SKB is too much in a hurry and convinced about the safety of the KBS-3 concept. Greenpeace questioned the several modifications that were made to the concept, the uncertainties about a system of monitoring and retrievability periods and aspects like proliferation, that is, that a disposal site might become a "plutonium mine" in the future. In its opinion, too much attention and effort is being given to find a site, instead of working out the method of storing waste more completely. It also stated: "There is also a risk that a certain prestige is involved: the desire to be the first country in the world to solve the unsolvable could turn our heads."[36]
From 1977, the old iron mine at Stripa had been used as an underground research facility. Studies were made on the properties of granite and proceeded till 1992, when the mine was abandoned.
In 1995 the underground Äspö Hard Rock Laboratory was completed as a KBS-3 research project, located close to the Oskarshamn units. It is situated 450 meters below the surface. Research is done on ground-water flow, mechanical damage and techniques for the refilling of a repository[37]. The site itself is not suitable as a possible disposal site as the volume of suitable rock is too small and crossed by large shear zones[38].
Swedish law prohibits the import of foreign nuclear waste, apart from some exceptions. The Act on Nuclear Activities states: "Final disposal in this country of spent nuclear fuel or nuclear waste from a nuclear plant or other nuclear activities in another country is prohibited without a special license." For instance, a special license could be granted for small amounts of waste arising from international research and testing on Swedish territory[39].

8. SITING AND VOLUNTARINESS

SKB has been conducting studies of geologic suitability in the country since the mid-1970s. Between 1977 and 1985, test drillings were made at about 10 sites[40].
The first drillings faced protests by local authorities and demonstrators. The 1977 drillings at Finnsjön (close to Forsmark), Kråkemåla (near Oskarshamn) and Sternö (near Karlshamn) attracted still little attention as the nuclear waste issue was rather unknown and therefore not very controversial.
The situation changed when drillings were planned in Kynnefjäll in April 1980. In that region plans had existed for building nuclear reactors and a reprocessing plant. Three nearby municipalities threatened to use their veto power against the storage plans. The local Save Kynnefjäll group started a 24-hour watch on the road leading to the test site and was supported by the local municipal council[41]. Even in recent years the group has still been active. They still note license numbers of unfamiliar cars, unknown trucks are "followed" by citizens, informing each other to find out whether they really leave the municipality[42].
Also at the Svartboberget (Ovanåker), the tests faced demonstrators blocking the road to the test site for three days in February 1981.
Drilling work at Klipperås started in 1983 and could not be stopped by protests. Local groups and politicians asked for adequate information and that an independent geologist could take part in analyzing the results. However, SKB refused the request of an independent geologist as he "would merely be in the way". In June 1984, some 40 metres of drill cores were stolen from a container. In an anonymous reaction to a newspaper,

a geologist report said the drill cores showed the unsuitability of the bedrock for waste disposal.
In 1985 plans were made for drilling at Almunge, east of Uppsala. People criticized the lack of information. In a newspaper SKB said: "We do not have the time to sit in on a series of showy meetings. We consider that the meetings cried for by the public have nothing to do with public information." A blockade was organised on the road to the test site and was cleared by the police. Finally the energy and environment minister reprimanded SKB for its lack of information dissemination. An information meeting was set up, being followed the same night by the first test drilling work. Protestors occupied the machines and after a couple of months SKB withdrew its machines from the area[43].
After 1985, SKB focused on a more general desk study on identifying potential suitable areas in Sweden. SKB used the following strategy for finding a suitable site. Firstly, it conducted a general study on Sweden's deep underground. This should give, on a national scale, insight into which parts of the country are unsuitable, interesting or suitable. Secondly, it will conduct five to 10 site-specific feasibility studies in interested municipalities. Finally, at no less than two locations site investigations should be made, including test drillings. Site investigating work should start in 2002. Then a detailed site characterisation can start. But only after an environmental impact assessment (EIA) process has been completed can the underground laboratory be constructed[44].

No formal permits are needed by SKB to conduct the general studies, the feasibility studies or the site investigations. Only for the detailed site characterization, the realisation of a laboratory, will a permit be needed. Although SKB only started the feasibility and site investigations after consent from the concerned municipality[45].
Some areas are excluded as a candidate for site investigations. The Scandinavian mountain range at Skåne and Gotland are unsuitable because of geological reasons, and being an area of national interest with regard to nature conservation. Areas with potential natural resources are also less favourable to use, to prevent possible future human intrusion of a repository[46].
After the late 1970s and early 1980s test drillings and consequent protests, SKB recognised it had failed to find a suitable site. The concept of voluntariness was their new strategy and in October 1992, it wrote a letter to the 280 municipalities in Sweden, asking for their cooperation in finding a suitable location for nuclear waste storage. Eight municipalities agreed to conduct a feasibility studies, which have already been carried out or are under way. These eight are: Storuman, Malå, Nyköping, Östhammar, Oskarshamn, Tierp, Hultsfred and Älvkarleby. Possibly, Nynäshamn will decide soon on joining. Later, we will go more deeply into these municipalities.

But there were also municipalities that showed their initial interest, but later withdrew. During the years there were Överkalix, Arjeplog, Tranemo and Gällivare. Initial contacts with SKB were made by local politicians and administrative officers who were interested. But when the general public became aware of this interest, unrest and opposition started. The decision to withdraw was made to avoid local conflicts within the community and also in political parties.
To be a candidate for a feasibility study has in general a lot of social consequences for a municipality. On one hand, it is said that the feasibility study will result in the perovision of an expense-free in-depth review of the characteristics of the municipality concerning issues like geology, land-use, prospects for industry, population development, etc. But it also leads to high pressure on the municipality council with the risk of overshadowing other important issues. The intense debate that will start within the community is seen as positive by some, it would improve local democracy and people's interest in politics. Others, however, see the risk of a broken municipality. In one of the municipalities, indeed the process led to broken families, harassment and boycotts of local shops.
In all cases, the referendum played an important role. However, it is not laid down in rules when exactly and if it has to be conducted. The municipality can withdraw at any time it wants to. This can be after a council decision or after holding a referendum. The referendum is used by the local government to poll the opinion among its citizens before a next step in the process is undertaken. The referendum may be held before the feasibility study starts, after its results have been published or later, in order to evaluate whether the municipality should go on with SKB[47].
So the municipality has the right to veto plans to site a facility. Swedish municipalities have a strong position that is laid down in the Constitution and special legislation on municipality self-determination. The Act on Management of Natural Resources (replaced now by the Environmental Code) states: "Permission ... may be granted if there is no obstacle on the basis of the stipulations of Chapter 2 and 3 or on the basis of other general planning considerations and if the municipal council has given its approval." Under special

conditions however the Swedish government has also the possibility to overrule such a veto: "... the Government may, if a facility is considered in the national interest to be particularly important, grant permission even if the municipal council has not given its approval. This does not apply if a suitable repository site has been identified within another municipality which it can be assumed will approve of the siting, or if another site elsewhere is judged to be more suitable"[48].

The voluntariness concept has also disadvantages from a safety point of view. It can be asked whether those municipalities that volunteered themselves are the most suitable sites, or what degree of safety they can meet, especially as there are only a limited number of volunteers. As Greenpeace said: "By limiting the selection process exclusively to those municipalities in their particular region, SKB has also severely limited the possibility of finding a site which is really best suited for a repository, since there is an exceedingly problematic shortage of voluntary municipalities."[49]
A municipality interested in a study has access to money from the Nuclear Waste Fund. As much as SK2 million (Dfl 493,000) per year can be spent on the setting up of reference groups and the organisation of debates, the spread of information, etc. When a preliminary version of a feasibility study has been presented, funds can be used for independent review[50].

Storuman
A feasibility study on Storuman was presented in February 1995. After its presentation, opponents of the plans for a repository criticized its conclusions. The report is not worth the paper it's written on. It had only positive things to say. Everything is perfect in Storuman", said local opponent Lundberg. She was afraid that local politicians would be on the side of SKB due to the resources it has for information campaigns and trips to the CLAB facility: "I don't know what the hell they did on these trips. People came home brainwashed. We have to campaign against our own politicians." SKB spent some US$ 1.5 million (Dfl 3.3 million) on its Storuman work.
The geologist Moerner, consulted by the People's Campaign Against Nuclear Power and Nuclear Weapons, said he did not believe in the safety of bedrock disposal: "Bedrock can not be depended upon. It's idiotic to put it in Storuman, just because there are mountains there." He pointed to the problem of predicting future geological events, as Sweden knew in earlier ice-ages very frequent earthquakes. He proposed the construction of long-term aboveground monitored storage[51].
In 1993, it was decided to hold a referendum as soon as the feasibility study would be ready. The 1995 outcome of it was 71% of the votes being opposed to the plans. One day after the referendum, SKB started preparations to leave the municipality, as was agreed before.
In a SKB-financed study, it was investigated what the reasons were for the negative outcome. In people's opinion it seemed that there were doubts about the safety of the KBS-3 concept and the necessary transports to a site. Besides, it was feared that a potential site would have a negative impact on wilderness tourism. It was also discussed why a municipality in the north of the country would have the duty to store waste that was produced in the south of it, it was seen as a threat from the industrialised south to one of the last remaining wild regions in the country[52].

Malå
In November 1993, the municipality council asked SKB to conduct a feasibility study, although the council was very divided over the issue. Fourteen members voted "yes", another 14 "no" and three abstained, the chairman made the final decision to participate. It was planned to hold a referendum after the results of the feasibility study would be ready.
A reference group was formed with 22 members from six political parties and 16 from different interest groups. It had to follow the work, spread information and contribute ideas.
In March 1996, the feasibility study was published after which an independent review started. This local working group consisted of members from political parties, local unions, local business, Laplanders, local tourism, local sports associations, senior citizen organisations, etc. Although opponents of the feasibility study were invited for comment, they refused to participate. The local working group formed four committees to study the issues of environment/safety, geology/hydrology, transport/facilities and socio-economics. Before the referendum, its results were published, including recommendations for further studies.
The outcome of the 1997 referendum was less negative than in Storuman, voting 55% against further cooperation. Reasons for this could be: the issue was better known at that time, Malå has an industrial tradition, no wilderness tourism, a massive information campaign by SKB, and extensive study work on the issue by the municipality itself[53].

Nyköpping
SKB decided not only to wait for volunteering municipalities, but also explicitly asked municipalities with nuclear activities on its territory to participate. Nyköpping, a municipality with such activities (research reactor and waste handling) on its territory, was asked by SKB in May 1997 to cooperate. The council declared it had officially no legal power to prevent SKB from doing a study, but were also not negative about the idea.
A working group for information was set up, with local politicians. Municipality administrative officers formed a second group and in 1996 a reference group was founded, consisting of members from different interest groups[54]**.** The twenty-four members of the reference group were selected by public nomination to the municipal board. It has only an advisory function, but it was tried to involve as much local groups and societies as possible[55].
During the process, sub-reports by SKB were discussed in these three groups and public meetings were held. In May 1997, the final report was published for review by independent experts[56]. A preliminary version of the feasibility study has been completed at the moment. After municipal review and comments to SKB, a final feasibility report will be made[57]. A council decision on further cooperation is expected when (and if) SKB formally will ask the municipality for a site investigation[58].

Östhammar
Östhammar, the municipality in which the Forsmark reactors are located, agreed in June 1995 to cooperate, with 36 council casting "yes" votes and 12 "no". In a formal agreement SKB was made responsible for conducting the feasibility study and the council for setting up the reference group. The reference group consisted of seven elected politicians and seven council members. Like in Nyköping, separate reports were discussed in the group and public meetings were held. A preliminary version of the feasibility report was presented in September 1997 for review[59]**.**
The Östhammar study is limited in terms of public involvement. The reference group is a advisory body to the council only and has no formal contact system with the public[60].

Oskarshamn
The process in Oskarshamn, were the CLAB and three reactors are located, started not earlier than 1996. After the spring 1995 invitation by SKB, the council started a consultation process on the plans and in October 1996 the council agreed to go ahead with a feasibility study under certain conditions. It wanted to have influence on the issues being studied and on the forms of interaction between SKB and governmental authorities. For instance, a proposal for the study was subject of a formal municipality decision. The council itself would act as the reference group. Besides, working groups were set up with elected politicians and representatives from different interest groups[61]**.** These working groups were independent from the reference group and can hire their own experts and advisers when they thought necessary[62].
Some believe that the choice has already been made that Oskarshamn should be the site for a repository. This conclusion was made when SKB presented figures on transports among the CLAB, the encapsulation plant and a repository site. As in the R&D Programme 1992 no figures were given about transports among those three it was concluded that the repository should be at the same place as CLAB and the encapsulation plant, and thus Oskarshamn[63]. A preliminary version of the feasibility study has been completed[64].

Tierp
In May 1998, the municipality of Tierp, next to the municipality of Östhammar, was asked by SKB to cooperate, as SKB wanted to expand the Östhammar feasibility study to parts of Tierp. In June 1998 it agreed[65]**.**

Hultsfred, Älvkarleby and Nynäshamn
In May 1999, the municipality of Hultsfred, close to Oskarshamn, decided positively on a feasibility study. In June 1999, Älvkarleby, neighbouring Tierp, agreed to cooperate. SKB asked the municipality of Nynäshamn, southeast of Stockholm, to show interest. The council has not taken a decision yet (as of July 1999)[66]**.**
So, up until now, apart from municipalities showing only initial interest, eight have agreed to be candidate for feasibility studies, and one has yet to decide. Two of the municipalities (Mala and Storuman) withdrew when the local public voted against further steps in a referendum. Nyköpping, Östhammar, Oskarshamn, Tierp, Hultsfred and Älvkarleby are the six candidates left (later possibly also Nynäshamn) for the next phase of test drillings, that should take place at two of these, at least. At the moment, no referendums are yet planned for any of the municipalities. It might be that they want to wait for the outcome of the final

feasibility reports. Municipal councils could also wait until site drilling results have been completed. The referendums in Storuman and Måla were held in an early stage. Other municipalities may decide to wait until more research results are known[67].

