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Factors Affecting Public and Political Acceptance for the Implementation of Geological Disposal

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FOREWORD

Scientists and technologists have identified several strategies for managing radioactive wastes produced by nuclear electricity generation. Many Member States are focusing on developing and implementing a geological disposal strategy. However, the choice to develop and implement a given strategy, or combination of strategies, is not purely scientific or technical. Today, making a choice and carrying it out requires a phased process engaging a range of stakeholders including political decision makers and the public.

Such considerations on societal aspects are now systematically part of any conference on radioactive waste management. Since a few years already, Member States are requesting to see such issues dealt with at IAEA level with a view to confidence building. This request has been translated in the programme and task's definition and is still regularly expressed by Member States in technical and advisory group meetings to supplement national efforts and gain public confidence in waste disposal schemes.

This report focuses on a geological disposal approach that consists of isolating radioactive wastes deep underground in a mined repository. It is not suggested here that geological disposal is the sole strategy that may be chosen or carried out by a country for managing high-level radioactive waste, long lived waste or spent nuclear fuel. However, the geological disposal approach is favoured in principle by many countries for it is seen to offer advantages in terms of safety and security of this category of radioactive materials, and as a way to address ethical concerns.

This report is meant for decision makers and others with a role in bringing forward a national programme to manage radioactive waste. Through different case studies, this report describes how programme acceptance has been fostered or hindered in different countries. It reviews factors that may affect whether a programme to develop and implement geological disposal strategy gains (or does not gain) societal support. The level of public and political acceptance that is needed to go forward with a programme will depend on the legal and institutional frameworks and cultural traditions of each Member State. In democracies, there is great demand for the views and preferences of the public and their elected representatives to be taken into account in decisions potentially affecting health and the environment.

This report was developed with the assistance of experts from many countries through consultants and technical meetings. The IAEA wishes to express its thanks to all those who were involved in the preparation of this report and its revision. The IAEA staff member responsible for this publication was B. Neerdael from the Division of Nuclear Fuel Cycle and Waste Technology.

SUMMARY

The main objective of this report is to identify conditions which affect public concern (either increase or decrease) and political acceptance for developing and implementing programmes for geologic disposal of long-lived radioactive waste. It also looks how citizens and relevant actors can be associated in the decision making process in such a way that their input is enriching the outcome towards a more socially robust and sustainable solution. Finally, it aims at learning from the interaction how to optimise risk management addressing needs and expectations of the public and of other relevant stakeholders.

In order to meet these objectives, factors of relevance for societal acceptance conditions are identified, described and analysed. Subsequently these factors are looked for in the real world of nuclear waste management through cases in several countries. The diversity of characteristics of such contexts — institutional frameworks/ cultural traditions — increases insight in the way society and values of reference are influencing technological decision making. These interrelated factors need to be integrated in step by step decision making processes as emerging the last years in HLW disposal management.

In Section 1, six stages of a repository development and implementation process are identified: policy development, framework, concept elaboration, underground investigations and assessment research, site suitability analysis and last but not least realisation of the repository itself. These are described in much greater detail in section 2. Historically, the dynamics from one stage of this process to the next has seldom been smooth. Technical feasibility as well as public and political acceptance issues had to be addressed continuously in an integrated way. Political decision making at different levels (national, regional, and local levels) interacted. These circumstances caused significant delays in many Member States and sometimes even caused an abrupt halt of programmes. In others they allowed to improve technical options. Indeed, reaching a particular stage in the development and implementation process was no guarantee that a programme would not be compelled to retreat to an earlier stage or even be forced to restart the process anew. In Section 3, a set of four factors — technical, structural, process, and behavioural — are proposed and discussed, whereas section 4 outlines illustrative case studies of the development and implementation process in 13 Member States.

In the conclusions, proposals about the effect of each factor on acceptance are derived from the empirical record. The main effect is the interaction of these factors throughout the whole time consuming process. In the course of carrying out this analysis, it became clear that acceptance had a different meaning in the first three stages of the process than in the last two stages, while few experience exists on the last stage. The first three stages mainly involve generic considerations, dialogue, and debate. It means that deliberations surrounding these stages are not site-specific. Consequently, decisions most often are made at policy level between authorities and affected stakeholders. The political acceptance process seems to be the key issue. Members of the general public and representatives of local communities are essentially involved in the last three stages are, by their very nature, site-specific. They recognize that they have a clear stake in the outcomes of decisions and almost always seek to have their views taken into account by the higher policy levels. This time, both public and political acceptances appear to be crucial.

The major challenge however remains to build confidence in a technology without definitive demonstration, as we are dealing with geological time scales. Further, the time period, largely exceeding the time scope of human civilisation, confronted the technical nuclear science community with other value judgements in society. In this context acceptance cannot be

obtained through a technical process only. Experience as clearly addressed in this report has shown that a feasible solution has its technical dimension but that “an acceptable solution” always will have a combined technical and social dimension. The latter dimension is focussed by the underlying report, but it can not be considered separately from the technical one.

More than providing tentative answers to the central question how factors affect public and political acceptance, this report aims at illustrating the added value of broadening the technical dimension with social dialogue and insight in value judgements. Other recent international projects and activities, in spite of being developed with different approaches, provide similar results and recommendations.

CONTENTS

1. INTRODUCTION

1.1. Repository development process

Long-lived radioactive waste is an inevitable by-product of generating electricity using nuclear power. So far, several strategies have been identified for managing those wastes so that they do not harm either individuals or the environment. Although a number of Member States have not yet selected which strategy or strategies they will pursue, many of them are now focusing their efforts on developing and implementing a geological disposal concept, whereby the high-level and long-lived wastes would be placed deep underground in a mined repository.

In all countries the paramount objective for the long-term management of radioactive waste is the safety as well as the protection of public health and the environment. There is a strong scientific and technical consensus that a well-sited and designed repository can ensure the long-term safety through a combination of geological and engineered barriers, providing isolation and containment of the radionuclides.

The process of developing and implementing a programme for geological disposal typically proceeds through several stages. Broadly, the stages may include:

(1) Development of a waste management policy;
(2) Establishment of legal and institutional frameworks;
(3) Identification and elaboration through research of a generic technical concept for geological disposal;
(4) Initiation of surface and underground investigations to characterize host rocks, and development of research programmes to assess waste management system interactions;
(5) Determination of the suitability of a site for development as a deep underground repository;
(6) Design, licensing, construction, operation, and closure of a deep underground repository.

A more detailed discussion about these six stages follows in Section 2.

These stages do not necessarily play out in a rigid order. Different stages may be pursued in parallel. For instance, conception and design of the repository may be started before site characterization but refined with growing understanding of a site. Licensing activities may be ongoing, with an original license being reviewed and updated in regard to repository construction, reception and emplacement of waste, closure, and termination of repository activities.

The various initiatives for developing and implementing a programme for geological disposal may be taken either by governments or by the waste producers, particularly nuclear power utilities. Setting legal frameworks, regulatory and licensing steps, and funding requirements are governmental responsibilities, while other stages of implementation may be undertaken either by governmental or utility organisations.

Programmes to develop and implement geological disposal possess characteristics that distinguish them from many other large projects, such as railroad construction or natural resource exploration. Geological disposal programmes will usually take place over longer time periods, perhaps half a century or even more to plan and to implement. The facilities constructed need to perform reliably over thousands of years. It follows that issues of inter-generational equity will be important in order to consider the needs for future generations. It also follows that issues of intra-generational equity and distributive justice must be considered as well, because the project has more of an effect on one region in a country, i.e. where the facilities are located, than on the rest of that country.

Experience to date suggests that each of the stages in developing and implementing a programme for geological disposal attracts considerable public interest and attention. In some cases, agreements have been reached among the affected parties. In others, proposals that have been advanced have met strong opposition from members of the general or affected public and their political representatives. Indeed, sometimes the anticipated opposition may appear so strong that proposals are never advanced at all.

1.2. Objective, methodology, and scope

The objectives of this report are:

- to identify factors (conditions) potentially affecting public concern and political acceptance (increased and decreased) for developing and implementing programmes that seek to manage long-lived radioactive wastes by disposing of them in a deep underground repository;
- to describe and analyse these factors in different case studies, representing different dimensions of repository programmes as well as distinct cultural, political and historical traditions;
- to provide conclusions that will help decision makers, politicians and institutions proceed with geological disposal programmes; and
- to serve as a reference publication for the Member States interested in addressing issues associated with public involvement and political acceptance in their national programmes.

Four classes of factors are identified: technical, structural, process, and behavioural (see Section 3). These are all interrelated, are likely to vary over time and among different interested groups. These factors are also representing what is most directly influenced by the institutions involved in waste management. However, it is acknowledged that more factors may exist. The economic cost and distribution of benefits for example, is an important issue in several of these factors.

Experience in various Member States is examined through the lens of these four types of factors mentioned above. The case studies should provide material for reflection and discussion in any Member State. Improved understanding of societal factors may help policy-makers in Member States to select approaches compatible with and effective within their national political cultures. This report, however, does not attempt to dictate particular approaches or practices.

In Section 4, several detailed case studies are presented. ***They cover the period ending in 2005***. Information about programmes in other countries is referred to from time to time to supplement the discussion in Section 5.

The cases presented in this study involve several types of long-lived radioactive waste, including intermediate-level waste (ILW), vitrified high-level radioactive waste (HLW), and spent nuclear fuel (SNF).

For those Member States developing and implementing a programme for geological disposal, the challenge consists of gaining sufficient support from relevant actors to take action at a given step in the repository development process. Where the support for the programme falls to the point where action is impossible, essential changes must be made. Thus, this inquiry focuses on the societal conditions that have allowed decisions to be made or implemented as well as on those that have forced decisions to be deferred, reviewed, suspended, or amended. Section 5 contains conclusions which may serve as a help for decision-makers, politicians and institutions to proceed with geological disposal programmes.

1.3. Insights from recent international projects and activities

Progress on the scientific and technical aspects of geological disposal made over recent decades have created the basis for the demonstration and confirmation of the soundness of the geological disposal concept. However, continuing societal concerns limit the application of deep geological disposal in many countries regardless its consideration of a technically feasible and a demonstrably safe option. In this context, there is a widespread consensus among the nuclear waste management community that increasing the level of public participation and enhancing transparency can lead to more effective decision-making processes. Furthermore, the long-term nature, the uncertainties and the range of societal impacts associated with radioactive waste management reinforce the need to open up a domain traditionally exclusive of technical expertise. The evolution is also of a more general nature regarding new trends in risk governance. Risk assessment of complex interactions of technology with society are being broadened worldwide in the context of new policy discourses on precaution and sustainable development [1, 2].

Wider societal involvement at a variety of governance levels in an open, inclusive and transparent manner is a top level concern in most Member States' national organisations involved in radioactive waste management. Similarly, international and European research projects and activities have addressed the need to improve decision making processes through public involvement and transparency. These projects are at different stages of development, and organised around different objectives. Under the 5th Framework Programme the European Commission conducted the Concerted Actions RISCOM and COWAM (Communities and Waste Management). The RISCOM I (1998-2000) and RISCOM II (2000-2003) projects developed and tested a theoretical model to support transparency of decision-making processes in the RWM programmes of some EU countries based on public participation (http://www.karinta-konsult.se/RISCOM.htm).

Through four seminars, COWAM 1 (2000-2003) examined cases in 8 European countries, and formulated recommendations for better governance of the RWM process focusing on the needs of local communities (www.cowam.com). The project brought together representatives of local communities, institutional stakeholders, and experts from outside and inside the nuclear establishment in a network exchange experience. COWAM emphasised the need for early involvement and empowerment of local actors in the decision-making process as well as a clear role of the participating parties from the start. Within the Sixth Framework Programme of the EC, COWAM 2 (2004-2006) aims at developing a set of guidelines on the governance of radioactive waste management by addressing societal expectations, needs and concerns, notably at local and regional level. COWAM 2 is also aimed at benchmarking and developing best practices on practical and sustainable decision-making processes recognised as fair and equitable by the stakeholders involved (www.cowam.org).