9. THE NATIONAL CO-ORDINATOR FOR NUCLEAR WASTE DISPOSAL

Four municipalities (Malå, Nyköpping, Oskarshamn and Östhammar) initiated the idea of a National Co-ordinator for Nuclear Waste Disposal. In a government decision of 15 May 15 1996, Olof Söderberg was appointed to this function for a three-year period, ending 30 June 1999[68].
The task of the National Co-ordinator is mainly to co-ordinate information and investigation work. The governmental decision states: "The task involves promoting co-ordination of information and investigating inputs found necessary by municipalities affected by Svensk Kärnbränslehantering AB's (SKB) studies concerning siting of facilities for spent nuclear fuel and nuclear waste." In its decision, the government emphasized that the formal responsibility for finding a solution is for the reactor owners, and thus SKB. The government states that the proposal for a national co-ordinator "does not in any way relieve the reactor owners of responsibility for handling and finally disposing of the spent nuclear fuel and nuclear waste"[69].
The National Co-ordinator has to propose forms for information exchange and co-ordinate between municipalities and county administration. As the government has advised SKB to make 5-10 feasibility studies as a basis for future selection of a repository site, the national co-ordinator also has made contacts with municipalities in an early and informal way, with the aim of interesting them for contacts with SKB. However, such activities do not in any way relieve SKB from its responsibility in the site selection process[70].
His main task should thus be the co-ordination of information flow in all stages and not to find interested municipalities or negotiating with them on the conditions for feasibility studies. He should be an "independent point of contact at the Cabinet Office for representatives from municipalities that would like information on the implications of participating in feasibility studies". This is also meant for individuals wanting information[71].
On request of the municipalities, the national co-ordinator set up a discussion forum called "National EIA Forum for Nuclear Waste Disposal". This informal forum should discuss the forms and contents of a future Environmental Impact Assessment process that has to be conducted in order to make an Environmental Impact Statement (EIS), necessary as part of the license request for construction of an underground laboratory[72].
In the phase of setting up the forum, around the end of 1996, Swedish EIA regulation was a recent invention and partly not quite clear. Municipal representatives interpreted the legislation as a possibility to have influence on SKB's work, while environmental groups saw it as a possibility to question the whole legal structure with SKB as the responsible entity.

In June 1997, an informal session was held with environmental groups, municipality representatives, SKB and other authorities. Environmental organisations wanted broader discussions than only SKB's study results. They wanted a discussion about the legal responsibilities of SKB, the procedure of decision-making, and actually a stop of SKB's work.
After having questioned the democratic representation of the elected municipal representatives, the municipal officials stated that they saw no point in further discussions with environmental groups. They also believed that the national level of environmental groups had urged local organisations to boycott local discussion groups. As the forum was an initiative of the municipalities, the national co-ordinator had to follow their will and environmental organisations were not invited for further meetings[73].
The National EIA Forum now has representatives from SKB, the four municipalities, county administration boards[74], SKI, SSI, Swedish Environmental Protection Agency, the National Board of Housing, and the Swedish Association of Local Authorities, and is chaired by the national co-ordinator[75].
The three main issues that were identified for discussion were: alternative options for disposal other than KBS-3, site selection criteria and related issues to the KBS-3 concept[76].
The alternative option included a zero alternative, when no disposal site would be made. The siting issue dealt with aspects like site selection criteria, feasibility studies, the structure of decision-making for the choice for two sites for site characterization, etc. It should also come to conclusions on when and how concerned parties, like municipalities, should be involved in the decision-making process. The KBS-3 related issues include alternative sites for the encapsulation plant, canister research and retrievability[77].
The National EIA Forum was planned to meet about two to four times a year and the memorandums from the

meetings should be publicly available. Special drafting committees could be formed to study certain issues before they are discussed in the forum. Members of drafting committees are mostly chosen forum members[78].
In autumn 1997, a drafting committee was formed to discuss the alternative options issue from an ethical perspective. The drafting committee included members from the municipalities, the county administration, and was chaired by a member of KASAM. At a June 1998 discussion in the forum, it was underlined that discussions from the ethical perspective should also take place at local levels. After the discussion, it was concluded that the present generation is responsible for finding an optimum solution based on now known technology. However, because of the long-term perspective of disposal, the consequences of the present choices are uncertain. The disposal concept should therefore be in a way that future generations can make other choices for it[79].
The results of this discussion were published in a booklet in Swedish and is intended to form a basis for discussion, for instance in feasibility municipalities[80].
The memorandums of the forum meetings have also been sent by the national co-ordinator to five environmental and nature organisations (the Waste Chain, People's Campaign against Nuclear Power / Nuclear Weapons, Greenpeace, Friends of the Earth and the Swedish Nature Conservation Society)[81]. The latest meetings of the forum were held in October 1998 and January 1999. The interest of the municipalities has shifted to other urgent issues, such as SKB's R&D Programme 1998 and the new Environmental Act[82].

Two more times, environmental organisations had a meeting with the national co-ordinator. In the fall of 1998, environmental organisations and concerned parties in the municipalities under evaluation were invited for a meeting on SKB's R&D report 1998. However, groups were divided about the pros and cons of taking part. So some accepted and others declined the invitation. Another meeting was held in February 1999, where again criticism of SKB and the KBS-3 method was raised. Much of the discussion was focused on the decision-making process and the roles of the regulatory authorities, the national co-ordinator, local governments and environmental groups.
The meetings are not always perceived as being constructive or of any influence. To quote a representative of environmental groups: "I have more and more come to suspect that the authorities look upon these meetings with environmental organisations as a purely therapeutic exercise. Therapeutic in the sense that they give anxiety-ridden, naive and disruptive elements (that's us!) an opportunity to vent, under appropriate constraints, their irrational feelings and frustrations. The authorities, for their part, sit back and listen and speak reassuringly to us in hopes that after the session we will go home and put our fevered minds to rest and let the experts get on with their important work."[83]
The EIA process is still less regulated and undergoes changes. In January 1999, a new EIA regulation was adopted which included provisions for environmental organisations for a role in preparing an EIS. And a new "Environmental Code" prescribed that the opinions of environmental organisations have to be considered seriously. SSI, SKI and KASAM have asked the government to give organisations some sort of support to give them the possibility to "provide well-founded advice"[84].
As the national co-ordinator had been appointed for the period of three years, ending June 30, 1999, his task officially ended at that date. In a government decision of June 1999, his task was reformulated, the name changed into "Special Advisor for Nuclear Waste Disposal", and he was appointed for another three years. Again, the co-ordination of information and investigation work is emphasized. The government decision recognised that his function should be clarified and the tasks more specifically defined, as desired by reviewing bodies and the National Co-ordinator himself. It also said that his function "should be more closely linked to the government offices"[85].

10. SUMMARY

Sweden has 12 nuclear power reactors and has a policy of a nuclear phaseout, although there are no deadlines. Low- and intermediate-level wastes from the nuclear program are stored at the final disposal site SFR in Forsmark, located below the bottom of the Baltic Sea. High-level waste, spent fuel, is stored at the interim near-surface CLAB facility in Oskarshamn.
SKB, responsible for waste management, developed the KBS-3 concept for the final disposal of spent fuel in an underground repository. First construction work for a repository should start around 2010 and should include a limited possibility of retrievability. Only after the first five-year demonstration period can the canisters be retrieved.
After the earlier failure to find a suitable site, SKB introduced the concept of voluntariness. It invited

municipalities to show interest in conducting a feasibility study. SKB wanted to conduct at least five feasibility studies, after which it will select two sites for test drillings, to start from 2002. Around 2010, an underground repository should be constructed at one site. Up until now, eight municipalities have shown interest, either by volunteering themselves or after an invitation from SKB. In two of these sites, Malå and Storuman, referendums were held and both voted against the plans. Now, feasibility studies have been completed or are underway at six other sites (Nyköpping, Östhammar, Oskarshamn, Tierp, Hultsfred and Älvkarleby), all of them having nuclear activities in their own municipality or in a neighbouring municipality. Possibly, Nynäshamn will be a candidate soon as well. All of these still have the opportunity to withdraw. Environmental groups have warned that the system of volunteering has the risk that not the safest site is selected, but one where there is an overall acceptance from a social point of view.
In 1996, a National Co-ordinator for Nuclear Waste disposal was appointed to co-ordinate the information flow between the different authorities and municipalities. Apart from being an information source for interested municipalities, he set up a National Environmental Impact Assessment (EIA) Forum. This forum, which does not include representatives from environmental organisations, should discuss the contents of the EIA that is necessary for constructing the underground repository.

11. CONCLUSIONS

1. Retrievability (still) plays a minor role in the KBS-3 concept as it is only guaranteed for five years. It might be more difficult to gain public acceptance for the KBS-3 concept as environmental groups and the public often emphasize the importance of controllability and accessibility.
2. Environmental groups have criticized the idea of voluntariness. And indeed it can be questioned whether the safest site is found in the underground of a "nuclear municipality" or some other volunteer. Another risk is the hurry with which SKB wants to proceed.
3. The exclusion of environmental groups, upon the behest of the concerned municipalities, in the National EIA Forum can later lead to new conflicts, when the EIA procedure really starts.

SOURCES:

1- M. Löwgren, "Nuclear Waste Management in Sweden: Balancing Risk Perceptions and Developing Community Consensus", In: Ed. E.B. Herzik and A.H. Mushkatel, "Problems and Prospects for Nuclear Waste Disposal Policy", Greenwood Press London, 1993, p. 106
2- M. Löwgren, p. 106-107
3- M. Löwgren, p.108-109.
4- M. Löwgren, p. 109.
5- Three options were to be chosen from: 1-Yes, nuclear energy is an option, twelve reactors can operate till 2020; 2-Yes, nuclear energy is an option, the twelve reactors can operate till 2010 and more research should be done on energy saving and renewable energy; 3-No, nuclear energy is no option, the use of the then present six reactors should be stopped within ten years and substantial investments in energy saving and renewables. The results were: option 1: 18.7 percent; option 2: 39.4 percent; and option 3 gained 38.6 percent. So, the use of nuclear energy would be ended no later than 2010 with a maximum of 12 reactors.
6- E-mail Olof Söderberg to Robert Jan van den Berg, 2 July 1999.
7- "The Present Situation and Prospects for Radioactive Waste Management in the European Union", Commission of the European Communities, 11 January 1999, p. 85.
8- WISE News Communique, 2 July 1999, p. 3.
9- "Radioactive waste management programmes in OECD/NEA Member countries; Sweden", OECD/NEA, 1998;
10- Sweden had some reprocessing contracts with Sellafield and La Hague. A total of 140 MT of fuel was sent to Sellafield and 57 MT to La Hague. After intense protests against the reprocessing policy the government decided to stop exporting fuel and in 1985 it tried to get back the fuel from La Hague. The reason was that it would be easier for final storage to have spent fuel instead of reprocessed vitrified high-level waste. In June 1986, a trade agreement was made between Sweden, France and Germany. Germany became owner of the 57 tonnes of Swedish fuel and in exchange Sweden accepted 24 tonnes of spent fuel from Germany, actually being spent Mixed Oxide Plutonium fuel (MOX). The transports were accompanied by several protest actions in German and Swedish ports. There are now plans to reprocess the Sellafield amount and use the plutonium in MOX-fuel. Source: Nuclear Fuel, 28 June 1999, p. 7-8.
11- OECD/NEA, 1998.
12- The abreviations used are taken from Swedish.
13- OECD/NEA, 1998.
14- OECD/NEA, 1998; Telephone conversation with Olof Söderberg, July 1999.
15- OECD/NEA, 1998.
16- "The Present Situation and Prospects for Radioactive Waste Management in the European Union", Commission of the European Communities, 11 January 1999, p. 86 and 90.
17- Nuclear Fuel, 6 April 1998, p.12.

18- "LLRW Disposal Facility Siting; successes and failures in six countries", A. Vari, P. Reagan-Cirincione and J.L. Mumpower, Kluwer Academic Publishers, 1994, p. 202.
19- "Disposal of nonstandardised packages in SFR", M. Skogsberg; in "Distec'98 Proceedings", International Conference on Radioactive Waste Disposal, Hamburg (FRG), 9-11 September 1998, p. 429-430.
20- Telephone conversation with Olof Söderberg, 1 July 1999.
21- OECD/NEA, 1998.
22- Nuclear Fuel, 6 April 1998, p.12.
23- SKB, Activities 1997, p.19.
24- OECD/NEA, 1998.
25- "The Present Situation and Prospects for Radioactive Waste Management in the European Union", p. 87.
26- OECD/NEA, 1998.
27- OECD/NEA, 1998.
28- "LLRW Disposal Facility Siting; successes and failures in six countries", A. Vari, P. Reagan-Cirincione and J.L. Mumpower, Kluwer Academic Publishers, 1994, p. 198.
29- In 1982 the Social Democrat government replaced the 1976 Stipulation Act by the new Act On Nuclear Activities. The industry was no longer asked for an "absolute safe disposal" as a requirement for starting up nuclear reactors. If research was promising, a start-up permit could be given. This change was criticized by anti-nuclear groups.
30- WISE News Communique, 13 August 1999, p. 8-10.
31- M. Löwgren, p.107-108.
32- M. Löwgren, p. 114.
33- "Nuclear Waste in Sweden; The Problem is Not Solved!", K.I. häll, e.a., 1998, p. 28.
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35- SKB, "This is How We Manage Sweden's Radioactive Waste: Activities 1997", p. 9.
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40- SKB, Activities 1997, p.28.
41- K.I. häll et.al., p. 43-45.
42- Nuclear Fuel, September 30, 1993, p. 10.
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44- "RD&D-Programme 98", SKB, September 1998, p. 70-71.
45- "The role of the decision-maker - whoever that might be", O. Söderberg, National Co-ordinator for Nuclear Waste Disposal, Ministry of Environment, contribution to a NEA workshop 13-15 January 1998 in Villigen, Switzerland.
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47- "Public Involvement in the Siting of Contentious Facilities; Lessons from the radioactive waste repository siting programmes in Canada and the United States, with special reference to the Swedish Repository Siting Process", P.J. Richardson, Swedish Radiation protection Institute (SSI) report 97:11, 1997, p. 28.
48- "Nuclear Waste; Disposal Technology and Site Selection", KASAM, 1996, p. 27.
49- "Nuclear Waste and the Environment", contribution Anders Fredriksson, Greenpeace, p. 244.
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51- Nuclear Fuel, February 23, 1995, p. 12.
52- "The role of the decision-maker", O. Söderberg
53- "The role of the decision-maker", O. Söderberg
54- "The role of the decision-maker", O. Söderberg.
55- Richardson, p. 28.
56- "The role of the decision-maker", O. Söderberg.
57- E-mail Olof Söderberg to Robert Jan van den Berg, 2 July 1999.
58- "The role of the decision-maker", O. Söderberg.
59- "The role of the decision-maker", O. Söderberg.
60- P.J. Richardson, p. 28.
61- "The role of the decision-maker", O. Söderberg.
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63- "Nuclear Waste and the Environment", contribution Tomas Kaberger, Sw. Society for Nature Conservation, p. 251.
64- E-mail Olof Söderberg to Robert Jan van den Berg, 2 July 1999.
65- "Local decision-making; facing issues of national interest", O. Söderberg, 7 September 1998.
66- E-mail Olof Söderberg to Robert Jan van den Berg, 2 July 1999.
67- Telephone conversation with Olof Söderberg, 1 July 1999.
68- "Encouraging ethical considerations - one important task for a National Co-ordinator for Nuclear Waste Disposal", O. Söderberg, Contribution to the International Symposium on Radioactive Waste Disposal, Stockholm, 31 August - 4

September 1998.
69- "Government Decision", Ministry of Environment, 15 May 1996 (unofficial translation, October 1996).
70- E-mail Olof Söderberg to Robert Jan van den Berg, 2 July 1999.
71- "Work Programme; for the period of January 1, 1998 - June 30, 1999", National Co-ordinator for nuclear waste disposal, February 24, 1998 (unofficial translation, April 1998).
72- The county administrative boards are, in the EIA process, responsible for contacts between municipalities and governmental organisations. In Kalmar county (Oskarshamn) an EIA discussion forum was set up and includes members from the county administration (chairman and secretary), SKB, SKI, SSI and Oskarshamn municipalitiy. Other authorities, organisations and neighbouring municipalities can be co-opted. Uppsala county (Östhammer) formed a reference group for information exchange, including the Östhammer municipality and three neighbouring ones, the province and county boards of land, the National Co-ordinator, SKB, SKI, SSI and other governmental authorities. The Södermanland county (Nyköping) did not form a special forum but held meetings on the EIA process and invitations were sent to municipalities, county boards, SKB, SSI, SKI, KASAM, the National Co-ordinator and local groups of the Society for Nature Conservation. The Västerbotten county includes the municipalities of Storuman and Mal . In the time of Mal being considered as a possible site, the county board organised public meetings and discussions with municipalities. When Mal would have decided to continue with siting studies, the county board would have set up a forum for discussion, including municipalities, authorities and environmental organisations.
73- E-mail Olof Söderberg to Robert Jan van den Berg, 2 July 1999.
74- The county administrative boards are, in the EIA process, responsible for contacts between municipalities and governmental organisations. In Kalmar county (Oskarshamn) an EIA discussion forum was set up and includes members from the county administration (chairman and secretary), SKB, SKI, SSI and Oskarshamn municipalitiy. Other authorities, organisations and neighbouring municipalities can be co-opted. Uppsala county (Östhammer) formed a reference group for information exchange, including the Östhammer municipality and three neighbouring ones, the Province and county boards of land, the National Co-ordinator, SKB, SKI, SSI and other governmental authorities. The Södermanland county (Nyköping) did not form a special forum but held meetings on the EIA process and invitations were sent to municipalities, county boards, SKB, SSI, SKI, KASAM, the National Co-ordinator and local groups of the Society for Nature Conservation. The Västerbotten county includes the municipalities of Storuman and Mal . In the time of Mal being considered as a possible site, the county board organised public meetings and discussions with municipalities. When Mal would have decided to continue with siting studies, the county board would have set up a forum for discussion, including municipalities, authorities and environmental organisations.
75- "Encouraging ethical considerations...", O. Söderberg.
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77- "Work Procedures and Premises for Discussion in the National EIA Forum on Nuclear Waste Disposal", National Co-ordinator for nuclear waste disposal, February 6, 1998 (unofficial translation of April 1998).
78- "Work Procedures and Premises for Discussion in the National EIA Forum on Nuclear Waste Disposal", National Co-ordinator for nuclear waste disposal, February 6, 1998 (unofficial translation of April 1998).
79- "Encouraging ethical considerations...", O. Söderberg.
80- Fax from Olof Söderberg to Robert Jan van den Berg, 30 June 1999.
81- "Work Programme; for the period of January 1, 1998 - June 30, 1999", National Co-ordinator for nuclear waste disposal, February 24, 1998 (unofficial translation April 1998).
82- Fax from Olof Söderberg to Robert Jan van den Berg, 30 June 1999.
83- WISE News Communique, 13 August 1999, p. 8-10.
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8. SWITZERLAND

KEY FACTS

Nuclear Power: Five nuclear power reactors; 3.0 Gwe; 40% Gen. Cap.; 1990 referendum: no new reactors build before 2000; NPPs close in the years 2009-2024; two new referendums planned on life-time and new capacity.
Waste (present): 10,000 m^3 L/ILW (nuclear energy 80%, non-nuclear 20%); L/ILW stored at NPP or PSI Wuerenlingen (non-nuclear); storage spent fuel at NPP or reprocessing plant UK/France.
Waste (future, cumulative): 100,000 m^3 L/ILW; ± 500 m^3 HLW and 2,000 m^3 TRU; L/ILW disposal at Wellenberg (?); HLW from 2000 at storage ZWILAG Würenlingen, at least 40 years, disposal yet unknown (research ongoing).
Waste authorities: Nationale Genossenschaft für die Lagerung von Radioaktive Abfälle (NAGRA), government (non-nuclear), Genossenschaft für Nukleare Entlagerung Wellenberg (GNW).
Retrievability: elements of retrievability foreseen for Wellenberg, unknown periods.
Dialogues (among others): referendum 1995 rejected Wellenberg with 54%; possibly new referendum in future; "Energy-Dialogue Disposal" failed, no consensus reached; new discussions on retrievability expected.
Key issues: choice for Wellenberg remarkable since it was not in initial list; new referendum expected for Wellenberg, including elements of retrievability; disagreements on future of nuclear energy overshadowed public discussion.

Introduction
In Switzerland, there is an ongoing discussion about the suitability of Wellenberg for the storage of low- and intermediate-level waste. A referendum has been held whose results rejected the proposal, but the location remains an issue of discussion: possibly a new referendum will be held in which retrievability will play an important role. That is the first subject of this chapter. The second subject is the "Energy Dialogue" of 1998, where experts of different backgrounds tried to reach consensus on the management and disposal of nuclear waste.
For this chapter, mainly information from governments, environmental organisations and the Nagra ("Nationale Genossenschaft für die Lagerung radioaktiver Abfälle" (National Company for the Storage of Radioactive Wastes) were used. A draft version of this chapter was commented upon by Armin Braunwalder, director of the Schweizerische Energie-Stiftung (SES, Swiss Energy Foundation); Prof. Hans Ruh, chairman of the Energie-Dialog Entsorgung (Energy-Dialogue Disposal); and Urs Frick of the communications division of the Nagra.

1. NUCLEAR POWER PROGRAM

Because of a 1963 governmental decision to be less dependent on fossil fuels, nuclear power plants were built. The oldest came into commercial operation in 1969, the latest in 1984[1]**.** Three pressurised and two boiling water reactors are now operating and have a capacity of 3,000 MWe and produce 40% of generated electricity (the rest is hydro power).
On five occasions, a referendum was held on the issue of nuclear energy. The latest was on 23 September 1990, when the people decided to implement a 10-year moratorium on the building of new nuclear reactors, but voted against the closure of the existing plants[2].
In 1998, about 40 environmental organisations took the initiative for two new referendums. The first referendum, which was called "Strom ohne Atom" (Electricity without Atoms), proposed the closure of the reactors Beznau 1 and 2 and Mühleberg within two years. The second referendum, called "Moratorium Plus", asked for a limitation of the lifetime of nuclear power plants to 40 years and was against the building of new reactors[3]. The existing reactors will reach the 40-year age around 2009 to 2024[4].
By October 1999, the environmental organisations are expected to present 100,000 signatures to the government to let the referendums take place. It will be a countrywide referendum. Apart from that, cantonal and communal referendums can take place. To let these take place, a much smaller number of signatures is needed[5].

Referendums can also be held on the storage of nuclear waste. The law gives several possibilities of public input, for instance through referendums on a number of issues: on preparing activities and the undertaking of test drillings, on the realisation itself of an underground storage site, and on the moment a storage site will definitely close[6].

2. PRODUCERS OF RADIOACTIVE WASTE

The nuclear power reactors produce most of the radioactive waste, including waste from reprocessing of spent fuel abroad and from the dismantling of nuclear installations. In Geneva, a particle accelerator at CERN is operated that produces radioactive waste, and later also dismantling waste. Apart from this, there is waste from other research and hospitals.
Of the existing radioactive waste, 80% of the volume comes from nuclear power and 20% from (CERN) research, industry and hospitals. On the share of hospitals, no separate figures have been published[7].

3. CATEGORIES OF RADIOACTIVE WASTE

Three types of radioactive waste are distinguished:
- low- and intermediate-level waste;
- long-lived intermediate-level waste; and
- high-level waste.

For these three waste types Switzerland plans two repositories. One would be for the low- and intermediate-level waste (LILW) which produces almost no heat, such as the production waste from nuclear reactors, waste from the industry, research and hospitals.
The second repository is planned for heat-generating high-level waste (HLW) and long-lived intermediate-level waste (i.e., alpha-emitting intermediate-level waste (TRU)) from reprocessing of spent fuel.

4. AMOUNTS OF RADIOACTIVE WASTE

4.1 Present amounts

To date, some 10,000 m^3 of radioactive waste have been produced: 4,000 m^3 production waste from nuclear power reactors, 4,000 m^3 reprocessing waste (that is still abroad) and 2,000 m^3 waste from industry, research and hospitals[8]. Between 1969 and 1982, some 5,300 MT were dumped in the ocean[9].
A rule of thumb is that 99% of the volume of conditioned waste is of the category low- and intermediate-level waste and 1% high-level, while 99% of the activity is high-level and 1% low and intermediately active[10].

4.2 Future amounts

Taking into account a production time of 40 years for every existing nuclear power reactor, 100,000 m^3 low- and intermediate-level waste would be produced. Of this, 24,000 m^3 would come from reprocessing, 12,000 m^3 from plant operation, and 43,000 m^3 from dismantling. Some 21,000 m^3 low- and intermediate waste from industry, research and hospitals would be produced[11].Other figures speak about 80,000 m^3, of which 15,000 m^3 would be from industry, research and hospitals[12]. The differences are caused by changes in estimations about the possibilities to condition radioactive waste and compressing techniques[13].
The nuclear power reactors also give:
1. 3000 MT of spent fuel (high density, roughly 10 MT/m^3; if all this would be reprocessed, which is highly unlikely, 500 m^3 of waste glass in 2000 flasks could be expected (no overpack).
2. Some 2000 m^3 of conditioned TRU waste are expected from reprocessing (there is no permit for this, but a so-called "Becquerel Swap" is still being debated by reprocessing plants and utilities, as the reprocessing plants would like to send back to Switzerland, instead of the ILW-barrels, a small additional amount of vitrified HLW waste)[14].

5. WHERE IS IT STORED?

Spent fuel is first stored in the cooling basins (pools) of the nuclear power plants. After transport, it may be stored at the reprocessing plants until reprocessed. Reprocessing wastes (long-lived intermediate-level and

high-level) are still abroad awaiting transport.
In 1990, the operators of the nuclear power plants founded the ZWILAG (Zwischenlager Würenlingen AG) for the interim storage of reprocessing waste or spent fuel that is not being reprocessed, the high-level waste glass as well as other types of radioactive waste. The facility consists of eight buildings located within the area of the Paul Scherrer Institute (PSI), less than two kilometers away from the Beznau nuclear power plant. The PSI is one of the few facilities in Switzerland where nuclear research is being conducted on a larger scale[15].
The ZWILAG was able to buy a piece of ground from the government--the owner of the PSI--and has obtained approval from the municipality of Würenlingen. After a six-year license procedure, the government issued the license on 21 August 1996, and construction work started five days later. Animated discussions have been, and still are, present about this storage. Much protests has come from the neighbouring South German areas.
The ZWILAG facility was accepted by the local government, but one can hardly speak about broad public acceptance[16].
The storage of spent fuel from the nuclear power plant Leibstadt and canisters with high-level reprocessing waste will begin in February-March 2000[17].

The low- and intermediate-level waste is currently stored at the nuclear power plants which still have variable but limited capacity for storage. If a low- and intermediate-level waste repository could not be built in the next decade, additional central storage facilities will have to be constructed at the ZWILAG site--or the storage capacity of the plants will have to be increased. The first possibility is considered as ground being reserved near the PSI[18]. (The disposal of high-level waste is not that urgent because it has to cool down for at least 40 years. Research is being conducted and in 2001 a survey is expected on the possibilities for final disposal of this waste[19]).
According to the law, the federal government is responsible for the storage of waste from industry, research and hospitals. In 1984, the decision was made to build an interim storage at the PSI site. After a delay of five years, this storage--the Bundeszwischenlager (the federal interim storage)--became operational in 1992. Its capacity of 5,000 m^3 is sufficient to store the waste that will be delivered until 2010[20].