Another initiative fully funded by radioactive waste management agencies with well developed concepts is the CARL project (**C**itizen-stakeholders, **A**gencies for radioactive waste management, **R**esearchers and **L**icensing and regulatory agencies). CARL is a two-year (2004-2006) social science research project aimed at establishing benchmarking opportunities for stakeholder involvement in radioactive waste management. Research is focussed on understanding the stakeholder involvement exercises in Belgium, Canada, Finland, Slovenia, Sweden and the UK.

Besides these projects, the Forum on Stakeholder Confidence (FSC) was created under a mandate from the Nuclear Energy Agency Radioactive Waste Management Committee in August 2000. The FSC is a framework for open discussion and exchange of experiences around stakeholder interaction and public participation in the field of RWM. The FSC groups representatives of national institutions — mainly regulators and implementers — from 14 OECD Member countries. It explores means of ensuring an effective dialogue amongst all stakeholders, and ways to strengthen confidence in decision-making processes [3-7]. (www.nea.fr/html/rwm/fsc.html)

Although the projects mentioned above are different in approach, they provide similar results and recommendations. Some of the conclusions that could be inferred from the projects and activities described above follow. First, new approaches to governance of spent fuel and high-level radioactive waste are emerging in different Member States all over the world. Second, alongside with technical issues, stakeholder concerns also need to be addressed during the geological repository development process [8]. Third, the decision-making process around RWM should be open, transparent, fair and participatory. Finally, there is no 'ideal' approach that may guarantee a sufficient level of public and political acceptance.

1.4. Definition of terms and concepts

The IAEA Glossary [9] defines the following key terms and concepts.

Disposal is the emplacement of waste in an appropriate facility without the intention of retrieval. A **geological repository** is a facility for the disposal of radioactive waste (or spent fuel), usually located several hundred metres below the surface in a geological formation to provide long-term isolation of radionuclides from the biosphere. As a synonym, the term **deep underground repository** also appears in the text. **Underground research laboratory (URL)** refers to a facility that is built for tests to be conducted within a geological environment that is essentially equivalent to that of a potential repository. Such a facility offers the possibility to investigate the full range of repository environment properties and waste repository system interactions, albeit on a limited time scale. The definition includes both URLs that are intended only for test purposes and URLs that might be transformed into a repository, or more generally URL's that are either generic or site-specific.

In addition this publication uses other key terms which are defined below.

Stakeholder is any actor, institution, group or individual, with an interest or a potential role to play in the societal decision-making around radioactive waste management [6].[1]

Public acceptance and political acceptance are concepts that probably take on different meanings in different political systems of the Member States. For the purposes of this report, these two concepts are taken to mean the following:

Public acceptance implies that a certain policy or a certain concrete measure is clearly or tacitly supported by members of the public who may be affected, positively or negatively, by its implementation. Various populations therefore will be distinguished according to the policy or measure in question. Note in particular that a local population (community) must often be distinguished from a national population at large, and that the degree of acceptance that can be observed in each type of population may possibly depend on different factors or different features of the situation.

Whether public acceptance exists or not can be judged with varying degrees of precision, through means ranging from formal referenda, well-conducted opinion polls or focus groups indications to media debates and informed judgments from people familiar with what is discussed among members of the public. It should be noted that "passive" acceptance i.e. not active opposition, may be sufficient to make decisions on developing a programme on geologic disposal, but could not be sufficient for the long-term decision making process. A successful association of relevant stakeholders in the whole decision making process should be reflected in the robustness and sustainability of final choices.

Political acceptance means that a certain policy or concrete measure has the passive or active support by the political institutions of a country. Clear examples of political institutions are national legislatures and government entities, but also elected representative bodies on the regional and local levels, over a broad spectrum of political organisations.

2. VARIATION IN THE STATUS OF DISPOSAL PROGRAMMES AMONG MEMBER STATES

As indicated in Section 1.1, Member States who have chosen to develop and implement a geological repository strategy today are at different stages of the process, and often have arrived there by different routes. To illustrate these differences, consider the following examples.

In South Africa radioactive waste is produced by the State-owned Koeburg NPP and by the SAFARI-1 research reactor. The Ministry of Minerals and Energy has the responsibility for the management of HLW and SNF, and the National Nuclear Regulator has the authority to grant licences. A RWM policy and strategy specifying options for the management and disposal of radioactive waste including HLW was issued in December 2005. The policy prescribes competent authorities to be responsible for waste disposal and for the approval of waste management plans. Waste disposal including deep disposal is an activity covered by the "Nuclear Energy Act". No implementing organisation has been created or mandated. No specific laws or regulations have been developed.

The current legal framework in Finland was passed by national Parliament by 1988; the State Nuclear Waste Management Fund also was created in the same year to secure financial

[1] In some countries, government agencies are not considered stakeholders.

resources; a private company, Posiva Oy, was established in 1995 to implement, on behalf of the nuclear electricity producers, the waste management programme. The regulations for disposing of HLW and SNF were promulgated in 1999. Although Finland does not have its own underground research laboratory (URL), it has actively participated in research at URLs located in Sweden and Switzerland. The nuclear electricity producers conducted detailed surface-based investigations at four sites between 1993 and 1999. Between 2000 and 2001, the municipality of Eurajoki, the government, and the Parliament successively granted approval for the selection of the Olkiluoto site for development as a deep underground repository. The construction of a rock characterisation facility (ONKALO), started in 2004, will continue in the coming years and plans call for the construction of the repository to begin sometime in the next decade (license application scheduled to be applied for in 2012).

In Belgium, financing and approval were got quite easily to build an underground research laboratory (URL) 30 years ago [10], what led to a sensitive contribution in the 80's to the EC PAGIS Report [11]. It allowed further to make performance assessment gradually through periodic reviews of the programme (Safety Assessment and Feasibility Interim Reports) [12], to promote comparison of safety assessments through international collaboration and to demonstrate the feasibility at EU level. The need for integration of social and economic science considerations was expressed in the SAFIR 2 recommendations. Technical feedback guided improvements of concepts with major attention for compatibility of waste forms with the host rock and site specificities.

2.1. Development of a waste management policy

In view of a consistent and sustainable waste management policy, today's state of the art in particular in high level waste management and disposal forms the basis for any further considerations. In order to achieve the public and political acceptance needed, disposition alternatives and timing of implementation have been and are subjects of paramount interest. Although geological disposal has been widely adopted, it should not be forgotten that, at one point, technical alternatives such as sending the waste towards the sun, were actively discussed. Even today the use of deep boreholes may emerge as a viable option for some countries. Other possibilities might arise in the future. Further the timing of when the chosen technical alternative might be implemented can also be addressed in the formulation of a "high-level" waste management policy.

Countries can develop waste management policies explicitly. For example, the United States formally selected the technical alternative of geological disposal through an environmental assessment process only in 1980, even though it had focused virtually all of its research and development efforts on that alternative. In Japan, the geological disposal was provided for in the law. Some countries, such as Canada and France, are now, *end of 2005*, in the process of deciding what its waste management approach should be. Still others have not adopted a waste management policy explicitly. In Spain, for instance, the 5th Radioactive Waste Management Plan, approved by the Spanish government in 1999, outlined that no decision on the final disposal of high-level radioactive waste would be taken until 2010. Deep disposal study would continue, but new technologies, such as partitioning and transmutation would also be considered and strong international collaboration sought. In a number of countries a political change of fuel cycle options, caused by public concern such as a stop in reprocessing caused indirectly a change in RWM approaches.

2.2. Establishment of legal and institutional frameworks

Typically this stage of programme development and implementation involves the completion of all or almost all of the following actions [13]. These include:

— Passage of laws establishing:
  - A general strategy for disposing of long-lived radioactive wastes in a deep underground repository;
  - The role of local, regional and/or national representation in making or validating the various decisions implied;
  - Funding mechanisms;
  - Dispositions regarding public involvement.

— Establishment of a roadmap for decision-making

— Promulgation of administrative rules, regulations, and decrees establishing
  - Criteria for selecting sites for a URL and/or a deep underground repository;
  - Safety standards for the performance of a deep underground repository;
  - Interaction and responsibilities of authorities and entities involved.

Member States differ in terms of how far along they are in establishing the legal and institutional frameworks for disposing of long-lived radioactive wastes in a repository. Finland and Sweden are among those countries that have either fully or nearly completed the needed actions. In 2000, Japan established the institutional framework for implementing the geological disposal, except for safety regulations. Bulgaria and Republic of Korea are among the countries that are at the earliest stages of development. The United States at one point had completed these frameworks but undertook a major legislative change in 1987 as well as major regulatory changes in 2001 and 2005. In Canada, the Policy Framework for Radioactive Waste in 1996 and the Nuclear Fuel Waste Act (NFWA) in 2002 established a process for developing the legal and institutional framework for management of nuclear spent fuel. That process culminated in 2005 with recommendations being made to the Government. In Spain, the government passed a resolution in December 2004 instructing the implementer organisation, ENRESA, to draw up a plan for the development of a centralised interim storage facility planned for implementation by 2010. It is unclear what the implications of this decision are for the future of the geological disposal programme in Spain.

2.3. Identification and elaboration of a generic technical concept for geological disposal

Research and development programs on high level waste disposal carried out by a number of industrial nations and international organisations laid the foundations for scientific and technical approaches for the management of radioactive wastes. The selection of concepts typically involves the following actions:

— Evaluation of the disposal concept with respect to the acknowledged state of the art;

— Identification of those geological and technical components which contribute essentially to operational and post-operational safety;

— Elaboration of a strategy for conducting long term performance evaluations and risk assessments.

Member States differ in terms of how far along they are in selecting geological technical concept. In Sweden, for example [14, 15], SKB has argued for more than 20 years that the so-called KBS-3 concept is the preferred disposal method. This method has its roots in the late 1970s. It involves encapsulating the fuel in copper canisters that are then deposited, surrounded by a buffer of bentonite clay, in deposition holes in a tunnel system at a depth of approximately 400 to 700 meters in crystalline bedrock. This concept has been gradually developed and has also been presented for review to the regulatory authorities and to the Government every third year since the middle of the 1980s. The Government has taken the position that it should not formally approve a certain method for disposal only on generic grounds. Instead, approval of a certain method should only be granted as a part of a decision to approve an application to construct a repository at a certain site. However, in 2001 the Government stated that SKB could use the KBS-3-method as a planning requisite when starting what is called 'site investigations' within defined land areas. Two site investigations are currently being made [15, 16]. They include drilling in the bedrock, with the aim to identify a site with geological conditions suitable to host a repository.

In Germany, the waste disposal program reaches back to the early sixties. In line with a recommendation of the US Academy of Sciences (1957), a rock salt has been selected right from the outset of deep radioactive waste disposal considerations since it provides an excellent geological barrier for high level and heat generating waste. Consequently a URL, the Asse mine, has been set up and the salt dome of Gorleben was selected for field and underground exploration in order to prove its feasibility for radioactive waste disposal. However, due to the controversy over the future of nuclear energy in Germany and the lack of a nationwide sustainable consensus regarding both the disposal concept in rock salt and the selection of the Gorleben site, the radioactive waste management programme became a political issue. In 2000, the Federal Government imposed a moratorium on the Gorleben project lasting three to ten years at its maximum. The current situation may be described as a reconsideration phase in order to achieve broader consensus on radioactive waste management.

2.4. Initiation of investigations to characterize host rocks and research programmes to assess waste management system interactions

Another key stage in developing and implementing a programme to dispose of radioactive waste in a deep underground repository is the initiation of investigations to characterize host rock. In order to achieve a reliable understanding of the behaviour of the disposal system in a particular host rock, in situ experiments and other R&D work is required to be performed at representative disposal depths. This requirement has led to the establishment and operation of a number of URLs. The identification and selection of a site for a URL implies a series of steps:[2]

- Definition of siting criteria (exclusion criteria, indicators of favourable conditions, socio-political constraints);
- Establishment of a platform for information exchange and development of public competence;

[2] As suggested in Section 1.3, national programmes differ in whether the legal framework forbids, allows, intends or requires a site-specific URL to be transformed after investigations into a repository, and in the type and level of decisions needed to effect that transformation.

- Setting up of rules for site investigations — breaking point: termination or continuation of investigations;
- Demonstration and explanation of the key disposal concepts/techniques.

Member States differ in terms of whether and how they are conducting surface or underground investigations. The investigations might include drilling boreholes from the surface. Underground investigations might take place in a generic or site-specific URL constructed within the country. Alternatively, a country could carry out part of its underground investigations in another country's URL. In that case, it might decide to pursue additional characterisation work at a later time at a site chosen for a repository.