6. RESPONSIBILITIES

As mentioned above, the federal government, according to law, is responsible for the storage of waste from industry, research and hospitals. According to a 1972 decision, the operators of the nuclear power reactors are responsible for the management and storage of their nuclear waste. In that year, these operators and the federal government together founded the Nagra, in which the operators have a share of approximately 95%. According to Swiss law, the wastes have to be stored within the borders of Switzerland, but for the long-term the option of an international storage is open for high-level waste, due to economic reasons[21]**.** Recently, Nagra President Hans Issler pointed to this possibility of international storage, especially for high-level wastes[22]. For instance, the Nagra already has a 10% share in the international company Pangea Resources Australia Pty Ltd., that wants to establish such an international disposal site in Australian deserts[23].
Environmental organisations fear that export will result in a shift of nuclear waste abroad. They see it as a recognition by the Nagra that the present waste policy has failed in Switzerland. Peter Steiner of the Komitee für die Mitsprache der Nidwaldner Bevölkerung bei Atomanlagen (NMA, Committee for the Involvement of the Nidwalder People Near Nuclear Installations) also points to the fact that country borders in Europe were formed quite arbitrarily and that therefore no discussions can be exluded[24]. The Nagra does not agree with this judgment: "That is what amateurs, and not national as well as international experts, say. Swiss ordinances and guidelines prescribe the same strict limits for the Swiss people as for any population, wherever waste is being disposed of"[25].
As a result of a governmental decision, a levy of 1 Rappen (0.01 Swiss Franc; Dfl 0.014) per kWh is paid for the interim and final storage of nuclear waste[26]. In early 1998, SF 6,700 million (Dfl 9,250 million) was set aside, of which SF 2,200 million (Dfl 3,010 million) has already been spent. The money is not managed by the Nagra but by the operators of the nuclear power reactors[27]. The operators estimate the costs for the storage of nuclear waste at SF 13.7 billion (Dfl 18.7 billion), but the Schweizerische Energie-Stiftung has calculated that this will be insufficient and pleads in favour of more funds[28].

7. WELLENBERG

The discussion about the storage at Wellenberg is relevant to the Netherlands because of the role of "retrievability of waste" and "Kontrollierbarkeit", i.e., long-term monitoring of a repository, which is under discussion in Switzerland.
In 1978, the Nagra started a selection process for low- and intermediate-level waste. Among others, the following criteria were used in this. The volume of the storage site should be sufficient. Disposal near the surface, that depends highly on technical barriers, is excluded because of the high density of population in Switzerland and a lack of thin populated areas, according to the government. The disposal in the deep underground has to be safe, without the necessity of long-term supervision. From the beginning, retrievability was therefore excluded. The choice for locations should take place on grounds of safety, and after the collection of sufficient data for this. Issues like infrastructure should play a minor role. If different locations could meet the criteria, then further research would be required.
From a list of 100 locations originally, the Nagra chose 20 in 1981. An evaluation gave three preferred locations: Bois de la Glaive (anhydrite), Oberbauenstock (marl) and Piz Pian Grand (gneiss). At the end of 1983, the Nagra asked permission for further research at these locations. On 30 September 1985, a license was issued but with certain conditions. The government only allowed test drillings and other research. Construction of a shaft was postponed until after the drillings at the three locations shall have been completed[29].
In 1987, the Nagra added to the list the location Wellenberg, near the municipality of Wolfenschiessen in the canton Nidwalden. At this location, the disposal could be conducted horizontally as well as vertically through accesible caverns and shafts. Another criterion for Wellenberg was--apart from the expected big volume and the good possibility to exploit from the earth's surface--the possibility to ship the waste by train. A disadvantage was the lack of available geological knowledge at that time[30].

Wellenberg was not on the original list of 100 locations, but Niederbauern which was close to Wellenberg indeed was on it. The Nagra now presents Wellenberg and Niederbauern to be one and the same location. In the period 1981-1983, the Nagra wanted to make speed and thus available knowledge was an important criterion in its choice. Therefore, Wellenberg-Niederbauern was placed at the end of the list, stated the Nagra. When later, more time seemed to be available, the lack of knowledge could be made up by an extensive research. According to the Nagra, with this the mentioned advantages of Wellenberg became valid[31]. On 31 August 1988, a license for extensive research was issued. It concerned the entrance shaft as well as the construction of the disposal mine itself that would costs SF 50 million (Dfl 69 million)[32].
Peter Steiner, representative of a regional action group, disagreed with the Nagra's presentation of the location choice. He said: "Everywhere Nagara wanted to conduct test drillings there was resistance. Hugo Waser, at that time an important administrator of the canton Nidwalden, made contact with the Nagra. In January 1986, the Nidwalden council decided to offer its canton to the Nagra for the storage of nuclear waste. A consideration in this was the fact that it was a structurally weak region which needed employment. The Nagra accepted the offer. We thought it concerned the location Niederbauern. However, the Nagra conducted research in the whole canton and selected Wellenberg as location. This came as a surprise, the more so since Wellenberg did not meet the criteria to be a location that could easily be researched. We are doubting the criteria for location choice. For instance, there are no criteria to exclude a location. That makes it possible to adjust the criteria on the basis of the results found. With this, it is not a clear and controllable process. That is one of our objections to the choice for Wellenberg"[33]. The Nagra reacted by saying: "So what? That's Steiner's activist view and is not a qualified statement."[34]
Research at the different locations faced resistance and could sometimes begin only after a long delay. This was the reason the Nagra could not choose Wellenberg earlier than 1993 as number one. The Nagra considered Wellenberg suitable because of safety reasons, the influence of the environment, but above all the sufficient storage capacity. The available storage capacity at Oberbauernstock would be just enough. At Bois de la Glaive there were questions about safety and at Piz Pian Grand, the tranport routes were less suitable than at Wellenberg[35].
For the building and management of Wellenberg, the Nagra founded the GNW (Genossenschaft für nukleare Entsorgung Wellenberg, or Company for nuclear disposal Wellenberg).

In the discussion about Wellenberg, critics of the project stated that the storage should be retrievable and controllable. The Nagra had strong doubts about this, but "the way and means of how certain amateurs planned retrievabilty and controllability was in contrast to existing guidelines from the authorities. Nevertheless, the Nagra and the GNW acknowledged that these are political issues which can be addressed by slightly adjusting the existing repository concepts"[36].

The discussion finally resulted in a June 1995 referendum, in which a majority of Nidwalden voted 52:48% (overall turnout was 72%) against a combined proposal, namely, to receive the state concession for an exploration drill plus repository construction. Given the distribution of powers in Switzerland, the storage had been abandoned with this outcome. The Nagra called it a serious setback[37].
The Nagra studied the voting behaviour of the people. It seemed that people, voters as well as non-voters, cared about the referendum. Mostly, the people informed themselves by magazines (72%), television (42%), radio (32%), conversations with relatives or family (29%), brochures (20%) or attending information hearings (16%). Only 4% did not inform themselves[38].
Main arguments to vote against were: lack of safety, fear for the future, and being principal opponent to nuclear energy. Only recently, the Nagra recognised that it underestimated the "emotions" of the people[39], as well as the campaign carried out on the TV, where the pro-Wellenberg people were left with a highly negative image[40].
Another aspect was the combined request for building an access research shaft and the building of the storage. The disposal concept included the direct closure of the storage caverns; in that way, retrievability might be costly. The Nagra studied how the citizens of Nidwalden would have voted if the license only covered the research shaft and not the building of the storage mine itself; and, secondly, what if the aim for retrievability and controllability had been followed. It seemed that in that case, 61 percent would have voted in favour of the storage in Wellenberg[41].
From this, the Nagra concluded that it would be worthwhile to ask for a new license, with a step-by-step implementation of the storage, in which decisions about closure of the disposal would be postponed. Future generations themselves would then have the possibility to decide[42]. So the Nagra did not want to give up Wellenberg and retrievability would give perspectives as "there exists an 'angepasstes Entsorgungskonzept' (adapted disposal concept) which left the control and the decision for backfill to future generations. It only required minor modifications of the waste emplacement procedures. The question then remained, what could happen within the life-time of men and what parameters could be monitored? This was the theme that was discussed among experts 10-15 years ago within the framework of activities in the Swedish underground facilities Stripa and Äspö. Within the possible timeframes and strict safety measures, there were no convincing concepts available for long-term monitoring"[43].
The government agreed with the Nagra. Swiss Minister of Energy Moritz Leuenberger announced to the canton Nidwalden in December 1996 that he considered Wellenberg suitable and not to have it excluded by a new referendum. After this, the council of Nidwalden, the Regierungsrat, agreed with a constructive cooperation[44].
A working group with all those involved should deal with the questions of a new referendum. The federal government and the canton council would require the storage to be retrievable and controllable. On 5 March 1997, the working group was formed by the government. In this group, some ministries, local and regional governments, supervising governmental authorities and opponents of the storage could participate. Opponents of Nidwalden and Swiss environmental organisations refused to participate[45]. Armin Braunwalder said: "A proponent of nuclear energy became chairman of the working group. And the goal of the working group was to turn back the results of the referendum. We, who won the referendum, did not feel like giving up our victory. Therefore, the environmental groups that acted as one group did not join the working group. I explained why we did not cooperate. I declared to be, and have been, indeed in favour of an international congress on the storage of nuclear waste. We also wanted a broad discussion at the national level. But they did not react on this"[46].
In the view of the Nagra, this was "a highly distorted view. The activists most probably did not cooperate because they had no realistic, useful and safe technical measures to support their often idealistic demands. Technical propositions can be scrutinized by the extisting national--and also international--expert guidelines. Activists had to avoid this due to common lack of know-how."[47]
The working group started two sub-groups, on technical and on economic aspects. The report on technical aspects was released on 15 April 1990 and the one on economic aspects in June 1998. The conlusion was: there were good technical as well as economic reasons to proceed with Wellenberg[48]. The storage should meet the criterion of retrievability and controllability[49]. The government announced that it would decide on Wellenberg Entsorgung" became available[50]. Although the results were now available (see next paragraphs), the government has taken no decisions up to now.
Steiner thinks there will be no new referendum: "The council of Nidwalden is no longer a proponent of the storage. And when a new license request will look like the old one, the council will refuse the request and not propose it to the people in a new referendum. If it comes to a new proposal, we will again try to let the

storage be rejected"[51].

8. "ENERGY-DIALOG ENTSORGUNG" (Energy-Dialogue Disposal)

8.1 Background and procedure

In June 1997, the Swiss government recognized that there remained open questions on energy politics that would have to be studied in detail by a broadly composed working group. The management and storage of radioactive waste was one of the open questions. On 10 February 1998, the working group Energie-Dialog Entsorgung, chaired by Professor Hans Ruh of the Zürich University, started. Since the 1970s, Ruh has published works about ethics and energy.

The working group had the task to answer questions about the management and disposal of radioactive waste, and make proposals for a consensus on these aspects. The working group was composed of 14 members coming from operators of nuclear power reactors, the Nagra, environmental organisations and the ministries involved[52].

Ruh explained that "according to the government, a decision should be made about the future energy supply and the future of nuclear energy. For each open question, the government has formed a working group. The ministries participated because they were dealing with the problem and must conduct policy. Such a broadly composed commission that is directed towards consensus is of typical Swiss culture"[53]. After earlier doubts, the environmental organisations which acted as one group joined in. "A long time it has been: firstly, a policy to stop the use of nuclear energy and then discussing the storage. That was explained as a refusal to talk. We questioned what could be the results of participation in a working group. We saw it as a chance to bring in our arguments in an offical framework. Afterwards, the participation was worthwhile as our position was in the final report," says Braunwalder[54].

According to the procedures agreed upon, at the end of 1998 a final report should be available. The working group itself could decide about study methods and, in limited amounts, give research orders. Experts could be invited and hearings held. The task of the secretariat was done by the Ministry of Energy[55]. According to Ruh, the working group discussed storage concepts from foreign countries, but not their procedures to reach consensus: "In Switzerland one says: 'there are referendums to solve conflicts'. Only now, they are thinking of methods for discussion[56]."

Until the end of September 1998, the working group had met seven times. Experts were heard on ethical questions about the use of nuclear energy, about arguments pro and contra retrievable disposal and about reprocessing versus direct disposal. The operators of nuclear power reactors and environmental organisations brought in reports. Representatives of the government prepared proposals to reach consensus, Ruh says. No consensus could be reached on essential questions. It was the goal that the participants should together prepare a final report, but because of lack of agreement, in fact no report could be released. Therefore Chairman Ruh, in accordance with the tasks of the working group, himself made a final report[57]. This was not without criticism. For instance, the environmental organisations issued 10 pages of criticism on the concept's final report[58]. In the following, we discuss two aspects of the report.

8.2 The obstacle of nuclear energy

One of the main obstacles to the attempt to reach consensus was the connection of disposal of nuclear waste with the use of nuclear power reactors. Prof. Ruh remarked that the theme of nuclear energy was beyond the mandate of the working group. But a decision to stop the use of nuclear energy would make it easier to discuss the storage of nuclear waste. Therefore, the working group did discuss the future of nuclear energy[59].

All members of the working group agreed that a referendum on the building of new reactors would be useful. The reactor operators, however, refused to talk about putting a stop to nuclear energy as a precondition for a solution for the nuclear waste. And this precondition was exactly what the environmental organisations wanted to hold onto[60].

Ruh tried to find a solution for this problem by seeking an agreement on ethical starting points: "I suggested proposals. In the beginning it looked hopeful, but as the discussion proceeded, it seemed that the operators wanted a solution for the nuclear waste problem as soon as possible to keep the nuclear power reactors open for another 20 years. Then the environmental organisations remarked on the unsolved problem of storage of nuclear waste and wanted to prevent the storage at Wellenberg."

Ruh had difficulties with the posture of the operators: "One of the operators said that opponents of nuclear energy would be responsible for a human disaster that exceeds Auschwitz. The reasoning was that if people opposed nuclear energy, there will be less energy available for, say, food production, and that would give

rise to famine. Such a statement did not contribute to the willingness of environmental organisations to reach a consensus"[61].
Till the end, Ruh tried to reach consensus. He proposed to limit the lifetime extension of reactors to a maximum of 10 years. If it were more than 10 years, this would require a referendum. This proposal, however, was unacceptable to the environmental organisations. Braunwalder emphasized that it concerned a guiding choice: "We should now determine which energy supply we want to use in the future. The longer we keep nuclear reactors in operation, the more chances we lose. We should give a clear signal, also for the investors. Therefore, we cannot agree to operate nuclear power reactors until the year 2025. And our attitude was also inspired by the tough and polemical way of discussion by the operators of nuclear reactors and the Nagra. They were not prepared to change their attitude and were not looking for a consensus"[62].
The Nagra disagreed strongly: "This is an unwarranted statement showing the typical arguments of various interest groups such as photovoltaic or geothermal lobbyists. And for a long time now, the Nagra's philosophy is to avoid polemics, at least this is what we employees are told."[63]

8.3 Future generations and retrievable storage
The working group had different opinions on how to give content to responsibilities to future generations. The operators of nuclear power reactors (who had the same points of view as the Nagra and GNW on all the cases mentioned below) aimed at a definite solution which will bring no problems to future generations. In their view, it is the present generation that has benefited from nuclear energy and therefore should be responsible for finding a solution that should also be safe if future generations are no longer willing or capable of maintaining the disposal. In their view, this is for the benefit of future generations. That means a choice for definite disposal. In the opinion of the Nagra, this is not a choice against retrievability: "Waste is always retrievable, whatever disposal concept is chosen. It's merely a matter of effort to do it. The Nagra may be against "retrievability" as viewed by activists, as its concept does not meet the criteria for final disposal but rather corresponds to infinite interim disposal. The "Angepasste Lagerkonzepte" allow for a politically accepted time, some "control" by man (whatever that should mean) and easier removal of waste containers. This can be implemented for L&ILW as well as HLW without changing the basic repository concepts."[64]

The environmental organisations stated that with the production of nuclear waste, a situation had been created that can not be turned back anymore, with consequences for thousands of years. With this, the present generation limits the freedom of action of future generations. By storing nuclear waste in a definite form, this freedom is even more restricted. Retrievable and controllable storage keeps open some freedom of action for future generations from the viewpoint of new technologies or the possibility to repair possible damage of storage canisters[65]. "But there is no word on the notorious unreliability of human society which, in the long run, is clearly unsuited for idealistic wishes. The right places in geology are far, far more reliable than any human society. Even on a historical time scale", is the reaction of the Nagra[66].
The working group could reach no consensus about this coherence between responsibilities to future generations on one hand and the question of non-retrievable storage, on the other hand. The operators pointed to the fact that retrievable storage needs societal control and thus a stable society. Environmental organisations considered retrievability to be a pre-condition in any form of storage. Also, beacuse of the fact that it is almost impossible to predict the behaviour of nuclear waste in the long-term. The representatives of the ministries stated that there should be further research on retrievable and controllable storage. That concept has been less worked out than definite disposal and therefore no good comparison could be made between the two concepts. Everybody agreed with this proposal[67].
Steiner referred to the fact that the concept of "controlled and retrievable storage" had not crystallised yet. For instance, the question has not been answered whether such a storage should be aboveground or underground: "We think that all aspects of this concept should be studied thoroughly. We should know better which storage can be controlled the best. That might be a storage at 50 metres' depth. That study should be conducted by a group of international experts whom we trust. And the study should not only consider technical, but also ethical and social issues. The Nagra can participate, but should not be allowed to be the main performer, because we have little trust in the Nagra."
Steiner also considers the Nagra's criticism of retrievable storage to be heavily overdrawn: "A long-term interim storage is planned. So the argument that a war could break out and could destroy the storage site also applies to an interim-storage."[68]
But what if there is no money left to control the storage? Steiner compares it to the problem of avalanches in Switzerland: "We are here dealing with avalanches. We take measures against such disasters. When we, as a

country, would come to the idea to neglect this issue, then it will take revenge upon us. And we have to spend a large sum of money anyway to repair the damage. For me, the control of the storage of nuclear waste is a similar obligation as measures to prevent avalanches. But we have to reserve much money for this, and that hardly happens"[69].

There was no agreement on further working out the concept of controlled retrievable storage with the storage of low- and intermediate-level waste. A majority of the representatives of the ministries were of the opinion that the Wellenberg repository should be realised soon with an adapted concept. The operators of reactors supported this proposal even as the environmental groups rejected it. According to Prof. Ruh, this difference of opinion lay very clearly in the fact that the operators want Wellenberg and want a solution at the soonest possible time. In their view, the realisation of Wellenberg is a political condition for the continuation of nuclear energy. The environmental groups, for their part, do not want to improve the political framework for nuclear energy. This goal, as well as the attempt to prevent the disposal being built at Wellenberg, is the principal issue and their arguments are adapted to this, according to Ruh[70].
As a result of the Ruh report, the Nagra felt strengthened in its opinion to stick to the concept of definite disposal. According to the Nagra, controlled storage is too unsure[71]. The GNW has announced it is for the adaptation of the storage concept at some points. After storage, the mine would initially remain open. During some generations, the waste would easily be accessible and stored safely. Next generations have the possibility to keep the storage mine open or to close it definitely or to choose another option. The GNW further announced it is planning to bring into the attention of a broad public the safety shortcomings of the "controlled storage"[72].
Steiner points to the half-hearted attitude of the Nagra and GNW: "On one hand they want retrievable and controlled storage to make possible a new referendum on Wellenberg. On the other hand, they disagree with our concept. But we see the political motivation behind the vision of the Nagra and the GNW. You can say that each mountain has its own climate, and say that each has a system of water streams. The geology of Wellenberg is such that with the creation of shafts, waterstreams in the direction of the shafts could be developed. This is shown in recent studies. If you would store nuclear waste there and want to close the mine after 100 years, than you have to deal with a water problem. Given the geology of Wellenberg, retrievable storage means problems to future generations. This is why we oppose a new referendum on Wellenberg. We want a new discussion about the waste problem, apart from the question of where such waste should be disposed of."[73]
These are "totally unqualified and ridiculous statements of an uninformed person," the Nagra says, "and these statements indicate an ignorance about what the Nagra has really done, building up know-how at the expense of large amounts of money, together with Swedish, Finnish, American, French, Canadian and whatever partners. Steiner has not the slightest knowledge and education to assess what has really happened in the Wellenberg marl. This marl is on a scale of a few meters on up as impermeable as a rock ever can be, so no water shall move on a relevant scale. We spent tens of millions of francs to be sure of that."[74]

9. SUMMARY

In 1972, the federal government and the operators of nuclear power reactors founded the Nagra, in which the operators have a share of 95%.
In 1978, the Nagra started choosing locations for low- and intermediate-level wastes. In 1981, Nagra chose 20 from a list of initially 100 locations to conduct further research. Evaluation of these locations gave three preferred locations: Bois de la Glaive, Oberbauenstock and Piz Pian Grand. In 1987, the Nagra added to the list the location Wellenberg near the municipality of Wolfenschiessen in the canton of Nidwalden. Wellenberg was not on the initial list of 100 locations. Niederbauern, which is close to Wellenberg, was on that list.
The research at the different locations have faced resistance and could sometimes begin only after a lot of delays. This resulted in the fact that the Nagra chose Wellenberg as number one, as late as 1993.
The storage plan was rejected in a referendum. If the storage would have been controllable and retrievable, the majority might probably have voted in favour.
The continuation of nuclear energy was a big obstacle to reaching consensus among different parties on the issue of management and storage of nuclear waste. Although the use of nuclear energy was not included in the mandate of the working group "Energie-Dialog Entsorgung" (Energy-Dialogue Disposal), the working group could not avoid this issue and it was put on the agenda. No consensus could be reached and this had an effect on all the discussions.

On the question of giving content to the responsibilities for future generations, the points of view also differed. From this responsibility, the operators and the Nagra choose for final disposal. The environmental organisations stated that retrievable and controllable storage gives the best options of handling to future generations. These organisations want this storage method to be worked out further.

10. CONCLUSIONS

1. The Nagra chose the location Wellenberg for the storage of low- and intermediate-level waste. Wellenberg was not on the initial list of 100 locations. It is remarkable that a choice was made for a location that was initially not considered.
2. The Nagra sticks to Wellenberg, regardless of the outcome of the referendum. With a new storage concept, that includes elements of retrievability, the politicians are trying to hold a new referendum. The politically different opinions will not solved with this. A new referendum on Wellenberg will increase the present conflict.
3. The discussion about storage of nuclear waste in Switzerland is overshadowed by disagreements about the future of nuclear energy. Discussions about nuclear waste are difficult without clearness on the future of nuclear energy.

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9. UNITED KINGDOM

KEY FACTS

Nuclear Power: 35 nuclear power reactors; 12.8 Gwe; 26.5% Gen. Cap.; since 1995 policy no new capacity.
Waste (present): LLW – 4,180 m^3 conditioned and 1,000,000 m^3 disposed of at Drigg; ILW – 2,180 m^3 conditioned and 59,300 m^3 unconditioned; HLW – 78 m^3 conditioned and 1,560 m^3 unconditioned; very-LLW (non-nuclear) disposed at landfills; Totally 1,060,000 m^3; LLW disposed at Drigg surface disposal; ILW stored at Sellafield (reprocessing waste, 65%), or at NPP; HLW stored at Sellafield and Dounreay.
Waste (future, cumulative): LLW – 2,820,000 m^3 (including present disposed at Drigg); ILW – 255,000 m^3; HLW – 1,480 m^3; Totally 3,080,000 m^3; LLW disposal at Drigg until about 2050; initial plan to dispose ILW at deep disposal, no plans existed for HLW; new government policy is developed for future strategy.
Waste authorities: Royal Waste Management Advisory Council (RWMAC), advisory body; Nuclear Industry Waste Management Executive (NIREX), responsible for only L/ILW disposal.
Retrievability: initially only considered for operational period of disposal site; new policy government expected.
Dialogue (among others): public objections in RCF licensing procedure, plans rejected in 1997; 1997-1999 - House of Lords inquiry on waste management policy, broad input, main conclusion: deep repository within 50 years; House of Lords conclude decide-announce-defend strategy failed, new bodies advised, possibly introduction of voluntariness; 1999 - Consensus Conference by Citizens Panel; panel rejects deep disposal and choose for full retrievability; subsurface storage chosen as protection against human influence and climate changes; panel has strong belief in transmutation.
Key issues: secrecy on RCF selection criteria did not create public confidence; Sellafield wrongly chosen on "nuclear culture" grounds; 50-year goal House of Lords criticized by environmental organisations, can lead to new conflicts; no possibility to withdraw for volunteering municipality, little attraction to cooperate; limitation of site inquiries to only site issues can cause conflicts; Citizen's Panel composed by other individuals would have come to other conclusions?; panel tried to combine isolation at depth and easy retrievability of aboveground storage; technical feasibility and problems unknown to panel; retrievable deep disposal chosen as favourable by government?

Introduction

After the 1997 decision to reject the plans for an underground Rock Characterisation Facility (RCF) in Sellafield, the government is now preparing for a review of its nuclear waste policy, to be conducted from the end of 1999. In this chapter we will concentrate on the RCF siting process, the parliamentary inquiry by the House of Lords Select Committee on Science and Technology and on the outcome of a Consensus Conference.

Several documents were studied for this chapter concerning the three issues that will be described. The Consensus Conference was visited by one of the authors; it gave him the opportunity to speak with several stakeholders. Comments on the draft text were given by Fred Barker, member of the Radioactive Waste Management Advisory Committee (RWMAC), though in a personal capacity, and by Rachel Western of Friends of the Earth UK (FOE).

1. NUCLEAR POWER PROGRAM

In 1947, the UK's nuclear technology program actually started to develop nuclear weapons. By 1953, the government was fretting over the prospect of coal shortages and the power of the National Union of Mineworkers. It ordered four Magnox reactors for the site at Calder Hall, next to Sellafield, later followed by 22 more at other sites. Because of inefficiency of the Magnox reactors, a new generation called Advanced Gas-Cooled Reactors (AGRs) was developed. A prototype opened in 1963 and a total of 15 AGRs went into operation. The first, and only, Pressurised Water Reactor (PWR) was built in Sizewell. Apart from these types, two breeder reactors and a heavy-water reactor had been in operation. At present 35 of these reactors are still in operation and 10 were shut down in the past[1]. Since May 1995, it has been government policy not to build any new nuclear power plant[2]. Two commercial reprocessing plants are in operation in Sellafield: one for Magnox fuel and the Thorp facility for uranium oxide fuel from AGR's and water-cooled reactors from foreign countries.

Nuclear energy has now a share of 26.5% in the UK's electricity production and a generating capacity of 12.8 GWe. Eight of the power stations are run by British Energy which was privatized in 1966, with its subsidaries Nuclear Electric and Scottish Nuclear. The older Magnox stations remained in the public sector because of the very high liabilities (dismantling, reprocessing and waste management costs)[3]. The decommisioning of aging reactors could run up to BP£ 18 billion (Dfl 60 billion), members of parliament warned[4]. Six of the Magnox stations are run by Magnox Electric and two others by British Nuclear Fuels (BNFL)[5].