Sweden constructed a URL first in the Stripa Mine and later built a more elaborate URL at Äspö; the constructing permit for this URL was given under the explicit assurance by the developer (SKB) that the URL would not be transformed into a repository [17] In Germany, the underground research facility (Asse mine) was put up in a very early stage of the programme. Disposal techniques for LLW and ILW were developed and demonstrated. However, this facility could not provide all data needed for the application this advanced technology at a site specifically dedicated to HLW disposal. Switzerland [18] has URLs at Mont Terri and Grimsel, taking advantage of existing underground infrastructures and accesses. Belgium has a URL at Mol, operational since 1984 and serving also for international investigations on clay behaviour studies. France is constructing a URL in Bure. Japan has provided guarantees that the URLs at Mizunami and Horonobe will not evolve into a repository. The Yucca Mountain site in the United States could be regarded as a URL and has now been authorized for repository development by the US Congress. Finland, Spain and Germany, among other countries, are currently carrying out underground investigations in other countries' URLs.

If public and/or political acceptance is not gained, surface and underground investigations may never commence. If public and/or political acceptance is withdrawn, surface and underground investigations may have to be suspended.

2.5. Determination of site suitability for development of a deep underground repository

Another key stage in programme development and implementation is the identification and validation of a site for a deep underground repository. In this respect the following steps are of strategic importance:

- Development of an approach in order to decide if a site is suitable to be developed as repository; including societal considerations;
- Development of a rationale for evaluating all information available in order to underly strategic and technical decisions and to support direct communication with stakeholders;
- Definition of the role of public involvement in the process of regional development and planning.

Member States differ in terms of how far along they are in the siting process defined by their legal framework. Some, such as the Republic of Korea, are not conducting any siting activities for geological repositories. Others, such as Bulgaria, are beginning to formulate siting criteria and to create siting processes. Still others, such as the Czech Republic and Japan, have begun the process of identifying sites that might be suitable for developing a deep underground repository. In Sweden, the government did not object to the implementer, SKB, choosing sites in Oskarshamn and Östhammar for detailed investigation. Finland and the USA have made siting decisions. In 2001, after local consent was obtained, the Finnish Parliament approved the governmental decision in principle authorizing development of a deep underground repository at Olkiluoto. In 2002, the United States Congress approved the Site Recommendation authorizing the development of a deep underground repository at Yucca Mountain.

On occasion, public and/or political acceptance for siting activities was never given or was later withdrawn, forcing the implementer to suspend those activities at least temporarily. Member States where that circumstance has arisen in the past include France, Germany, Spain, Sweden, Switzerland, the UK and the USA.

2.6. Designing, licensing, constructing, operating and closing of a geological repository

Typically the implementer must integrate the general repository concept with the specificities of a particular site to present a case that a facility constructed in the designated location would perform at an acceptable level. Once that case is advanced through a step by step approach, it is either accepted, or amended or even rejected through a formal governmental authorisation process. The overall objective is to demonstrate clearly for all parties involved that:

- The proposed practise is justified regarding the ALARA principle and takes social and economical considerations into account;
- the design of the repository matches the safety requirements for operation and post-operation, including optimisation and Environmental Impact Assessment (EIA);
- detailed plannings for subsequent closure of the repository will be done in the course of the operation using all experience gained.
- funding is available throughout the whole stage

One deep underground repository for long-lived radioactive waste has been designed and licensed, and is now in operation: the Waste Isolation Pilot Plant (WIPP) in the United States. This facility currently enjoys broad public and political acceptance. Although many other countries have developed conceptual designs for a repository that might be used to dispose of HLW and SNF, only the USA has produced detailed designs for a potential facility sited at Yucca Mountain. Both Sweden and Finland are the closest to start a formal licensing process for a repository. With the exception of US when referring to the WIPP for defence waste at Carlsbad, no country has yet completed the licensing process or has operated, nor obviously closed, a geological repository for HLW and SNF.

3. FACTORS AFFECTING PUBLIC AND/OR POLITICAL ACCEPTANCE

High-level radioactive waste and spent nuclear fuel exists. As Member States wrestle with how to manage them, the need to obtain public and political acceptance of any approach has become increasingly clear. Experience to date suggests that a large number of factors could affect the level of acceptance. For analytical convenience, it is useful to sort them into categories that are conceptually coherent. Based both on that experience and on research that has already been conducted [4, 19,], this report focuses on four factors: **technical, structural, process, and behavioural**.

The **technical factor** incorporates considerations having to do with the properties of a site that might be selected for a repository, the details of a design that might be adopted and associated feasibility aspects and the requirements for the safety case that might be advanced to build confidence in the projections of repository performance. The **structural factor** incorporates considerations related to the framework under which the geological disposal programme is implemented. The way in which the ground rules for siting and licensing procedures are established and the responsibilities among the different organisations involved are part of this structural factor. The **process factor** incorporates considerations having to do with how, when and why decisions are made in the course of implementing programmes for geological disposal. Issues such as the role the public plays in the process or the benefits and incentives offered to local communities that may host a repository are discussed as part of this factor. Finally, the **behavioural factor** incorporates considerations related to how those individuals representing the implementing and the regulatory organizations interact with interested and affected members of the public and other stakeholders.

These four factors are often interrelated and are likely to vary over time. Of course, different factors may influence the level of acceptance of different groups and affected parties. Also other factors, such as economic and distributive ones, may be important under certain circumstances. Finally, although the factors examined in this report are largely under the control of those responsible for developing waste management programmes, events outside the control of the waste management policy makers may end up significantly influencing public and political acceptance.

In the discussion that follows below, each of the four factors is broken down into specific considerations. In effect, hypotheses are advanced that suggest a link between each consideration and public and political acceptance. For example, it has been suggested that the more an implementing organization is seen as legitimate, the more likely the repository system it proposes will be accepted (all other considerations being equal). The case studies, which appear in the next section of this report, provide some empirical evidence either to support or undermine the hypotheses, for a particular country.

3.1. Technical factor

The technical factor associated with a particular (proposed) facility site, design, and safety assessment may affect public and/or political acceptance. Specific considerations have been proposed in the *Safety Requirements for the Geological Disposal of Radioactive Waste* [20]. In this respect, some very specific aspects, like the resistance to seism or acts of terrorism could be considered by national authorities but are not referred to in this section. Among the technical considerations that may affect public and/or political acceptance, the following considerations appear to be especially relevant.

Considerations having to do with the site:

— Relevant natural analogues;
— Natural barriers;
— Transportation.

Relevant natural analogues: Repositories are developed to isolate and contain radioactive waste for many thousands of years. For the most part, projections of performance necessarily will have to depend on computer-based models. Depending on the site, however, relevant natural analogues may provide insights into long-term performance and permit those insights to be easily communicated. To what degree are relevant natural analogues available?

Natural barriers: Repositories can be constructed in a variety of geologic media, including salt, granite, clay, volcanic tuff, etc. Depending on the design proposed, the geological and hydro-geological environment in which the waste is to be emplaced may play a large or a small role in isolating and confining waste for thousands of years. The capability of the natural barriers may be easier to demonstrate if projections rely on well understood physical principles. When these projections rely on complex models that have large associated uncertainties, the barrier's capability is more difficult to assess. How much "credit" is given to the natural barriers for isolating and confining waste? How easy is it to project the behaviour of the natural barriers over many thousands of years?

Transportation: Radioactive waste will need to be moved from generator and storage sites to a repository site. Is the infrastructure available or easy to develop at a proposed or selected site? How much risk does the public perceive to be associated with transportation? How has the public been involved in the design of the transportation and in the selection of routes to be used?

Considerations having to do with the design:

- Multiple barriers and defence-in-depth;
- Retrievability;
- Monitoring;
- Flexibility.

Multiple barriers and defence-in-depth: Depending on choices made about siting and designing a repository system, long-term performance will depend either on one, a few, or many barriers and processes. Some international guidance exists suggesting that post-closure performance should not unduly depend on a single barrier or process [20]. To what extent is the isolation of radionuclides in proposed or developed repository dependent on multiple barriers? How much defence-in-depth is provided in the repository system? How far is feasibility demonstrated?

Retrievability: As a technical matter, waste can be retrieved from most, if not all, repository sites. Has the repository been designed to facilitate retrievability? How much will it cost to retrieve the waste at a particular site and how far is it necessary to provide funding? What will be the level of occupational exposure if the waste has to be retrieved? Does ensuring retrievability adversely affect the performance of the repository?

Monitoring: Particularly in a first-of-a-kind undertaking, it is impossible to rule out miscalculations in the projections of repository performance. It may be prudent to establish means to identify this type of error. Can the conditions of the waste be monitored? Can the key processes upon which repository performance depends be controlled by monitoring? Can institutional arrangements be established to address the requirements and results of monitoring? Can particular release pathways in ecosystems be monitored over long periods?

Flexibility: It will take decades to site and design a repository system. Once constructed, it may be operated for a few hundreds of years or more. Initial decisions may have been based on conditions or projections that no longer hold. To what degree can the initial repository design accommodate a wide range of waste types? To what degree can the initial design be reconfigured to take into account new information or new priorities?

Considerations having to do with the safety case:

- Documentation and communication;
- Acknowledgement and evaluation of uncertainties;
- Acceptable risk or level of safety;
- Broad consensus among technical specialists.
- Quality assurance of waste forms
- Compatibility of waste forms with host rocks
- Confidence;

Documentation and communication: The audience for the safety case includes regulators, government policy-makers, and other affected parties. Does the safety case and environmental assessment contain the information and communicate that information in a manner that satisfies the needs of the audience? Does the information provided support decisions to be taken? Is it independently reviewed?

Acknowledgement and evaluation of uncertainties: “Demonstrating” the performance of a repository is not possible in the ordinary sense of the word. Thus, uncertainty is inevitably associated with projections of repository performance for many thousands of years. Does the safety case evaluate and communicate effectively the significance and meaning of those uncertainties?

Acceptable risk or level of safety: Each Member State has developed or will develop standards and regulations that specify a required safety level or how much risk (or dose or health effects) is tolerated under which conditions. How high is the level of safety or which risk is considered acceptable (dose or health effects, environmental impact)? How is this comparable with risk acceptance at international level and in non-nuclear waste activities?

Broad consensus among technical specialists: Typically, a safety case will rest on a relatively small number of technical premises. Within the community of technical and scientific specialists, there may be widespread agreement on those technical premises. Or there may be strong disagreement. To what extent is there a broad consensus (not necessarily unanimity) within the technical and scientific community on the key premises underlying the safety case?

Quality assurance of waste forms: Quality assurance of waste forms is not necessarily based on full quality control. Non destructive measurements of waste forms is limited to simple measures such as dose, contamination and heat while characterization of content is referred to data from waste generation processes. Full characterization requires comparison of deductive and non deductive control measurement. Only some countries consider attempts such as the super control of intermediate waste in France [21].

Compatibility of waste forms with host rock: During concept development and site selection but in particular during the authorization process compatibility of waste forms with host rock is of particular importance. Not all waste forms, such as organic waste, can be disposed in all available/potential host formations. This may require international solutions for some particular waste forms for countries having limited siting capacity.

Confidence: The safety case is aimed at providing assurance that safety standards will be met. Implementers typically will undertake technical analyses to support the development of a repository. Those analyses will include performance assessments as well as other lines of evidence specifically developed to build confidence, such as natural analogues, that are independent of the performance assessments. How robust is the safety case? Has the evidence used to establish the safety case been gathered under a rigorous quality assurance process? Has the evidence been peer reviewed?

3.2. Structural factor

The organisation of programmes to develop and implement geological disposal of radioactive wastes will undoubtedly vary among Member States due to their national political cultures and traditions. Some relevant considerations are presented below.

- Scope;
- Power and responsibility;
- Organisational legitimacy;
- Organisational learning;
- Funding;
- Site selection criteria;
- Mechanisms for societal control;
- Waste management as a part of energy policy;

Scope: In structuring the programme, attention typically is given to what types of waste streams and volumes will be managed. Further, other types of wastes may be explicitly excluded for specific host rocks. How clearly is the scope of a programme specified?