2. PRODUCERS OF RADIOACTIVE WASTE

As the UK has an extensive nuclear energy program, most of the waste in storage or disposal comes from this source. Only 1 volume percent comes from hospitals and industry, including isotope production facilities.
In May 1996, a waste inventory (up to 1994) was published, made on request of Nirex and the Department of the Environment. Seven main producers were identified. Nuclear Electric and Scottish Nuclear run the nuclear reactors for British Energy. BNFL operates some older Magnox stations and has facilities for enrichment, fuel fabrication and reprocessing. The UK Atomic Energy Authority is responsible for waste from its research facilities. Urenco owns an enrichment plant in Capenhurst. Amersham International operates two isotope production facilities for use in industry or hospitals. And finally the Ministry of Defence produces radioactive waste in its nuclear weapons program and submarine bases[6].

3. CATEGORIES OF RADIOACTIVE WASTE

The UK has four main categories of radioactive waste: high-level or heat-generating waste (HLW); intermediate-level waste (ILW); low-level waste (LLW) and very low-level waste (VLLW).
Most of the spent fuel that arises is being reprocessed. For Magnox metallic fuel the choice was made to reprocess it, also because it is difficult to store it for long periods due to corrosion vulnerability, especially when it has been wet-stored once. For half of the AGR spent fuel to be produced, contracts were made with BNFL for reprocessing. No contracts were made for the fuel from the Sizewell PWR[7].

4. AMOUNTS OF RADIOACTIVE WASTE

4.1 Present amounts

According to the above-mentioned inventory, as of April 1994, 78 m^3 of vitrified HLW had been stored, and 1,560 m^3 HLW was in storage in an unconditioned form, as highly active liquid waste. For ILW, 2,180 m^3 had been conditioned and 59,300 m^3 still has to be. LLW in conditioned form totals 4,180 m^3 for the 1994 stocks. The "present" amount of LLW looks very small in the figures because the waste that was "disposed of" at the Drigg and Dounreay facilities is not calculated as "waste in stock". When we include this waste it will be about 1,000,000 m^3 of LLW[8]. The category VLLW was not explicitely mentioned in the inventory and is included in the LLW category.
In the inventory, spent fuel and plutonium from reprocessing is not accounted for as it is not seen as a waste but as a useful resource. Of course, it will later end as HLW or ILW from reprocessing if all fuel will be reprocessed. Also not included are the uranium stocks that arise from reprocessing and enrichment.

4.2 Future amounts In 1996 it was estimated that the following waste amounts will arise and be stored in the future (after being conditioned): HLW - 2,280 m^3; ILW - 289,000 m^3 and LLW - 1,910,000 m^3 (excluding LLW that was disposed of at Drigg). This total of 2,200,000 m^3 will include the present (up to 1994) amounts.
In making up the 1994 inventory, however, it was assumed that eight further PWRs would be built in the future and a life-time extension of facilities beyond what was committed at that time (fuel manufacture and reprocessing facilities). If the number of reactors would not be expanded and no life-time extension would take place, which could be assumed, the total volumes would be less. For HLW, about 1,480 m^3, for ILW 255,000 m^3 and for LLW about 1,820,000 m^3[9].
Uranium stocks, reprocessed uranium and depleted uranium from enrichment, could run up to 100,000 MT and plutonium up to 150 MT when it would not be re-used[10].

5. WHERE IS IT STORED?

VLLW is waste that contains less than 4 Bq/g activity. It mainly arises in materials that contain natural activity, for instance in the ore-processing industry. It is mostly disposed of at landfills. Due to local opposition, the government decided not to encourage greater use of that method, although it is still used by non-nuclear industries[11].

LLW is "disposed of" at Drigg, a surface disposal facility near Sellafield where waste is buried. Some LLW can not be placed at Drigg because of its specific volume, activity or chemo-toxicity. This is mainly stored at Sellafield, or elsewhere. Drigg's use already started in 1959 and in its earliest phase it consisted of trenches in which the waste was simply buried and covered with sand. A 1985 government inquiry learned that the operator BNFL used a philosophy of "dilute and disperse" and that it was sometimes unclear what was actually dumped. As late as the end of the 1980s, improvements were made like concrete vaults and impermeable layers[12]. Drigg will receive more wastes for the coming decades. It is said that its "radiological capacity" would be reached around 2050. That would say that by that time no more activity could be added anymore because of possible long-term radiological impact on the environment, as this is the vision of the operator[13].

ILW is for the biggest part (65%) stored at Sellafield. Mainly it is fuel cladding that comes from reprocessed fuel elements and other contaminated reprocessing equipment. Other ILW is on-site stored at research facilities and nuclear power stations. The strategy at the nuclear station sites is to keep it on-site. When the station would be decomissioned, a special building called "safestore" would be built around the reactor part as a kind of sarcophagus, 30-35 years after having closed the reactor. Within this building, the ILW could be placed, after which the building would remain in place for another 100 years, when final dismantling would take place.

Most of the HLW arises at reprocessing in the form of liquid waste or later, after conditioning, vitrified high-level waste. These wastes are stored on site at the Sellafield and Dounreay reprocessing plants[14].

6. RESPONSIBILITIES

For the disposal of nuclear waste an authorisation according to the Radioactive Substances Act 1993 is needed from the Environment Agency (England and Wales) or the Scottish Environment Protection Agency (Scotland), that both operate under the national Department of Environment. For operating and managing a waste facility a license according to the Nuclear Installations Act 1995 is to be granted by the Nuclear Installations Inspectorate (NII), part of the Health and Safety Executive (HSE) under the Department of Trade and Industry[15].

In 1978, the Radioactive Waste Management Advisory Committee (RWMAC) was set up. It has to advise government and consists of experts from different disciplines, including nuclear, medical and environmental.

In 1982, the Nuclear Industry Radioactive Waste Management Executive was founded, that became UK Nirex in 1985. It is responsible for research and implementation of a disposal site for LLW and ILW, not for HLW.

7. HISTORY OF WASTE POLICY

After a 1976 report by the Royal Commission on Environmental Pollution (RCEP), it was government's policy to create a disposal site as a long-term solution of the waste problem. The Department for the Environment was made responsible for this task.

In 1979, first test drillings were taken at Altnabreac (Scotland) and Harwell in a search for a place for HLW disposal. These drillings were stopped in 1981 due to public opposition.

In 1982, Nirex was established with the task to implement disposal facilities for LLW and ILW. In 1983, Nirex announced it had selected a clay site in Elstow for a subsurface repository for LLW and short-lived ILW. Besides, it had chosen a disused anhydrite mine at Billingham for the disposal of long-lived ILW. Protest by local citizens and the owner of the mine let the government drop the idea. A year later, the government decided to investigate three possible sites for near-surface disposal and another three for deep disposal. In 1986, Nirex announced to have selected four sites for the near-surface facility: Killingholme, Fulbeck, Bradwell and Elstow. The government announced in a policy paper that only LLW could be placed in such an underground disposal. At that moment there was still no official policy for underground disposal of HLW. Aboveground storage for 50 years was the only strategy.

For economic reasons, the policy was changed again in 1987, when it was decided to place both LLW and ILW together in a deep disposal site. The four selected sites for near-surface disposal therefore were dropped[16].
During the late 1980s, Nirex had initially identified 500 possible locations for deep disposal. Reviewing these sites, the amount was narrowed to 120, then to 39 and finally to 11[17]. At present, the list of locations is still secret, both the "long list" of 500 sites and the "short list" of 11. Until now, NIREX has refused to make both lists public[18]. Sellafield was later added to the list of 11 for consideration. It was thought that the presence of four nuclear reactors (Calder Hall) and the reprocessing plants would have created an "existing nuclear culture", which would lead to an easier acceptance of a waste repository. In 1989, Nirex announced to have chosen Sellafield and Dounreay as potential sites for deep disposal and started test drillings, two at each site. In 1991, Dounreay was dropped due to the reason that most wastes arose in Sellafield[19].

8. SELLAFIELD ROCK CHARACTERISATION FACILITY (RCF)

A 1986 government White Paper (policy document) on the siting issue said: "Nirex have made it clear from the outset that they will make available the data gathered from the geological investigation of the four sites, which will enable its validity to be checked independently. They will also want to involve the public as fully as practicable in their further work." At that time, the Cumbria County Council was content with the consultation commitment for the general situation of site selection.
But when, in March 1989, Nirex announced that it had selected Sellafield as a potential site, the council was disappointed. Details of the selection criteria were not made public and the community itself was not informed about the process. In the council's view, the site was not selected because of favourable geological conditions but by the thought that the surrounding communities would have a "measure of support"[20].
In 1994, the RWMAC and the Advisory Committee on the Safety of Nuclear Installations (ACSNI) conducted a review of the followed approach. It was government's reaction to the growing concern that Sellafield was the only site left for research. From the opponents it was argued that the promised "open and transparant approach", as mentioned in the 1986 White Paper, had not been carried out. In its 1995 report the study group concluded: "The general view was that the current process of site selection and site characterisation, and the criteria on which site selection is based, are not sufficiently transparant to ensure public confidence. From the evidence presented therefore public safety is considered to be the paramount issue in siting a repository." The study recommended a change of the procedure and the creation of an Independent Commission to oversee the process. With this and using clear disqualifying criteria, 10 to 12 sites had to be found in which in an early stage consultation should start. That should be conducted by the proposed independent commission. The commission should select three sites for test drilling and including public hearings, after which it should recommend to the government which site was favourable[21].
In the 1995 White Paper on waste management, the government made clear that it did not consider to follow the recommendations. Although it recognised the need of transparancy, the idea of public consultations at 10 to 12 sites was found to be impracticable. Besides, apart from only geological criteria the government considered the issue of transports and the issue of costs as a relevant factor in the site selection. The idea of an independent commission was not welcomed as this would "diminish the responsibility of the waste producers and create confusion", between regulators, communities and the commission[22].
To qoute a reaction of the Cumbrian County Council Manager for Environmental Planning: "The good intentions have been present in policy and remain there to an extent in the 1995 White Paper, with the right buzz words used, 'openness', 'transparancy', 'publication of results' and so on." Nirex was considered not open and transparant enough, the working culture to be too much goal driven instead of driven by the needs of science or the need to build community trust[23].

In 1994, the planning application for the RCF was submitted by Nirex and an inquiry started in 1995. In March 1997, the Secretary of State for the Environment decided to reject the proposal. He based his decision on a report of the inquiry inspector. Two main reasons had made him to take the decision: "straightforward planning matters" and reasons "particular to the RCF", concerning scientific uncertainties and technical difficulties of the proposal. The straightforward planning matters concerned the visual impact of aboveground constructions, traffic and natural conservation. The particular reasons concerned a lack of knowledge about hydrology and geology, a doubt whether the best location was chosen and the potential damage the RCF construction itself could have on the future repository zone[24]. According to the inspector, too little was known about chemical retention mechanisms of leaked isotopes and the isolating effect of vault

backfill. The possible build-up of gases due to degradation of waste and containers formed another uncertainty. On one hand it should not lead to dangerous pressures in the repository zone, on the other hand it could form a transport mechanism for radionuclides through fractures[25]. Other underlying reasons that were mentioned were concerns about the process of selecting the site and its suitability. It would be more geologically and hydrogeologically complex than expected[26].

9. HOUSE OF LORDS SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

Procedure

Because of the failure to get permission to construct a research laboratory at Sellafield, no practical plan for a future disposal site for LLW and ILW was present. The government decided to start an inquiry, to be conducted by the House of Lords Select Committee on Science and Technology. This inquiry on the "management of nuclear waste" took place from 1997 and its report was released in March 1999. Whereas the history of siting was concentrated on finding a disposal site for LLW and ILW, the House of Lords process did concentrate more on ILW and a strategy for HLW[27].

One of its first actions was a call for evidence that were received from "witnesses", both as written comments as well as from hearings. A total of 119 individuals, organisations and authorities gave evidence. Comments were from a broad range of groups, varying from the nuclear industry, community councils, regional and country-wide environmental groups, individuals, etc[28].

Deep disposal or surface storage?

For the nuclear industry, deep disposal is the preferred option for the long-term. But the industry also emphasized that time is not pressing. It thinks that waste can be stored in surface facilities for decades. And when a deep repository has been realised, the wastes could be kept monitored and retrievable for another period of a few decades, during the operational phase of the repository.

Environmental organisations, however, have a contrary opinion. For Greenpeace, surface storage is "the least environmentally damaging and most responsible option" available at present. In future, better options can be chosen based on better knowledge of the environment and improved technologies. Greenpeace explicitly stated to be opposed to deep disposal as this "inevitably involves future contamination of the environment". A similar view is held by FOE UK, which sees aboveground storage for the next 50-100 years as the only practicable way forward, in combination with scientific research. With this, future generations are able to judge about better solutions. Both for Greenpeace, FOE UK and other environmental groups, the closure of nuclear reactors and a ban on reprocessing are a vital part of future waste policy[29].

In its final conclusions, the Lords Committee recognised a too much fragmented management strategy. The policy for ILW differs from that of HLW, and for certain materials it is still unclear whether these could be seen as re-use materials or as wastes. Thus, it concluded that a fully comprehensive strategy was needed for all wastes. For instance, a clear policy is needed for plutonium from reprocessing, with a minimum strategic stock and the rest to be declared as waste.

For the Lords Committee, the preferred approach is geological disposal. Such an underground repository should include a certain degree of retrievability, during the period of emplacing wastes and doing scientific research. According to the Lords Committee, one or more deep repositories should be operational within 50 years, as otherwise a replacement program should be started for existing storage sites[30].

Public acceptability

For the realisation of such repositories, public acceptability is considered to be essential, "but achieving it will be difficult". Uncertainty, inherent in long-term risks and a level of distrust in certain organisations are some of the reasons for this. Many of the witnesses criticized the nuclear industry for not being open enough, where the RCF inquiry was mentioned as an example in which Nirex often refused to give data. The Lords Committee recognised that there is no one general "public perception" and that they change in time, but that there is "no simple means of changing them". More openness and transparency is needed to build trust, but other mechanisms also are needed. Referring to the past, it concluded that the earlier strategy of "decide, announce, defend" had failed. To overcome the problem of local acceptability, the Lords Committee suggested "supporting measures" as a means of compensation for accepting a waste repository[31].