Power and responsibility: National government may grant regional and local governments a role in developing and implementing a programme for the geological disposal of radioactive wastes. Veto power is one means of influence, although it is not the only one. Is power and responsibility concentrated in the central government? How much power and responsibility do regional and local communities hold? How should responsibility of waste producers in the global energy market be defined regarding funding?

Organizational legitimacy: Member States have created a variety of implementing organisations, including government agencies, government-chartered corporations, and private sector collaborations. Similarly, Member States have created a variety of regulatory organisations, including some that are independent of the implementing organisation and some that are not. Independency of regulatory decision making is put forward in [22] in order to limit unwarranted external influences while allowing appropriate dialogue also with the public. Further, regulatory agencies use or will use a range of processes to certify a repository system. The range is probably bounded by informal certifications that do not involve the public and by a trial-like approach to licensing that encourages intensive public involvement. There may or may not be widespread agreement among politicians and affected parties whether the type of organisation and what it is doing is appropriate. How much legitimacy do the implementing organisations and/or regulatory organisations enjoy?

Organizational learning: Several decades to centuries will pass between when a repository programme commences and when it concludes. What was known and valued at beginning will almost certainly be different from what is known and valued at the end. Has the programme built the capacity to learn what these changes might be? Has the programme anticipated the requirements for making changes in its course?

Funding: Developing a repository system requires a firm commitment of resources. Different mechanisms for ensuring the availability of those resources have been adopted by Member States. Some use a surcharge on the production of nuclear energy; others use taxes; still others require the utilities to provide the funds out of their revenues or have set-up the polluter pays principle in law. Will the funds generated be sufficient? Will the funds be available when needed over long-time periods?

Site-selection criteria: Site-selection procedures may be established in a number of ways. Typically the procedures must satisfy two requirements: the procedure must be technically sound and the procedure must be seen as fair. To what extent do the procedures used or proposed pass the technical soundness and fairness tests?

Mechanisms for societal control: During the construction, operation, and perhaps the post-closure period, mechanisms may be created to maintain a responsive management presence on the site and to enhance the ability of oversight groups to audit and control. How well developed are those mechanisms?

Waste management as part of energy policy: Proponents of nuclear-generated electricity often believe that the expansion of this source depends in some sense on the resolution of the waste management issue. Opponents of this energy source often believe that efforts to contract or eliminate nuclear power can be furthered by preventing such resolution of the waste management issue. How closely connected are energy and waste management policies?

3.3. Process factor

The character of the decision-making process used to develop and implement programmes for geological disposal may influence public and political acceptance. Examples of relevant considerations are described below.

- Acceptability of “wait and see” ;
- Moving from one stage to another;
- Public participation;
- Incentives and benefits

Acceptability of ‘wait and see’: A ‘wait and see’ policy means that planning for a long-term solution with regard to radioactive waste is postponed into an undefined future. There is no unanimity among Member States about whether a ‘wait and see’ policy regarding radioactive waste is acceptable or not. Even within a given Member State, some groups may believe that action must be taken within a near future, and others may not. A “wait and see” policy increases the risk regarding the availability of funding while increasing technological capacity over time to solve the problem. Are views disregarding a ‘wait and see’ policy widely held?

Moving from one stage to another: A series of decision-making approaches has been identified in previous research [23]. At one end of the range is an approach that seeks to make decisions, such as repository site-selection, licensing, and closure, in one large step. At the other end of the range is an approach that sub-divides the decision-making process into relatively small, discrete steps. Criteria are established that specify the conditions under which the programme can move from one step to another. Care is taken to ensure that a particular step can be reversed if necessary. To what degree has a step-wise process been adopted? To what extent is there agreement on the criteria for moving from one step to another? To what extent is the process reversible?

Public participation: In Member States, there are different traditions with respect to public participation in public policy issues. Moreover participation may vary depending on which decision is being considered. How much participation takes place? When and how actively is public participation encouraged and supported? Which decisions attract public participation? Are the most affected communities provided with the capacity to be active and informed participants?

Incentives and benefits: Member States may conclude that it is important to recognize the contribution to the nation by the host locality and region. If so, processes need to be developed to identify which areas should receive incentives or benefits and how much those incentives or benefits should be. Are incentives or benefits available? Is the process for providing those incentives or benefits fair and appropriate?

3.4. Behavioural factor

In addition to the factors mentioned previously, there is also the important aspect of the social, cultural and behavioural environment within which all the stakeholders find themselves. This will be a function of their backgrounds, values, history, and experience. It will affect the institutions, the experts, the public, and all their interactions. The conduct of persons and institutions responsible for developing, implementing, or regulating a programme for the geological disposal of radioactive waste may also affect public and political acceptance. These aspects of behaviour lead to the following considerations.

- Openness;
- Transparency;
- Accountable actions and decisions;
- Fairness;
- Respect for values and interests;
- Perception of technical competence.

Openness: Historically, decisions about radioactive waste management were often taken by a small group of individuals, typically dominated by the technical and scientific communities. More recently, deliberations have taken place in the public domain with broad and inclusive access to all the relevant information. How open is the process? How committed are the relevant organisations to maintaining openness even if the public offers serious challenges to the progress of the programme?

Transparency: Related to openness is transparency. Transparency refers to whether the *reasoning* behind actions, deliberations, and decisions is clear and made available. How transparent is the process? To what degree do the individuals involved understand the importance of transparency? To what degree are individuals rewarded by their organisations for safeguarding transparency?

Accountable actions and decisions: When a Member State decides to create a participatory process, it can treat inputs from the public in various ways. The responsible organisations can go through the motions soliciting comments but not alter the course that was the subject of the deliberations. Alternatively, the organisation can use the comments as a basis for modifying proposed actions and decisions. How compelling are the explanations given to the public? How frequently do the responsible organisations modify their proposals as a result of public comments?

Fairness: Whenever interactions take place with the responsible organisations, the fairness of the process and the fairness of the outcomes are typically important considerations. Do the responsible organisations treat affected parties differently? If so, why are they treated differently? Are decisions made that take into account the distribution of costs and benefits to localities and regions?

Respect for values and interests: Although full agreement on values and accommodation of interest is often difficult to obtain, there can be considerable variation in the extent to which responsible organisations respect stakeholder knowledge, traditions, preferences, aspirations, and concerns. To what degree is this respect demonstrated?

Perception of technical competence: Developing a repository is a technical challenge. Affected parties will have perceptions about how technically competent the responsible organisation is. When dealing with complex technological risks, a clear statement of data, models and scenarios uncertainties, even gaps in knowledge, could improve decision-making. How broadly is the competence of the responsible organisation recognized?

4. CASE STUDIES

Illustrative case studies are provided (see Table 1) from most of the countries that were represented in consultancy services and/or the technical meeting. These case studies are presented for the following reasons:

— First, the countries involved represent different stages and dimensions of the repository development programmes.
— Second, the countries involved have different political and historical traditions and cultural contexts.
— Third, legal, institutional and political frameworks of the countries represented differ from each other.

These cases provide some important variation with respect to the technical, process, structural, and behavioural factors aforementioned.

TABLE 1: CASE STUDIES PRESENTED

MEMBER STATE	TYPE OF "WASTE" CONSIDERED	EVENTS OR ACTIVITIES DISCUSSED	TIME PERIOD IN FOCUS
Canada	SNF	NWMO Recommendation to government for Adaptive Phased Management	1998-present
China	HLW & Candu fuel	Site Selection 3-Step Strategy	1980-present
Germany	HLW & SNF	Site Selection Gorleben case	1977-present
Japan	HLW	Waste Management Programme Site Selection	1962-present
Sweden	SNF	Waste Management Programme Site Selection	1970's-present
United Kingdom	ILW	Controversy URL Sellafield	Before and after 1997
United States of America	HLW (defence) SNF (commercial)	Passage of the 1982 Nuclear Waste Policy Act	1978-1987
Countries with Small Nuclear Programmes	SNF	General	Pm

4.1. Experience in Canada

Context

Canada has 22 nuclear reactors that, at this time, supply approximately 15% of the country's electricity. Canada's spent nuclear fuel is now stored on an interim basis at licensed facilities at the reactor sites located in Ontario, Quebec and New Brunswick and at the Atomic Energy of Canada Limited (AECL) facility in Manitoba. The issue of long-term management of spent fuel has been the subject of considerable study in Canada.

At the request of the federal and Ontario governments, and after a 20-year research program, a concept for the management of spent fuel was developed by AECL. This concept was subjected to an extensive and lengthy period of deliberation through an environmental assessment and review process of approximately ten years. In its 1998 report, the environmental assessment panel provided insight and direction on key issues that had to be addressed in order to move the decision-making forward. With respect to the AECL disposal concept the panel concluded:

- “From a technical perspective, safety of the AECL concept has been on balance adequately demonstrated for a conceptual stage of development, but from a social perspective, it has not.
- 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” [24].

On the matter of criteria for safety and acceptability they concluded that:

- “Broad public support is necessary in Canada to ensure the acceptability of a concept for managing nuclear fuel waste.
- “Safety is a key part, but only one part, of acceptability. Safety must be viewed from two complementary perspectives: technical and social.”

The Government of Canada considered and responded to the panel report, and in November 2002 brought into force the Nuclear Fuel Waste Act (NFWA) [25] which assigned roles and responsibilities and established the legislative framework for decision-making framework for the long-term management of its spent nuclear fuel. As required by that legislation, the Nuclear Waste Management Organization[3] (NWMO) was established by the nuclear energy corporations. The NWMO was tasked with conducting a study of storage and disposal options, and will be responsible for implementing the management approach selected by government. After the Government selects the approach, implementation will unfold under the ongoing oversight of Natural Resources Canada. The Canadian Nuclear Safety Commission is responsible for the licensing and ensuring NWMO’s compliance with regulatory requirements.

The immediate task of the NWMO was to conduct a three-year examination of different management options, consult widely and make recommendations to the federal government about an appropriate long-term management approach for spent fuel. The NWMO believed that an approach that generates confidence for the long term would need to resonate with citizen values and objectives for the study, and bring to bear the best science and technical understanding. A dynamic and iterative study was conducted to involve specialists and citizens in the collaborative development of a management approach. The NWMO set aside traditional consultation in favour of engagement, to pursue dialogue and deliberation conducive to participants listening and learning about a broad range of perspectives and discussing the best path forward. Dialogue techniques were tailored to engage a variety of communities of interests as well as the general public. Extensive outreach was designed and delivered by Aboriginal peoples, with the support of NWMO. Deliberative research with statistically representative sampling of the general public played an important role in understanding the values and expectations of Canadians and formed the foundation for a broader dialogue. A National Dialogue on Citizen Values was convened to identify the overarching requirements that the public felt should be reflected in a management approach [26].

[3] See www.nwmo.ca

The NWMO completed its study [27] and submitted its recommendations to the Minister of Natural Resources Canada on November 3, 2005. The recommendation is Adaptive Phased Management, which consists of both a *technical method* and a *management system*. The *technical method* proposed by the NWMO includes ultimate centralized containment and isolation of the spent fuel in a deep geological repository in a suitable rock formation. Continuous monitoring is proposed, as is the potential for retrievability of the spent fuel. An underground characterization facility constructed at the selected central site will support demonstration and confirmation of site suitability. Financial provision is made for contingencies, including an optional step of shallow underground storage at the central site, to allow the used fuel to be moved to the central location earlier if necessary, while the deep repository is being prepared. The management system forms an important part of the recommendation. The proposed system embraces the precautionary principle, and provides for phased, collaborative decision-making with flexibility in the pace and manner of implementation, allowing future generations to adapt the implementation of the management approach to experience and societal change. A high level of adaptability is provided in the near term, through sequential decision-making that is supported by genuine choice and informed by new learning advances in technology, natural and social science research; aboriginal traditional knowledge; and societal values and expectations. The proposal assigns a priority to fairness to current and future generations and commits this generation to taking the first steps now in managing the used fuel created. The NWMO recommendation has been submitted to the Government of Canada for review and decision on the management approach.

Technical factor

For NWMO, technical factors were among the essential considerations for the recommendation. A deep geological repository was selected as the most appropriate end point for meeting the NWMO's stated overriding objectives of safety and security for the long term. Key features include continuous monitoring to support data collection and confirmation of the safety performance of the repository, and the potential for retrievability for an extended period of time. A determination on the timing of final closure, and the appropriate form and duration of post-closure monitoring would be determined by future generations. In arriving at its recommendation NWMO set out to incorporate the best knowledge and expertise of specialists in Canada and internationally, while acknowledging that expectations for managing risk and safety will be influenced by societal values and judgements.

Structural factor

The NFWA sets out requirements for the establishment of trust funds by the waste owners (the three nuclear corporations and AECL) to finance the long-term management of the spent fuel. The NWMO has an ongoing obligation to assess the ongoing accuracy of the cost estimates for the selected management approach and the sufficiency of contributions to cover cash flow obligations for the life of the project. Following a government decision on a management approach, NWMO will implement the decision under an extensive system of regulation and oversight, including regular reporting to the Minister of Natural Resources Canada and licensing and regulatory requirements of the Canadian Nuclear Safety Commission and other governmental agencies.

Process factor

The NWMO sought to develop a socially acceptable management approach based on a process of collaborative development with citizens and specialists. NWMO attempted to use the best available knowledge and expertise and to be responsive to the values and principles citizens said were most important to them. The assessment framework and study of management options was developed jointly with specialists [28] [29], who provided technical information, and citizens who established the social and ethical platform.

Behavioural factor

The NWMO study has begun a process of dialogue and engagement with specialists and citizens that will continue through different phases of implementation. Participants emphasized that the *manner* in which any approach is implemented will be as important as the choice of technical method. Accordingly, in setting out a proposed implementation plan, NWMO has committed to an open, inclusive and fair siting process as it seeks an informed willing host community. Continued public engagement and respect for aboriginal rights, treaties and land claims will remain key issues. The implementation process proposed by NWMO would allow for all interested parties to have an opportunity to have their views heard and taken into account, and encourage active involvement of all groups most likely to be affected by the facility, including through transportation.

4.2. Experience in China

Context

China operates 10 nuclear power reactors and has 5 more under construction. A large extension of nuclear power is expected by 2020. Nuclear generated electricity accounts for 2% of the total electric power generation. The Chinese policy is to have spent fuel reprocessed in China. So, final disposal include vitrified waste and some CANDU spent fuel for direct disposal.

There is a legal framework in place in China to manage HLW. The China Atomic Energy Authority (CAEA) has the responsibility for setting policy on HLW disposal and implementing the disposal programme, while the National Nuclear Safety Administration (NNSA) and the State Environment Protection Agency (SEPA) are the regulatory bodies, which are responsible for licensing and reviewing of environment impact assessment report. The China National Nuclear Corporation (CNNC) is considered to be the actual implementer, conducting the major activities for HLW management [30].

In the 1980's, China started generic research and development for HLW disposal. After reviewing the major progress made in other countries and considering the actual situation in China, the experts in CNNC proposed to choose granite as the host rock, to select multi-barrier system as the disposal concept, and to start site selection process. The granite is widely distributed in China, with large volume, good integrity, low permeability and favourable engineering properties. The Beishan granite site, located in northwest China's Gansu province has been selected as the most potential site for China's HLW repository. It is located in a Gobi desert area, with few permanent people, low precipitation, high evaporation, little vegetations, large granite intrusions and favourable hydrogeological conditions. However it is now considered as necessary to review the suitable host rock types (granite or clay) in China and the potential suitability of Beishan granite.

The preliminary strategy for HLW management is a 3-step strategy: the “site-URL-repository” strategy. The strategy involves selecting an area for an underground research laboratory which might later be transformed into a repository, then to construct a site specific URL at the repository area, and at last to build a repository. The preliminary schedule is to have an URL ready by 2020 and to construct the repository by the middle of the 21st Century [31].

Technical factor

It is still unclear whether or how the technical factor affected the public and political acceptability of the repository development process.

Structural factor

The CAEA has not clarified the responsibility of CNNC as the actual implementer, and, consequently, this might affect the progress of HLW disposal programme. In addition, the funding mechanism for waste disposal has not yet been established. Further, the nuclear power plants companies have not been involved in the HLW programme.

Process factor

Due to the favourable conditions in China’s Beishan site, it was considered as the most potential site for a HLW repository, but without much discussion and consultation with regulatory body and scientists. China Atomic Energy Authority (CAEA) established an Expert Group for High Level Radioactive Waste Disposal in 2005. The expert group has pointed out the importance of stepwise decision process and indicated it is necessary to review the siting process and host rock type in 2006 in an open manner. It is also necessary to involve representatives from different scientific sectors, in order to get consensus at least among technical experts. In this context, explanation to choose granite and Beishan site should be presented in detail and the expert group will make its judgement for further activities [32].

Behavioural factor

Successful implementation of HLW disposal programme depends not only on a properly instituted process and structure, but also on the behaviour of those involved in the process. Prior to 1997, due to the small scale of HLW project, it was not so open and transparent. The local government and local people have not been well informed about the site characterization activities in the Beishan area. Recently, CAEA has realised the importance of openness, transparency, accountability and communication with local government. In August of 2005, CAEA organised an open workshop on HLW disposal, and 110 participants from different sectors attended. During the workshop, a report named “A Guideline for the Short- and Long-term Plan of High Level Radioactive Waste Disposal in China” was released, waiting for open comments and modification.

4.3. Experience in Germany

Context

Germany has 17 operational nuclear power reactors and 19 are shutdown. The nuclear share in the gross electricity production is approximately 30%. Phase out of nuclear energy production is planned to be realised between 2020 and 2025. Spent fuel is stored at reactor sites, vitrified reprocessed waste and spent fuel is stored at the centralised storage facility at Gorleben.

In the 1970s, a mix of technical and social criteria (e.g., seismic activities, farming and transportation issues) was considered in site selection. Focus shifted to three salt domes in Lower Saxony, but local populations were not involved in policy decisions, which resulted in local resistance. In 1976, the government of Lower Saxony asked that site investigations be stopped until they could identify a site on their own. In 1977, the government of Lower Saxony identified the Gorleben salt dome and the Federal Government accepted this decision. Neither a systematic decision-making process nor a wide site investigation preceded the designation of the Gorleben site. The decision resulted in strong local and regional opposition to the project. In 1977, the predecessor to the Federal Office of Radiation Protection (BfS) filed an application to start the licensing procedure. Surface-based investigations started in 1979, and a decision on underground investigation was made in 1983 [33, 34].

This decision was reached despite the fact that several experts found the site unsuitable due to some unexpected hydrogeological findings (particularly the so called „Gorleben channel"). In 1985, underground investigations started and an exploratory shaft was built by 1996. The first section of the underground area was studied until 2000, when investigations were interrupted as part of a 1998 agreement between the Federal Government and the utilities about phasing out nuclear power. A key element of that same agreement committed the government to establish a deep geological repository for all types of radioactive waste by 2030.

Because of public concerns about the selection of the Gorleben site, in 1999 the Federal Ministry for Nature Conservation and Reactor Safety (BMU) established the AkEnd Committee. The Committee was charged with developing a siting procedure based on a set of technical selection criteria that are independent of the rock characteristics. The Committee included experts with different backgrounds and different views. It followed a new approach (for Germany) of sharing information with the public: it organized public workshops and fora, established a website, gave lectures, and, published its decisions in 2002, including the minority opinions [35, 36]

The key recommendations of the AkEnd Committee follow: (1) safety first, (2) geological disposal as the only sustainable option, (3) national responsibility (i.e. no export from or import to Germany), (4) responsibility of today's generation, and a site selection process that begins with geological criteria to identify potential sites.

In addition, in 2000 BfS has been assigned the task of having the fundamental conceptual and safety-related issues valid for all potential host rocks in Germany investigated with respect to the disposal of radioactive wastes. BfS was instructed to evaluate the investigation results and prepare a synthesis report focussing on a comparison of these host rocks [37].

Technical factor

The work of the AkEnd Committee and the BfS reinforced the view that site selection has to be made on a sound technical defensible basis. In particular, the BfS investigations concluded that, in principle, no host rock always ensures a higher level of repository safety than another one. Repository concepts can be elaborated and adopted to all relevant types of host rock in Germany. Different options can only be compared if the comparison is made between specific sites and repository concepts. This conclusion implies that a comparison of sites is necessary.

Structural factor

In Germany two main structural factors can be identified which may reduce public and political acceptance of geological disposal. First, the responsibilities of the policy maker, the regulator and implementer fall within the jurisdiction of one agency, the BMU. This may lead to public mistrust. Second, the costs for geological disposal are first supported by the government. Government gets the funding by fees from the waste producers. If waste management policy has to change for political reasons, the government has to pay back the money. This leads to a situation that might be very inflexible.

Process factor

Several reasons for the failure of the German approach in implementing the Gorleben site can be identified. First, until 2002 there was no attempt to involve the broader public in radioactive waste management decisions. Second, since the late 1970s the Gorleben site is heavily criticised by non-institutional experts for technical reasons, while institutional experts continue defending it. Third, after the Chernobyl accident the issue of nuclear energy has come to the fore and has become the subject of national party political platforms. Since then, the issue of radioactive waste has become increasingly of political nature. Indeed, although reaction to the AkEnd efforts was generally positive, views were divided along pro- and anti-nuclear lines, since attitudes towards radioactive waste management are strongly influenced by attitudes towards nuclear energy in general.

Similarly, attitudes among industry, NGOs, and institutional actors with respect to the importance of developing a deep underground repository may also fall along political lines.

Behavioural factor

There is general agreement that the approach taken by the implementer in the past did not meet the current requirements for openness and transparency.

4.4. Experience in Japan[4]

Context

One-third of the total electricity produced in Japan comes from 53 nuclear power reactors. The basic Energy Plan states that nuclear fuel cycle will be promoted as national policy that includes reprocessing spent fuel. At the present, spent fuels are stored at each reactor site and an interim storage facility in Rokkasho, where they await reprocessing. Some spent nuclear fuel has been reprocessed in Japan, and the vitrified waste is currently being stored. Some of the HLW from fuel reprocessed in France has been being shipped back and is stored at Rokkasho. Other high-level waste is waiting in the U.K. for its return to Japan.

An administrative framework for the utilization of nuclear energy in Japan was established in 1956. By 1962, two realistic alternatives for final disposal of radioactive waste were proposed: dumping the waste into the deep ocean and disposing of the waste in deep underground repositories. By the mid-1970s to 1980s, geological disposal gradually came to

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4 For more information, see following websites: aec.jst.go.jp; www.enecho.meti.go.jp; www.numo.r.jp; www.jaea.go.jp (Japan Atomic Energy Research Institute [JAERI] and Japan Nuclear Cycle Development Institute [JNC] were unified to the new organization, Japan Atomic Energy Agency [JAEA])

be recognized as the most probable option for the management of HLW. In 1976, Japan's Atomic Energy Commission (AEC) published comprehensive guidelines including some key elements relating to geological disposal. In 1980, the Special Committee of the AEC indicated a stepwise procedure (revised in 1985) for geological disposal. In 1987, the AEC, in its long-term programme report on research, development and utilization of nuclear energy (LTP), recommended:

- the establishment of an implementing organization;
- a clear allocation of responsibilities among the related organizations; and
- a site selection process with a sufficient degree of public support and understanding.

The safe disposal of HLW is widely considered to be one of the most important tasks remaining in connection with the promotion of nuclear power generation. A law relating to geological disposal of HLW, the Specified Radioactive Waste Final Disposal Act, was promulgated in June 2000. The Act specifies the overall implementation scheme and defines the roles and responsibilities of the government (METI) and relevant organizations: implementing organization (NUMO), funding management organization (Radioactive Waste Management Funding and Research Centre -RWMC), and owners of power reactors, as shown in Figure 1 [38]. Based on the Act, NUMO was established by owners of power reactors as a private non-profit organization and approved by METI in October 2000. NUMO is responsible for identification of the disposal site, licensing application, construction, operation and maintenance of the repository, closure of the facility and post-closure institutional control. A siting programme for geological disposal was started by NUMO in December 2002 [39]. To initiate the site selection process, NUMO has chosen an "open solicitation" approach for finding candidate sites, which means a wholly transparent volunteering approach.