In its final conclusion, the House of Lords Committee repeated that: public acceptance is essential; openness and transparancy are necessary to gain trust, but in themselves are not enough; and "offering compensation [...] would do much to achieve acceptance"[32].

Governmental policy
The Lords Committee concluded that there is a need for an overall policy, that should be laid down in a new bill and undergo Parliamentary debate and decision. Before this, a proposal should be made, in the form of a "Green Paper" (policy document) for public review.
The Lords Committee recommended to set up a new body, the "Nuclear Waste Management Commission" (NWMC) to oversee the national program. In time, it could possibly replace the existing RWMAC. As a first task it should undertake the consultations on the Green Paper. Its members should be appointed by the Secretary of State and should have "a wide range of backgrounds"[33][34] **.**
A second body suggested is the "Radioactive Waste Disposal Company" (RWDC), which in time would include the work that Nirex is doing. The company should be responsible for site selection and the construction of the disposal site. The company itself would be a nuclear industry organisation.
The method of site selection differs not that much from earlier attempts, apart from the aspect of voluntariness. Initially, the RWDC would use desk studies to identify a "long list" of 15-20 potential sites. From this, a list would be made for possible field investigations. The final list for test drillings is "derived by consultation or by using a volunteering aproach". But this volunteering approach has an important limitation. Once the field investigations have begun, the local community cannot withdraw anymore as government would take the final decisions. Only after the final selection would a public inquiry start. According to the Lords Committee, this inquiry should be less extensive than previous inquiries, and be limited to local impact issues. It argues that broad issues, as the national policy, would be under discussion in developing the new bill[35].

Critical reactions on the outcome
With the strong choice to proceed with the quick realisation of deep disposal, the report got critical reactions from nuclear critical groups. The proposed recommendations on the other hand got support as well. As Nuclear Free Local Authorities (NFLA), a coalition of nuclear critical local councils, said: "Despite important flaws, the Lords' report makes some useful proposals. It also provides a guide to many of the issues that will be exposed to public scrutinity once the Government review--and subsequent public consultations--begins." According to the NFLA, too little attention was given to the "main alternative to deep disposal--interim surface storage combined with research on longer-term options". They hope it would be included in the review of the Green Paper by consulting proponents of this concept.
The idea to let the new NWMC conduct the consultation on the Green Paper was not welcomed. NFLA would rather have the proposal for the commission itself being subject of the Green Paper consultation, as it will be an important commission that will oversee the national policy. The recommendation that the proposed RWDC should be a nuclear industry organisation could mean a risk that it will be difficult to reach public trust, in contrary to when it would be an independent company. That Nirex work is to be handed over to the new company, however, was welcomed as Nirex had built little credibility.
For NFLA, the recommendation that a volunteer community in site selection can not withdraw once field investigation had begun, was a guarantee for future conflict and dispute. Instead of this proposal, NFLA refers to international experience where communities have more abilities to withdraw at any stage and final decisions are made by a local referendum.
Overall conclusions of NFLA were: the consultation on the Green Paper should not be rushed; all relevant issues should be included, also reprocessing; siting should not be pushed through and more attention should be given to international experience with voluntariness; and the government should consider whether acceptance might be more easily reached by establishing a phased closure programme for the nuclear industry: "it may be a necessary prerequisite for achieving social consensus on the long-term management of radioactive wastes"[36]**.**
FOE UK criticised the main conclusion to proceed with a deep disposal strategy and feared that it could only lead to a costly repeat of Nirex's failure at Sellafield and stated that: "deep disposal remains a concept which can only be considered compatible with sustainable development if the actual practical, scientific and technical realities are ignored".

They referred to a 1995 White Paper that said that "decision should be based on the best possible scientific information and analysis of risk" and that "no fixed Government deadline should be set for the completion of this process". This was ignored by the House of Lords Committee.
Referring to the "precautionary principle" of sustainable development, FOE UK called "retrievable disposal" to be a "contradiction in terms". The concept of retrievability is still in a rudimentary state. Earlier, the Department of Environment had asked the Lords Committee for further advice on that issue, but when the Lords reported, it only said that it "should be able to retrieve the waste if this became necessary". Key

questions how to achieve, at what costs or risks, were not answered. Retrievability needs special design measures, structural materials to prevent collapse of a repository, no backfill can be used, equipment must be replaced over time, a decontamination facility. This all could double the necessary costs, thinks FOE UK. With present technology, only aboveground retrievable storage would be realistic.
The Lords Committee waived away the idea of interim surface storage as that would be a too big risk, concerning societal stability. But FOE UK pointed to the fact that the Lords Committee had no critique on the dismantling strategy for nuclear reactors, that assumes aboveground storage for over a century. And the argument could also be applied to other parts of the nuclear industry: "It may be seen that concerns over the reliance that may be placed on the stability of society brings into question the acceptability of the whole of the nuclear industry".
On the question how to build public trust in governments policy, FOE UK considered the Lords Committee's conclusions too much goal driven, as the chapter on that issue "is marred by its presumption that the outcome of the consultation excercise would be a phased approach to geological disposal". Like the NFLA, it thought that the proposed NWMC should be subject of the coming public consultation. The idea to compensate hosting communities raises an ethical dilemma. Future generations that will be exposed to radiation are not the ones that benefitted from the money offered. FOE UK feared that compensation was only being used to realise a disposal site, as of course is the proposal of the Lords Committee.
The main conclusions of FOE UK were: the fundamental lesson that was learned by the outcome of the RCF Inquiry, that is, the models used for predicting radioactivity releases from a repository were unreliable, was not recognised by the Lords' Committee; the Lords Committee failed to adopt an interim approach to develop a scientifically robust long-term solution and thus a 50-100 years monitored and retrievable aboveground storage; and to solve the shortcomings of earlier disposal proposals, the Lords Committee introduced retrievable disposal, which is impossible thinks FOE UK.
As a final remark, FOE UK said: "The Lords report cannot be seen as the basis of the way forward for long term radioactive waste management policy. Following the Lords recommendations in this area would simply result in a repeat of the mistakes of the past."[37]

10. CONSENSUS CONFERENCE

Procedure

After the release of the Lords Committee report, a Consensus Conference was held in London, 21-24 May 1999. The organisation for the conference started in the summer of 1998. The conference was organised by the UK Centre for Economic and Environmental Development (UK CEED), in conjunction with the Science Museum. It was the second Consensus Conference being held in the UK, the previous one being on plant biotechnology.
The conference actually consisted of a Citizens' Panel that had to make up its opinion on the nuclear waste policy, after having studied relevant literature and having heard selected witnesses at the conference itself. The panel was not forced to reach an actual consensus, but rather to search for the extent to which they could agree.
The main aim of a Consensus Conference was to influence policy by having a dialogue between citizens, experts and politicians. The conclusions of the panel are not officially binding for any party, but it is said that worldwide experience of panels proved to be influential on development of policy[38].

The first initiative was to set up an advisory committee of nine members. The committee had to consist of a balanced group of experience [39] and should oversee the whole process. It had to define the broad scope, select the method for recruiting the panel and make a list of possible witnesses. The panel itself could choose the witnesses to be heard. Apart from the advisory committee, a facilitator was appointed. His task was to monitor group dynamics, ensure all members have a fair say and helping in writing the final report. He explicitly should not in contents contribute to the discussions or the report.
The panel was selected by firstly selecting randomly 4,000 names from the national election register. These persons received a letter with an invitation to become a panel's member, without mentioning the topic of the conference. The 125 people who reacted positively were told what the actual topic was and what was expected from them, after which 70 people became the final candidates for the Panel. A group of 15 people finally formed the panel.
In preparation of the conference, the panel members received an information package and held two preparatory weekends. The information package was compiled by the advisory committee and had to be a balanced set of information. The preparatory weekends had the goal to get known to each other and get an

overview of the relevant issues. It had to result in key issues, to be discussed at the conference and a selection of witnesses to be heard.
To prepare a list of potential witnesses, a letter was sent to people that submitted evidence in the House of Lords inquiry, the RCF inquiry and a 1984 Nirex consultation. Those again were asked to do suggestions for further witnesses. The panel could choose on the basis of the registration forms, filled in by the potential witnesses.
At the conference, the first two days were used for discussing the key questions and hearing the witnesses. At the third day, the panel met behind closed doors to work on the consensus statement, that was presented at the press conference at the fourth day[40].

The Conference
The hearings for the Consensus Conference took two days. A number of 32 witness hearings were held on nine key questions. In the nine sessions, the witnesses had the possibility to give a short introduction, after which the panel members could ask further questions. During the hearings, it became clear that the panel gave priority to the asking of questions to witnesses. The witnesses' presentation contained more general introductions, where the panel had already in its preparatory weekends read and discussed a lot of information[41]**.**
Some questions raised among environmental groups were about the balance between pro-nuclear and anti-nuclear witnesses. Of the 32 hearings, only six can be said to come from anti-nuclear, being sessions from Greenpeace UK, FOE UK and freelance consultant Dr. Sullivan[42]. For instance, the hearing on the future of nuclear energy question consisted of two witnesses that can be said to be pro-nuclear. A British Energy representative and a safety consultant held a presentation strongly in favour of nuclear energy. After asking a question about the selection of these two witnesses, the panel answered that apart from the conference, a lot of information was studied before and its balance had been correct. And secondly, that the safety consultant had not worked in the nuclear industry and the panel had selected him as an independent witness. The panel could not answer the question why it had not, exactly for this nuclear energy hearing, asked for an anti-nuclear witness to gain some balance[43]. FOE spoke about a "mishandling" of that question[44].
Besides the unbalanced witness list, it was also a fact that among the public at the conference there were more representatives of government and nuclear industry than from local and national anti-nuclear groups. Exact reasons for this absence can not be given. But from conversations with visitors it might be due to: a certain level of distrust in the conference or in talking with the nuclear industry; the hearings were held just before and at the weekend of Whitsuntide; or the possibility that people were unaware of the conference[45].

Key questions
The nine issues on which hearing sessions were held dealt with: deep disposal vs. surface storage; regulation; R&D; privatisation; informing the public; reprocessing; nuclear energy future; the military and waste classification. In short we will go only through the most relevant themes for our study and the Panel's conclusions, whereafter we describe panel's main conclusions[46]**.**

Q: What do you see as the primary advantages and disadvantages of deep disposal? What do you see as the primary advantages and disadvantages of shallow/surface storage?
The discussion about the choice whether to store nuclear waste aboveground or underground knew two opposing visions. Representatives from Nirex, the Royal Institute for International Affairs and British Geological Survey were proponents of deep disposal as they consider the long-term storage aboveground too risky. On the other side, Dr. Sullivan and FOE UK argued that there are too much uncertainties in "burying" nuclear waste and thus prefer a monitored retrievable aboveground storage, to give future generations the chance to make other choices. Both parties although recognised that any choice that would be made had its own advantages and disadvantages. For long-term aboveground mainly on the question of social stability, and for underground on the question of uncertainties[47].
In their conclusions at the fourth day, the panel unanimously agreed that for an acceptable solution, the waste "MUST remain accessible and monitorable". This for the case that in future a solution may be found. The panel rejected the ideas for a deep repository as presented by some witnesses, that is, one that would be backfilled. They feared a future leakage of radioactive material from a deep disposal that could "lead to passing on to future generations bigger problems than managing and monitoring the radioactive waste in below surface storage". Below surface storage is the concept the panel favours. Storage near the surface should protect it against environmental changes and human intervention, like sabotage. The emplacement near the surface would guarantee access to the waste and the possibility to retrieve it. One member of the panel, however, disagreed with the others, he felt very strongly that by placing wastes underground it would

become forgotten - "Out of Sight, Out of Mind". On the question how deep such a facility should be placed, the panel had no answer. It could be at tens of meters as well as a hundred meters. For the panel, it was important not to seal off the wastes and keep them retrievable.
The panel also unanimously proposed not to use the word "disposal", as it would be misleading to the public. Disposal would too much suggest that one can "get rid off" it. Seen the choice to "give future generations a chance to deal with the problem", they rather prefer "storage"[48].

Q: Currently, what R&D is there into nuclear waste treatment?
This session had as theme the research that is being conducted on waste management. An important discussion point in this hearing was transmutation as it was of influence on the panel's choice how to store waste. Mr. Beck of the Royal Institute for International Affairs mentioned three concerns about deep disposal that would plead for intensified research into transmutation: the very long-term problem, the possible radioactive spread due to faulty design or natural events, and the risk that repositories might become "plutonium mines", which is a proliferation threat. Dr. Sullivan on the other hand argued that transmutation feeds the myth of "final solutions" and that it "gives carte blanche to the nuclear industry to continue". Besides, transmutation needs extensive chemical reprocessing, is expensive and enlarges the volume of waste to be stored, which is not to be favoured[49]. The discussion took place at a rather theorethical level. There was no input on the technical aspects of transmutation, for example, the almost impossibility to fission certain long-lived fission products and the separation of these to condition them, the real costs and implications for the reprocessing industry, etc[50].
The panel welcomed more and increased research on transmutation, because when successful, "then clearly the issue of the acceptable disposal would be close to resolution". How optimistic they were on transmutation was already made clear in the conclusions of another session: "The Panel hopes and believes that science **will** find an answer, to make waste non-hazardous, in the not too distant future" [bold as is used in the report][51]**.** This strong belief in a future scientific solution was also part of the reasoning to place wastes in a near-surface storage, that is, to keep it on one hand protected against external influences and on the other hand accessible to deal with it in the future: "waste must be removed from the surface and placed underground as an interim solution"[52].