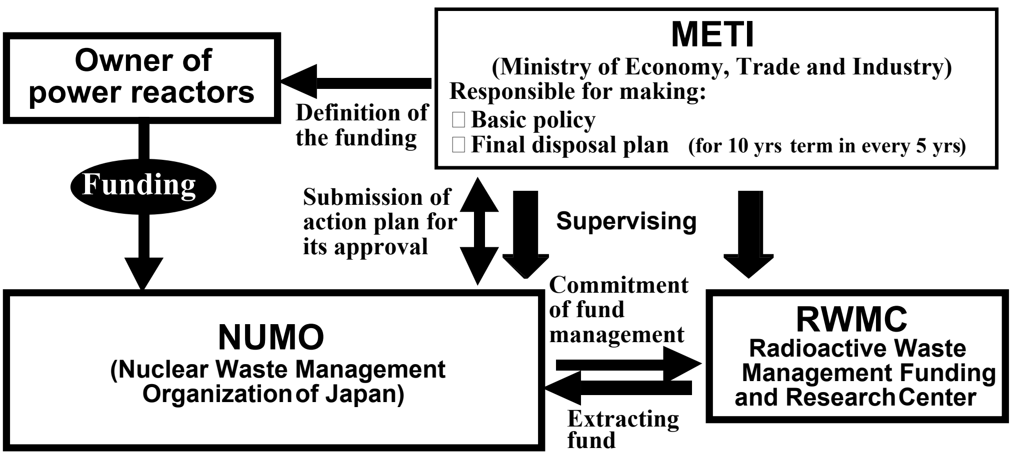

Figure 1. Framework of Implementation for the HLW disposal programme in Japan

The safety regulation is not included in the Act and will be established as the site selection process progresses. The regulatory body (Nuclear and Industrial Safety Agency [NISA]), which is housed within METI, has been actively discussing the safety regulatory framework for HLW disposal.

The above-mentioned Act also stipulates that the siting process shall identify locations with increasing specificity (*Preliminary Investigation Areas, Detailed Investigation Areas, Final Repository Site*), and that the Minister of METI shall respect opinions of Mayors and Prefectural governors in the decision-making on candidate sites.

As of December 2005, no official application had been received from a volunteer municipality, NUMO has continued to interact with communities and carry out discussions aimed at inviting solicitation.

Technical factor

Given the ‘volunteering approach’ recently taken in Japan, it is not clear at the present time whether or how the technical factor will affect the public and political acceptability of the repository development process. Flexibility is important to maximise the number of possible volunteers.

Structural factor

Some political officials and NGOs maintain that NISA should be separated from METI and re-established as an independent regulatory body in order to increase public trust.

The distribution of power amongst national, regional and local governments also appears to make a difference in public and political acceptance. For example, there has been some controversy surrounding each of the URL projects. Much of that controversy was resolved when the local communities in Mizunami and Horonobe reached agreements with JNC that certified that neither URL would ever be developed into a HLW repository.

Process factor

The public does not believe that the policy-making and decision-making processes were carried out in a transparent way and in a manner that involved their representatives, especially in very early stage of nuclear energy development. In many public forums dealing with HLW disposal, some participants put forward their complaints about a lack of transparency and the public involvement for selecting nuclear energy and geological disposal. Recent policy-making and decision-making have been carried out in a more transparent way to take the public opinions into consideration by holding public hearings and/or asking the public to submit comments.

NUMO maintains the importance of public participation in its activities and is aiming at promoting public involvement in the process of site selection. This process consists of “adopting a stepwise approach,” “respecting the initiative of municipalities,” and “ensuring transparency in information disclosure”, in accordance with the government’s basic policy issued by the Cabinet in 2000.

Behavioural factor

It is unlikely that a community will consider hosting a repository unless local decision-makers and the public have sufficient information and expertise to make an appropriate judgment. NUMO believes that it is therefore essential to set up a framework by which critical information can be accessed by the interested public. Such information includes the overall and detailed schedules for siting, safety principles and plans for the promotion of the local economy and infrastructure, both by the government and the implementing organization. Accordingly, NUMO has established a rule of conduct for information disclosure.

4.5. Experience in Sweden[5]

Context

Sweden has currently 10 operating nuclear power reactors; 2 such reactors have been closed down since 1999. Nuclear power generates almost 50% of the electricity consumption. SNF from all reactors is stored at one central facility close to one of the reactor sites (CLAB in Oskarshamn). Since 1988, one central repository for radioactive operational waste, the SFR located at the Forsmark site near the community of Östhammar, is functioning.

According to current Swedish legislation companies licensed to operate nuclear power plants have full responsibility for safely managing all waste, including SNF. This responsibility includes conducting the necessary research and development work as well as carrying all costs. The obligations of the nuclear power utilities are carried out through a jointly owned company, the Swedish Nuclear Fuel and Waste Management Company (SKB).

To fulfil the provisions in the current legislation (1984), SKB has to present to the Government every third year a comprehensive programme for research and development activities in a shorter and longer perspective. A regulatory authority, the Nuclear Power Inspectorate (SKI), is responsible for reviewing the programme and recommending whether the Government should approve the programme or not. SKI may also propose that the Government impose conditions on SKB's future work. As an integral part of this review, comments on the programme are invited from a wide range of interested and affected parties, including other regulatory authorities and municipalities potentially affected by the activities within the programme. In addition to this comprehensive review, a scientific advisory committee (the National Council for Nuclear Waste [KASAM]) with a broad area of competence also reviews SKB's programme and gives recommendations directly to the Government.

The system of regular review of the programme means that Government can exercise influence on more important strategic steps, although the responsibility for taking the necessary measures still rests with the operators/SKB. To make major concrete steps to implement the programme. SKB has to apply for a type of general licence by the Government and for more detailed permits and licences by the Environmental Court and the regulatory authorities.

SKB started in the late 70s to develop its repository concept, today known as KBS-3. This was subjected to intense national and international review. The concerned regulatory authorities seem to be confident in the method for disposal that SKB suggests, although they stress that much work remains to be done before a licence can actually be granted [40, 41]. The Government has taken the position that it should not formally approve a certain method for disposal only on generic grounds. Instead, approval of a certain method should only be granted as a part of a decision to approve an application to construct a repository at a certain

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[5] For more information, see following websites: www.skb.se; www.ski.se; www.ssi.se; www.sou.gov.se/kasam (or www.kasam.org); www.karnavfallsfonden.se

site. This Government position created difficulties for local politicians because they felt a need to be able to give a clear answer on questions from the public about what kind of facility may be located to the municipality. After pressure by local politicians in the concerned municipalities, the Government declared in 2001 that the suggested method could be used as a "planning requisite" for SKB in its future work – although the Government at the same time stressed that this declaration must not be interpreted that a licence would be given once an application had been submitted [42].

Planning for siting a repository for SNF started during the 1970s. This siting process should not be regarded as the result of a plan that was carefully thought out from the start. Instead, the process has developed during this period through an interaction between concerned municipalities, SKB, the regulatory authorities, and the Government. The process has functioned without major disturbances since the middle of the 1990s. The following steps can be traced [43, 44].

- The utilities (during an initial period in cooperation with government authorities) started to gather general knowledge of bedrock characteristics from 1976. This was achieved both through desk studies and by drilling activities at some places. Drilling activities were opposed by local populations and stopped in 1985, but desk studies continued.
- In 1992 SKB contacted most municipalities in Sweden, explained their task according to current legislation and asked for volunteer cooperation to be able to carry out "feasibility studies" in order to find suitable geological and other conditions somewhere in Sweden for a deep repository. It was clearly stated that "feasibility studies" did not comprise drilling activities. Discussions resulted in two volunteering municipalities, Storuman and Malå, situated in the northern part of the country.
- After some time, the Government declared that it expected SKB to base a future application for a permit to construct a repository on 5-10 feasibility studies and at least two "site investigations". In this situation, and faced with local opposition in Storuman and Malå (eventually resulting in local referenda in these two municipalities and a majority voting against future involvement with SKB), the company approached municipalities where nuclear activities already were established and where the bedrock was thought to be suitable for hosting a repository. Around 1995, three of these municipalities (Nyköping, Oskarshamn and Östhammar) gave their consent for SKB to start feasibility studies within their respective boundaries.
- Neighbouring municipalities to Oskarshamn and Östhammar were approached some years later and in 2000 SKB had carried out a total of eight feasibility studies (including those in Storuman and Malå).

Based on the result of these feasibility studies and on other information, SKB announced in late 2000 that it wished to conduct detailed site investigations in three of these municipalities. After a thorough review by the regulatory authorities, KASAM [45, 46] and other bodies [47], the Government declared that it had no objection to SKB's choice of sites for these investigations. Two of the concerned municipalities, Oskarshamn and Östhammar, agreed a year later to allow SKB to start site investigations, but the third (Tierp, a neighbour of Östhammar) was opposed. Two investigations are currently being carried out and results are forming a basis for consideration within SKB [15].

On the basis of the expected outcome of the ongoing two site investigations and other preparations, SKB plans to submit an application in 2008 for constructing a repository for spent nuclear fuel. But as early as 2006, SKB plans to submit an application for constructing an encapsulation facility that will be needed as a part of a system for disposal of spent nuclear fuel [15, 48].

Technical factor

For a long time, SKB has argued that the so-called KBS-3 concept is the preferred disposal method. The KBS-3 concept was subjected to intense internal and international peer review and over the years a strong consensus on the technical feasibility of the concept has developed among technical specialists. The Swedish government supported developing this concept further. The leaders of local communities were aware of this support, which may have influenced their willingness to participate voluntarily in feasibility studies.

Structural factor

The structure/framework within which SKB has to function contains an independent regulator, as well as a clear distinction between the tasks of the regulator and the tasks of the implementer. In addition, the framework contains a financing system. It seems as there is a general trust in the institutions that have been set up.

A factor of decisive importance is the distribution of power between local/regional and national bodies. Even if the central Government is the body with power to issue the necessary licences, the strong position – both formally and informally – of the municipalities must be stressed.

SKB's site selection process is based on the assumption that it is possible to find a site that fulfils regulatory safety requirements for a repository and that this site is suitable for industrial establishment as well as located in a municipality where the public attitude is not negative with regard to the construction of such a facility.

But there are also some factors outside the control of the implementer that may have worked in the same direction. One such factor is the fact that the role of nuclear power in Swedish electricity production is no longer as high on the political agenda as it was in the late 1970s and the 1980s. The phase-out of nuclear power, voted by referendum in 1980, may still be a declared goal for energy policy, according to a clear majority in the parliament. But recent opinion polls indicate that such a policy seems to have decreasing support among the public. The fact that the general public does not seem to worry so much about the issue of nuclear power may also have contributed to a less agitated discussion of the issues concerning disposal of spent nuclear fuel.

Process factor

During the development of the current siting process, demands for a transparent process were raised. Such demands came especially from those formally representing the population in the concerned municipalities (elected local politicians) and from groups with an overtly critical view of SKB's activities. The regulatory authorities at an early stage also recognized the need for transparency, clarity and predictability. It seems as if these demands have been satisfied to a great extent. It has been done partly by providing information to the public about the process, partly by actively inviting people representing the affected municipalities to take an interest in the process, including compensating them economically for lost earnings when participating in meetings and seminars for example. This funding system has functioned as a way of empowering concerned municipalities. Recently, a system has also been set up to fund the activities of non-governmental organizations, provided they qualify according to certain criteria and that they take part in the prescribed Environmental Impact Assessment (EIA) process.

It has also become clearer for people who are interested in the issue that siting a repository for SNF is a stepwise iterative process.

However, the current siting process has also been criticized for giving too much weight to criteria like political acceptance or existing infrastructure with regard to geological aspects. This criticism has led to requests by the regulators that the implementer should make clear, a posteriori, what criteria are relevant for site selection and how these criteria should be applied. These would cover all relevant aspects (e.g. geology, infrastructure etc). SKB has stated that the safety of the site is a prerequisite but that also other factors, such as infrastructure and demographic aspects etc, could be taken into account. Given the fact that the siting process is based on voluntary participation of concerned municipalities, it remains to be seen how SKB will prove — in a future application to construct a repository at a certain site — that the safety of the repository is not compromised even if non technical considerations, such as infrastructure aspects, have been taken into account.

Other process factors seem to come into play. First, there is a continuous dialogue going on between the implementer, SKB, and the regulators and the concerned municipalities. On the local level, SKB meets both representatives of the municipalities and concerned inhabitants. The system of regular reviews of research programmes serves as a kind of dialogue between SKB and most of the interested and affected parties. Second, the programme is reversible because all major actors seem to be willing and ready to reconsider their positions, should new facts become known or public support for current planning activities be lacking. Third, but not least, there seems to be confidence in the minds of most of the general public that the implementer *and* the regulatory authorities are firmly committed to acting according to given rules. Taken together, all these factors have contributed to a feeling of trust in the process among most people who are concerned by or are participating in this process in one way or the other.

Behavioural factor

The system of regular reviews of the implementer's programmes for research and development work in connection with disposal of spent nuclear fuel has been important. A wide audience, which includes interested members of the public in concerned municipalities, has had access to comprehensive reports describing the plans of the implementer and has also had the possibility to provide comments on the plans. Over time these reports have been refined and developed in a way that has made them more and more accessible (understandable) for non-experts.

The behaviour of the implementer is no doubt of vital importance for earning and maintaining trust and confidence. SKB seems to have gradually developed an attitude that "there are no silly questions".

The behaviour of the regulator is also of great importance. It can be noted that the siting process has resulted in changes in the regulatory approach. Before the process was initiated the focus was on supervision, safety reviews and building of competence for the review of SKB's future licence applications. Communication and dialogue had a rather low profile and procedures for regular interaction with the municipalities were not established. As experience grew, regulators gradually came to the insight that the municipalities had great expectations for the active involvement of the regulatory authorities in the siting process. Since the middle of the 1990s regulators have been active and visible in the site selection process. This behaviour is not regarded as an obstacle to their future independent review of licence applications [49].

Public attitudes regarding a future repository have been affected positively by the conclusion to the discussion about "international repositories." The Swedish position is clearly not to accept nuclear waste from other countries in a Swedish repository. Both municipalities where site investigations are currently made have even declared that it is a condition for their positive attitude that a possible repository is only intended for Swedish waste.

4.6. Experience in the United Kingdom[6]

Context

The United Kingdom of Great Britain and Northern Ireland has 23 operational nuclear power reactors operating on 12 sites and an additional 22 reactors are shut down. Nuclear power generates almost 20% of the electricity consumption. Waste is stored at reactors sites and at Sellafield, where some are awaiting reprocessing. Vitrified HLW is also stored at Sellafield.

In the United Kingdom, there is a legal framework in place to manage radioactive waste. A government department (formerly the Department for Environment [DoE], now Department for Environment, Food and Rural Affairs -Defra) has the responsibility for setting policy on radioactive waste. There are two key regulatory functions: one is responsible for installation and worker safety (Nuclear Installations Inspectorate [NII]), and the other for environmental issues (Her Majesties Inspectorate for Pollution [HMIP], now part of the Environment Agency (EA) and the Scottish Environmental Protection Agency [SEPA]).

Middle of the 90s, Nirex, a company then owned by the waste producers, applied for a permission to construct a rock characterization facility (RCF) near the community of Sellafield. The RCF would have allowed the detailed *in situ* investigation of the rocks beneath Sellafield to see if they were suitable for a geological repository for ILW. The local planning inspectorate refused permission after a Public Inquiry. This decision was confirmed in 1997 by the Secretary of State for the Environment.

Because the application was just for constructing a RCF, insufficient attention was paid in this process by the implementer to a potential consequence of such construction, the development of an ILW repository. Although there was a discussion in the RCF planning application of the uncertainties involved with a geological repository, the safety description was not simple or easily understandable by lay audiences. Moreover, there were major disputes between experts about how a repository might perform. One specific issue that was not addressed to the satisfaction of the public was the extent to which the waste could have been retrieved at some point in the future. There was a strong feeling that a degree of flexibility should be built into any concept for long-term waste management.

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[6] For further information, see following websites: www.nirex.co.uk; www.corwm.org.uk; www.bnfl.com

The government subsequently launched the Managing Radioactive Waste Safely (MRWS) [50] consultation programme in 2001 to review its policy on ILW and HLW. As part of this (in 2003), the government established an independent committee on radioactive waste management (CoRWM) to make a recommendation as to which option(s) the UK should adopt. It is expected that CoRWM will make a recommendation in July 2006 [51] and then for Government to make a decision [52].

In April 2005, the Government made Nirex independent of industry, in a move to boost transparency and accountability in the long-term management of radioactive waste [53, 54]. The shares in Nirex, previously owned by the nuclear industry, have been acquired by a new Company limited by Guarantee, jointly owned by the Department for Environment, Food and Rural Affairs and the Department of Trade and Industry. Under the arrangements, Nirex will also remain independent of and separate from the NDA, with funding coming through the NDA via a funding agreement between the two parties.

However, it must be noted that at this time there is no work specifically associated to siting or implementing a deep geological repository facility.

Technical factor

In retrospect, Nirex should have ensured that the underlying science and technology involved with the RCF was seen as correct, robust, and safe. Moreover, Nirex failed to appreciate the close connection between the RCF and a possible ILW repository that might be constructed at the same site [55].

Structural factor

Over the years, Nirex as the implementer was owned and controlled by the radioactive waste producers and was viewed by the public as part of the problem rather than part of the solution. There was no clarity between the short and long-term issues meaning that the regulators and the others who would have to make decisions could not easily do so.

Studies undertaken after 1997 using focus groups [56] have shown that the general public feels that the organization responsible for long-term waste management should be able:

- To demonstrate its independence from all waste producers and from short-term political pressure; and
- To gain respect by being technically competent, politically impartial and by considering the protection of future generations.

Process factor

Discussions with a wide range of interested and affected parties have revealed that, in the years leading up to the Public Inquiry, the decision-making process adopted by Nirex was seriously flawed. In particular, it is generally recognized that the approach used prior to 1997:

- Was not transparent
- Was not developed in consultation with all interested and affected parties
- Did not have clear decision points
- Did not explain how decisions had been taken
- Did not provide opportunities for interested and affected parties to provide inputs.

Nirex used a closed process whose pace was driven by pre-determined deadlines and not by the needs of those interested and affected by the proposal.

The pace of progress – the speed at which the process moved from one phase to the next - was determined by the time allocated in a project plan. In addition, there was no independent review of technical options for the management of long-lived radioactive waste, nor was there any consideration given to create a “contract” between the authorities and a potential host community. Consequently, there was little clarity about the role of the local community in the proposed project.

Behavioural factor

There was no open debate or free access to all relevant information. There was little transparency associated with the reasoning behind actions, deliberations, and decisions that were taken. Interested and affected parties and the wider public were not involved, and their opinions were not seen as being taken into account. Nirex did not publicise the reasoning behind its decisions and did not give people feedback on how their views had been taken into account, or if not, why not. Moreover, Nirex was not widely viewed as technically competent to undertake these projects. Nirex did not create such a perception even though many experts supported their position.

4.7. Experience in the United States of America[7]

Context [57-60]

In the United States, 103 nuclear power reactors generate approximately 20% of the country’s electrical power. An additional 28 reactors have been shut down. Most of the waste is in the form of SNF, most of which is stored in pools and dry casks at reactor sites. A small amount of SNF is stored at a privately-owned centralized facility located in Morris, Illinois. Minor amounts of HLW from reprocessing commercial fuel are also being stored in West Valley, New York.

The United States developed the legal and institutional framework for disposing of HLW and SNF over a period of more than 50 years. HLW and SNF were produced by the country’s defence nuclear programme and by its commercial nuclear power programme. Between 1945 and 1968, the country had not adopted any laws or regulations directed specifically at the disposal of those long-lived radioactive waste. In 1968, the U.S. Atomic Energy Commission promulgated the first regulation dealing with such waste. The regulation required that waste generated at commercial reprocessing plants had to be solidified within five years of their generation. The regulation further required that the solidified wastes be transferred within another five years to the Federal Government and disposed of in a federally constructed and owned deep underground repository.

Although the Federal Government initiated efforts to site a repository beginning in the late 1960s, the development of the legal and institutional framework for disposing of long-lived radioactive waste did not begin until the mid-1970s. Most notably, in 1978, President Jimmy Carter established the Interagency Review Group (IRG), composed of representatives from more than 20 federal agencies, to formulate an administration-wide approach to managing

[7] For more information, see following official government websites: www.ocrwm.doe.gov; www.nrc.gov/waste/high-level-waste.html; www.nwtrb.gov; www.epa.gov/rpdweb00/yucca/index.html.

such waste. The IRG carried out its work over a period of nearly one year, during which time it held several public meetings and solicited comments on a draft report. The IRG also created an advisory committee made up of scientific experts and representatives of a range of interested and affected parties from outside the Federal Government.

In 1979, a majority of the IRG recommended a siting approach that would result in at least three sites being fully characterized and a process that would lead eventually to one site being selected for a deep underground repository. The IRG unanimously recommended that States be consulted and be given the opportunity to concur in the site selection process. President Carter approved these recommendations in 1979 and called upon the U.S. Congress to pass legislation to implement the approach adopted by the IRG.

In 1982, Congress passed the comprehensive Nuclear Waste Policy Act (NWPA) by large majorities in each house. This comprehensive law codified many of the key recommendations of the IRG. The law designated the Department of Energy (DOE) as the organization responsible for siting and developing a repository for HLW and SNF. It authorized the Environmental Protection Agency (EPA) to develop safety standards and the Nuclear Regulatory Commission (NRC) to develop regulations that would be used to decide whether the DOE should be permitted to construct a repository. The NWPA also required the DOE to prepare guidelines for selecting sites for characterization and to follow a specific process for choosing a site for a repository. The law provided for a State veto of any site selected for development as a repository, but that veto could be overridden by a majority in each house of Congress. Further, the NWPA established funding mechanisms for ensuring that those consuming nuclear-generated electricity would pay for the disposal of the radioactive waste thereby created.

The NWPA struck three fundamental bargains among parties who were interested in and affected by the generation of HLW and SNF.

— *Site selection would be driven primarily by technical considerations.* The NWPA listed the geologic criteria that had to be used in selecting candidate sites for characterization. It explicitly established a process by which the sites would be compared almost entirely based on their capacity to isolate and contain the long-lived radioactive waste.

— *Disposal would not be deferred.* The NWPA ratified the idea that the generation creating the waste would be responsible for ensuring that at least the capacity for disposing of the waste would be developed. Moreover, in exchange for accepting a surcharge on nuclear-generated electricity, utilities received a contractual commitment that disposal would begin by a fixed near-term date (January 1998). The commitment to early disposal addressed concerns, especially among environmental NGOs, about intergenerational equity. At the same time, the nuclear power industry accepted to levy a surcharge to customers on nuclear-generated electricity, which internalised waste management costs, in return for a contractual commitment by the federal government to begin accepting SNF for disposal by a fixing date.

— *The geographic burden for disposing of the waste would be distributed fairly.* At the time the NWPA was passed, more information was available about the technical properties of potential sites located in the western part of the country than was available about sites in the eastern part of the country. This circumstance raised concerns that one region of the country might have to bare a disproportionate burden. Thus the NWPA authorized the construction of two repositories, with the presumption that the second one would be sited in the east. Communities selected would be provided benefits.

Technical factor

The NWPA contains an explicit requirement that multiple barriers be employed to isolate and contain the waste. That requirement was added to increase confidence that the repository would perform as projected. In addition, the law required that the impact of transportation be considered in the selection of a repository site. States were concerned that the transportation of waste to some sites might present too large of a risk.

Structural factor

Those involved in the passage of the NWPA believed that it was important to ensure that sites were selected predominantly on the basis of their technical merit. Hence the emphasis in the law was lying on pre-specified criteria for selecting sites for characterization,[8] on parallel characterization of sites, and on explicit comparisons among the characterized sites. This focus on technical merit appears to have facilitated political acceptance by seemingly requiring choices to be made on an objective basis.

The question of how power would be distributed between the Federal Government on the one hand and the States on the other had been resolved in an acceptable manner. The IRG had suggested that the States be given an unconditional veto at the site characterization stage of the process. The National Governors Association, however, convinced policy makers that, if Governors had such power, they would be forced by public opinion to use it. Consequently, it was decided to give a State the power to veto the selection of a site for development as a repository but also to allow Congress to override any veto.