Q: What is the current/future policy with regard to informing the public about radioactive waste?
These hearings dealt with the question how to communicate with people. Dr. Brown from the Department of the Environment confessed that the previous strategy of "decide, announce, defend" had not worked and that other ways have to be found. In general, the need for open and correct information was recognised. Mr. Thompson of the US Institute for Research and Security Studies pleaded for a new strategy based on "decision-making partnership among public, government and industry", use of openness, public debate and peer review, a complete workout of alternatives and the preparedness to adjust[53]. The panel concluded that indeed there was a lack of trust among the public and that a neutral body might increase trust. Hereby it referred to the NWMC as the Lords Committee was to propose[54].

Q: What is your opinion on the continuation of nuclear power? What are the financial, environmental and social costs?
Both presentations were made by proponents of nuclear energy and used arguments like the greenhouse effect. The panel said that it would welcome a phaseout of nuclear energy, if it were possible with pollution-free alternatives. At the moment it should not increase due to the unsolved waste issue. The issue, whether there exist such "pollution-free alternatives" was not discussed, maybe due to the absence of a proponent of alternatives[55].

Q: What are your opinions on the current terminology used for the classification of radioactive waste?
All the three contributors recognised that waste classification knew shortcomings. Mr. Duncan of BNFL said that classification is only based on concentration or activity, but that an ideal system should take into account the toxicity, half-life and chemical properties, but that this would be unlikely to be adopted. Dr. Sullivan agreed by stating that wastes should be classified by the lifetime of the materials. Dr. Wallace of Greenpeace argued that plutonium had to be classified as waste.
The panel's view was that a new method of classification was needed. There was no consensus that plutonium should be regarded as waste, but "as a harmful substance it still needed to be included in the classification"[56].

Overall conclusions
The panel made the following main conclusions, that were presented at the press conference at the last day (shortened and if relevant from the perspectives of this study): "Radioactive waste must be removed from the surface and stored underground, but must be monitorable and retrievable. Cost cannot be an issue. We must leave options open for future solutions. We recommend the appointment of a neutral body. Criteria for site selection should be open and publicised. Research and development must be continued on a much larger scale and international cooperation should be encouraged. At present there is a lack of trust and understanding and public awareness must be raised. Decision-making must be open and transparent. We are not fundamentally opposed to nuclear power, but it should not be expanded until a way is found to deal adequately with the waste problem. A new method of waste classification is needed, clear and openly communicated. Finally, while the industry has in the past had a well-deserved reputation for secrecy, we have in the course of the conference noted a welcome shift."
The panel expressed its wish to be consulted in the future on nuclear waste policy[57].

Reactions
After the presentation of the panel's conclusions a number of relevant authorities reacted. The minister of environment, Mr. Meacher, announced that the expected Green Paper with a policy proposal will be released at the end of 1999. He welcomed the concept of retrievability and the possibility to monitor stored wastes, and thus not to use backfill material in a repository. But on the other hand, he also doubted the advantages of easily accessible near-surface storage as some wastes are very long-lived.
Lord Flowers, one of the House of Lords Committee members, did not welcome the idea of near-surface storage, as it would imply that later a deep disposal site still has to be realised to definitely isolate the waste from the environment. An interim subsurface storage would mean extra costs and risks. For transmutation he referred to the consequence that either new reactors should be built or a choice should be made for the expensive technology of accelerator-driven systems.
Mr. Murray, managing director of Nirex, was in of favour retrievable deep disposal and that this would fit in the criteria of sustainable development as "options were kept open". However, he did not explain for how long such retrievability should be assured.
Mr. Secrett, director of FOE UK, said he welcomed the panel's conclusions as their opinions were close to FOE UK, in not agreeing with deep disposal. That conclusion means that government has to rethink its policy, and wastes should be stored monitored and retrievable. He welcomed the panel's conclusion that plutonium should be classified as a waste. But he opposed the idea of near-surface storage, as FOE UK prefers aboveground storage at the site of the producer to prevent transports. The arguments the panel used in its plea for subsurface storage, the issue of human threats, had another implication: that this argument is also valuable for existing installations. The waste problem can be said to be a "very tricky, scientific and political problem."[58]

Dr. Western, witness during the conference for FOE UK, was said to be content with the outcome of the conference: "my impression is very good. The choices the Panel made on waste storage are a move forward, and away from disposal. But the question is whether Nirex will take over the Panel conclusions and whether the panel's favoured subsurface storage is suitable from an engineering point of view." She does not think that Sellafield will be put on the agenda again, because of the intense opposition that has grown. A near-surface storage is a totally different concept for which other sites could be considered by Nirex.
Western is not sure whether the government will try to combine the preference of the Lords Committee to continue with deep disposal and the expressed wish of the panel for retrievability into a concept for a deep repository that is retrievable as well. In that case, the government has to prove the real abilities and guarantees of retrieving waste. FOE UK was said to be very sceptical about proposals for retrievable disposal as they fear that it is likely that it would be turned into final disposal facilities. It thinks the nuclear industry will presently act more slowly and carefully than in the past as it have lost credibility. But there is also another reason why it could take more time, as at the time it planned the Sellafield RCF there were plans for four new nuclear power stations. That urged a quick solution for the waste problem. Western hoped that the panel will be consulted again on the contents of the upcoming Green Paper[59].

11. SUMMARY

The United Kingdom has an extensive nuclear energy program that started in the 1950s. It includes enrichment, fuel fabrication and reprocessing. There are no plans for building new nuclear power reactors.

Since the 1970s, studies have been conducted on the possibility to realise a deep disposal site. The test drillings that were undertaken faced opposition. Apart from some drillings to high-level waste disposal, most of the attention was given to finding a site for low-level and/or intermediate-level waste disposal. In the late 1980s, Nirex had, from a (not public) list of 500, selected 11 sites. Later, Sellafield was added with the idea that a "nuclear culture" might lead to an easier acceptance. Data on how Sellafield was considered to be suitable for a Rock Characterization Facility (RCF) were kept secret and local communities were not informed about the selection process.
In March 1997, the plans for the RCF at Sellafield were rejected by the Secretary of State of the Environment. The effects of the aboveground works and the uncertainties from a geological and hydrological perspective were too high. It was also doubted whether the RCF itself would have negatively influenced the safety of a repository.
With no prospects of a disposal site, the UK needed a change of its waste policy. A House of Lords Committee started an inquiry as a first step. The inquiry was more directed to high-level waste. The House of Lords concluded that one or more underground repositories were necessary within the next 50 years. Environmental organisations protested that there was no discussion possible about a long-term aboveground storage. They consider the 50-year goal too hasty since a 1995 White Paper earlier had spoken about "no fixed deadlines".
The Lords Committee concluded that the earlier strategy of decide-announce-defend had failed and that public acceptance is necessary to realise plans, but that it would be difficult to achieve. In order to ease that process, it proposed offering compensation for a hosting community. Environmental groups consider this as a too-much-goal-driven process with the use of compensation to "buy" acceptance.
The Lords Committee recommended the creation of two new bodies. The first would be known as the Nuclear Waste Management Commission (NWMC) to oversee national policy. As a first task, it should conduct consultations on the Green Paper on waste policy, to be expected at the end of 1999. Environmental organsations, however, think the NWMC itself should be subject of the consultations.

A second body, the Radioactive Waste Disposal Company (RWDC), should be responsible for site selection and construction. The Lords Committee mentioned the possibility of voluntariness. But this voluntariness has the limitation that once a community has agreed, it can no longer withdraw, according to the Lords' proposal. According to the Lords Committee, a site-specific inquiry should be limited to site-relevant issues, as broader aspects would have been part of the Green Paper consultation.
A second event in the process of restructuring government's policy was the Consensus Conference in May 1999. A randomly selected Citizen's Panel had to study literature and hear witnesses to form an opinion on nuclear waste policy. In a two-day session, hearings with 32 witnesses were held. It was perceived that there was an imbalance between pro- and anti-nuclear witnesses and visitors.
The panel rejected the idea of deep disposal because of the risks of leakages. Secondly, it concluded that the waste MUST remain accessible and monitorable, and thus retrievable. Because of the risks of human intervention and climate change, a storage should be placed below the earth's surface.
Much attention was given to the technology of transmutation, and the panel was strongly convinced that in future this would be feasible. Transmutation played an important role in the panel's motivation to keep the waste accesible in a near-surface storage as an "interim solution".
Although the outcome of the Consensus Conference is not binding, it is said that such conferences are of influence on policy making. Responsible Minister Meacher of Environment expressed his reservations about subsurface storage due to the longevity of some wastes. Nirex used the words "retrievable deep disposal" as another possibility.

12. CONCLUSIONS

1. The secrecy about the list of 500 and the criteria upon which Sellafield was chosen did not contribute to public confidence, and is still of influence on the public's trust.
2. On the basis of the negative outcome of the question whether Sellafield would be safe, it can be concluded that it was wrong to add Sellafield, on "nuclear culture" grounds, to the list of 11 sites that was derived from comparing geological information.
3. If the government will adopt the Lords Committee conclusion to proceed with constructing a deep disposal within 50 years, new conflicts with environmental organisations can be expected.
4. The Lords Committee mentioned the possibility of voluntariness, but once a municipality has shown interest, it can no longer withdraw, according to the proposal. This will not attract communities to volunteer.

5. The Lords' proposal to limit site-specific inquiries to only site-specific issues, as broad issues are discussed in the Green Paper consultation, can lead to conflicts.
6. Concerning the Consensus Conference, it can be asked whether a randomly selected panel of just 15 other individuals would have come to the same conclusions.
7. The panel's favour for a near-surface storage was not worked out, i.e., at what depth and how to realise it from a technical perspective. Therefore it looks as if the panel tried to combine the idea of supposed isolation at great depth and easy retrievability of an aboveground storage.
8. Transmutation played an important role in the panel's choices, but the real technical feasibility and problems were not discussed profoundly.
9. It is doubtful if the government will take over the favoured near-surface storage. It is possible that retrievable deep disposal will be the concept to be introduced, instead of working out for the UK the new concept of near-surface storage.

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3- "Radioactive waste management programmes in OECD/NEA Member countries: United Kingdom", OECD/NEA, 1998.
4- The Times, 4 February 1994.
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10- "High Level Waste and Spent Fuel Disposal Research Strategy: Project Status at the Half-Way Point", QuantiSci, May 1998.
11- "Management of Nuclear Waste", Select Committee on Science and Technology, House of Lords, HL Paper 41, 10 March 1999, p. 32; After here to be referred to as "HOL, 1999".
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17- "Radioactive waste - where next?", p. 15.
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20- "Nirex and deep disposal: the Cumbrian experience", J. Hetherington, Environmental Planning Manager of the Cumbrian County Council, on personal title; in "Management of radioactive waste; issues for local authorities", F. Barker et. al., 1998, p. 17-31.
21- J. Hetherington, 1998.
22- "Radioactive waste - where next?", Parliamentary Office of Science and Technology, November 1997, p. 86-87.
23- J. Hetherington, 1998, p. 22 and 28.
24- HOL, 1999, p. 20-21.
25- "Reality Check", Friends of the Earth UK, R. Western and P. Green, 18 May 1999, p. 2-5.
26- HOL, 1999, p. 20-21.
27- HOL, 1999, p. 71.
28- HOL, 1999, p. 72-74, list of received evidence.
29- HOL, 1999, p. 26.
30- HOL, 1999, p. 67.
31- HOL, 1999, p. 38-44.
32- HOL, 1999, p. 67.
33- HOL, 1999, p. 45-54.
34- Fred Barker, member of RWMAC, though doubts whether the NWMC can replace the RWMAC. The proposed role of the NWMC is much broader than the advisory task of RWMAC. It could be difficult to combine RWMAC's task as independent advisor with NWMC's role to oversee the implementation of the national program. Source: e-mail Fred Barker to Laka, 23 June 1999.
35- HOL, 1999, p. 45-54.
36- "Briefing on the Government Review", Nuclear Free Local Authorities, Radioactive Waste Policy, April 1999.
37- "Reality Check", Friends of the Earth, R. Western and P. Green, 18 May 1999.
38- "Consensus Conference", J. Palmer, at internet http://www.ukceed.org/consensus.htm, 1999.

39- The advisory committee members were: Ian Christie, Deputy Director, Demos; Professor David Cope, Director, Parliamentary Office of Science and Technology; Professor Charles Curtis, Research Dean, Faculty of Science & Engineering, Manchester University; Professor John Durant, Assistant Director, Science Museum; Dr Simon Joss, Senior Research Associate, Centre for the Study of Democracy; Sir Ron Oxburgh, Rector, Imperial College; Jane Palmer, Project Manager, UK CEED; Dr Andy Stirling, Research Fellow, SPRU; John Winward, Executive Director, UK CEED.
40- Internet: http://www.ukceed.org, 1999.
41- Panel Press Conference, 24 May 1999.
42- Conversation with representatives from Greenpeace, FOE and other visitors, 21 May 1999.
43- Answer Panel to questions Robert Jan van den Berg, Hearing session 7, 22 May 1999.
44- Conversation with Rachel Western, FOE, 24 May 1999.
45- This question was posed to several visitors of the Conference, varying from environmental groups to independent consultants and a member of RWMAC. All saw this unbalance in visitors, but no one could give an example of motivated absence.
46- We will deal more extensive on the questions that are relevant for this study.
47- Consensus Conference, 21 May 1999.
48- "Radioactive Waste Management; UK National Consensus Conference", Citizen's Panel Report, 21-24 May 1999, p. 8-10.
49- Consensus Conference, 21 May 1999.
50- "Advanced Technologies for the Reduction of Nuclear Waste", Netherlands Energy Research Foundation, November 1998, p. 76.
51- Panel Report, p. 10 and 12-13.
52- Panel Report, p. 10.
53- Consensus Conference, 22 May 1999.
54- Panel Report, p. 16-17.
55- Panel Report, p. 20.
56- Panel Report, p. 23.
57- Panel Report, p. 24.
58- Consensus Conference, press conference, 24 May 1999.
59- Interview with Dr. Western, 24 May 1999.