Concerns about intergenerational equity led Congress to establish a funding mechanism and a relatively tight schedule. The funding mechanism required that the current beneficiaries of nuclear power would pay the cost of disposing the waste. The schedule required that waste be removed from temporary storage as expeditiously as possible.

Finally, those involved in the passage of the NWPA believed that the need for creating a legal and institutional framework for disposing of HLW and SNF existed independently of whether the nuclear power option expanded, stabilized, or contracted. In particular, no one was prepared to hold the legislation hostage to the larger and more complex societal issue of the future of nuclear energy.

Process factors

The legislative process that ended with the passage of the NWPA never attracted, like most other laws enacted by Congress, the attention of many people in the general public. And because it was passed prior to any effort to site a repository, the process also did not attract the strong attention of local communities. Rather, the NWPA ultimately passed because a quite small elite, including national legislators and their staffs, state legislators and their staffs, political appointees and career officials of several agencies, and representatives of environmental groups and the nuclear power industry, believed that the legislation struck a balanced set of bargains, which were described above.[9]

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[8]A focus on the properties of the natural system at a site led the Department of Energy to give only limited performance credit to the engineered system when selecting sites for characterization. See 10 CFR 960.
[9]Notably, five years after it was passed, the level of public and political acceptance for the NWPA dropped dramatically. Many of the fundamental bargains had broken down, and many of the reasons for supporting the

Because members of the general public were not involved in the legislative process, a number of factors having to do with the extent of public participation are not relevant for this case. Nonetheless, the vast majority of the elites involved did believe that it was important to create an institutional and organizational framework that would force the repository development process to be open to a wide range of public input. Thus, the NWPA required the DOE to solicit public comment on its *Mission Plan*. The EPA, the NRC, and the DOE had to prepare draft standards, regulations, and guidelines, hold public meetings, and receive and respond to public comments before those rules could be finalized. The DOE had to prepare an Environmental Impact Statement, which would be scrutinized by the public. The DOE would have to conduct a public meeting before the Secretary of Energy could recommend a final site for development of a repository. The public also could be involved in the NRC process for licensing a repository.

Behavioural factor

The behavioural factor, as used in this report, generally refers to how those responsible for developing a repository, i.e., implementers, government officials, regulators, etc., interacting with members of the general public or with interested and affected parties, such as members of a community being considered as a site for a waste management facility. As noted above, neither the general public nor citizens living at potential sites were at that time much involved in the passage of the NWPA. Thus, this factor is largely irrelevant in this particular case.

4.8. Experience of countries with small nuclear programmes

Context

Many countries with limited number of nuclear power reactors have developed plans for management of their radioactive waste but have some common difficulties to implement some stages of each national plan [61]. Examples of such countries are Lithuania, Slovenia, Bulgaria, Hungary, Romania, and Argentina (see Table below).

Examples of some countries with small nuclear programme

Country	**No. of operating power reactors**	**No. of shut-down power reactors**	**% of electricity production**
Argentina	2	-	~ 8
Bulgaria	4	2	~ 45
Hungary	4	-	~ 38
Lithuania	1	1	~ 70
Romania	1	-	~ 10
Slovenia	1	-	~ 20

legislation had become suspect. Frustration with the implementation of the repository program by the DOE probably contributed to Congress' decision to amend the NWPA to require that only one site, at Yucca Mountain, Nevada, be characterised to determine whether it was suitable for a repository.

Management of radioactive waste in these countries must address considerations that are not usually present in countries with large nuclear programmes. Because of the small quantities of waste involved, the unit cost of disposing the waste is considerably higher. Simultaneously, these programmes have limited financial resources and very often limited human resources. These factors strongly constrain the development of waste management programmes, especially geological disposal programme. These countries tackle the challenges they confront in different ways, but some common features may be outlined.

In most cases these programmes started later than countries with more advanced nuclear power programmes. Therefore the need for geological disposal appeared later. This suggests that some countries, like Hungary, Bulgaria, Argentina or Lithuania, have chosen to postpone a decision on long-term spent fuel management. Other countries, such as Slovenia and Romania, have taken strategic decisions on geological disposal but have kept open other options such as the development of multinational repository or the export of spent fuel.

The legislative framework in these countries is mostly set and responsibilities of the different institutions defined. Most countries have already established the waste management organisations, responsible for the development and implementation of the disposal programmes. Radioactive waste management organisations were established in Slovenia (ARAO, 1991), Hungary (PURAM, 1998), Lithuania (RATA, 2001), Romania (ANDRAD, 2004), Bulgaria (SERAW, 2004) and Argentina (PNGRR Programa Nacional de Gestion de rsiduos Radioactivos), within National Atomic Energy Commission, 2003).

In the context of countries with small nuclear programmes, it is clearly premature to reach conclusions about how the different factors discussed below have affected public and political acceptance.

Technical factor

Countries with small nuclear programmes that have already taken a decision on geological disposal are usually at an early stage of the disposal programme development. Direct disposal of spent fuel seems to be the preferred option for those countries.

Due to the constrained financial and human resources in the spent fuel disposal scenario, R&D activities are usually limited. The development of a URL is not regarded as a necessity, if research results in similar geological environments are available from other URLs. However, some countries may include some kind of URL into their national programmes (e.g. Hungary, Bulgaria). Development of long-term waste management solutions, including disposal, are more or less in line with approaches taken in countries having more advanced nuclear power programmes.

Structural factor

In countries with small nuclear programmes it is even more complicated to take a position regarding waste disposal. Deferring action at present is often justified by the argument that small countries should first await implementation of geological disposal in countries with larger/advanced nuclear programmes.

Among this group of countries, two circumstances can be at present identified as affecting their disposal programmes:

- It is particularly important for a small programmes to know well in advance future nuclear liabilities and to set up provisions for covering these liabilities. Otherwise, there is a danger that the required financial resources will not be accrued.
- Early shut down of nuclear power reactors and the need for their decommissioning requires the preparation of the disposal programme to cover the long-term management of spent fuel (e.g. Lithuania).

Countries with small nuclear programmes apply different funding mechanisms. For example: Slovenia established a special fund for decommissioning and waste disposal 10 years ago. The contributions to the fund are regularly adjusted to take into account new estimates of liabilities to guarantee sufficient financial resources at the end of the scheduled lifetime of the nuclear power reactors. In Hungary, the nuclear fund has been established as part of the state budget in 1998. This fund is supposed to cover the cost of decommissioning of nuclear power reactors as well as waste management activities. Similar funds exist also in Bulgaria and Lithuania. Preparations for establishing such a fund are ongoing in Romania and Argentina, where waste management activities are now financed from the state budget.

Lithuania is faced with the early shut down of the nuclear power reactors at Ignalina. Unit 1 was shut down in 2004 and is now being decommissioned. Unit 2 is still in operation and expected to stop by 2009. This situation will certainly prompt some decisions to be made regarding the long-term spent fuel management.

Process factor

The details of implementation of the geological disposal programme have not been defined for most of these countries. In Slovenia a reference scenario for geological repository was developed in 2004 as part of the Joint Decommissioning and Waste Disposal Programme. The programme is required to be updated with new developments and data at least every 5 years.

Public involvement and participation in the decision-making process is not specified in great detail. This aspect of the decision-making process is left for further elaboration in later stages of the programme. There is however a common understanding that public involvement should be an integral part of the whole process.

Incentives to the hosting communities and/or other affected parties also have been discussed in countries with small nuclear programmes. In many countries incentives are regarded as a tool to facilitate the siting process for a geological repository. In Slovenia, for example, a Government decree defines the financial incentives to be provided to communities which may host different types of nuclear facilities, including a geological repository.

Behavioural factor

Given the small quantities of radioactive waste arisen in these countries, it may be even more difficult to convincingly present the need for a national disposal programme. Consequently, time schedules for their implementation are shifted far into the future. This allows relatively open and transparent discussion of the programme without time pressure. On the other hand, time distant plans raise less public interest and attention and it is more difficult to achieve two-way communication and get insight into the public's perception of the proposed solutions. For implementers, the long planning horizon presents an additional challenge. Their responsibilities extend over a time period of more than one generation with relatively low engagements in the current generation. Under such conditions, developing and maintaining the necessary expertise can be quite difficult as is the transfer of knowledge between generations.

5. CONCLUSIONS AND RECOMMENDATIONS

Until 15 to 20 years ago, the scientific and engineering expert communities directed technological decision-making. The best technical approach was looked for; regulatory bodies were asked to reflect on safety and selection criteria, mainly from a geological point of view. If such an approach was feasible and a compatible site was found, interested and affected parties could agree on the design and authorisation for a repository system or at least of an URL that could be constructed at the site for characterisation purposes. It seemed an article of faith that concerns about the performance of a repository could be met by developments in earth sciences, engineering and safety, aiming to guarantee waste immobilisation and isolation. International coordination, as developed by the EC, came to support in the eighties the demonstration of feasibility and capability to perform all steps of complex assessment on representative disposal sites. But the elaboration of an administrative and institutional framework was at an embryonic stage and did not yet allow for accompanying the process of systematic decision making. There were not yet economic assessments or clear financing mechanisms. Concerns like reversibility were not yet expressed and involvement of local communities was almost inexistent.

Obtaining complete agreement on how effective a particular technical approach might be in isolating and containing radioactive waste was becoming a quite complex challenge. Considering the time perspectives associated with the disposal of HLW, the liability of this by-product of the nuclear energy process had finally to be taken over by the State or public sector, even in countries where waste management could be fully organised by private companies. The time period, largely exceeding the time scope of human civilisation, confronted the technical nuclear science community with other value judgements in society. In addition, it was not practical to investigate in detail more than a few sites even in a large country. Identifying a "best" approach or site is never possible. Looking for an "acceptable" approach and site seemed to require a social process, where each Member State had to determine its most appropriate way to proceed.

Experience as clearly addressed in this report shows that a feasible solution has its technical dimension but that "an acceptable solution" always will have a combined technical and social dimension. The latter dimension is focussed by the underlying report, but it can not be considered separately from technical criteria. The importance as well as the constraints and limitations of public involvement are demonstrated in numerous cases with differences and similarities with regard to other Member States. All conditions set have a price and have inconveniences that need to be distributed. The improved understanding of social interaction demonstrates that major nuclear project developments are not isolated from other societal dynamics. Direct links are visible with recent discourses such as sustainable development, including key elements like precaution and public involvement and complementing risk assessment as highlighted in new proposals for complex risk governance issues.

In the subsections below, general propositions about the effect of each factor on acceptance are derived from the empirical record. In the course of carrying out this analysis, it became clear that acceptance typically took on a different meaning in first three stages of the process than in the last three stages. The first three stages mainly involve generic considerations, dialogue, and debate. The deliberations surrounding these stages are not site-specific and, consequently, decisions most often are made by policy level between authorities and affected stakeholders. Members of the general public and representatives of local communities tend not to be involved. The last three stages are, by their very nature, site-specific. Members of the general public and representatives of local communities recognize that they have a clear stake in the outcomes of decisions and almost always seek to have their views taken into account by the policy "elites." At the generic stages of the process, **political acceptance seems to be the key issue.** At the site-specific stages, both **public and political acceptances** seem to be crucial.

An important qualification must be made to the preceding observation. In countries with long-standing geologic repository programmes, there is an important consequence of an inability to obtain permanent acceptance from at least one significant segment of the public: as the programme begins to transition into the site-specific stages, a public (and sometimes political) demand often arises to revisit decisions made during the generic stages. As those decisions are reassessed, securing public acceptance generally becomes much more important than it had previously been.

5.1. Technical factor

Considerations associated with the technical factor include the technical aspects of a design, the physical and geographical properties of a site, the feasibility of building the proposed underground structures, and the contents of the safety case advanced by the proponents of repository development.

— ***As a programme moves through the stages of the development and implementation, considerations associated with the technical factor increasingly influence public and political acceptance.***

  In every country, a decision to focus on geologic disposal requires at least confidence that a repository system can be theoretically designed and sited in a manner that protects human health and the environment. In particular,

  - ***Acceptance appears to be increased when specific technical requirements, such as defence-in-depth, retrievability, and monitoring, are explicitly incorporated in the regulatory framework.***

  These requirements already reflect considerations regarding the public, and have been identified as influencing perception as they are related to controllability and flexibility of choices over time. Evidence in support of these proposals can be found in the case of the United States and Sweden, although experiences in other countries suggest that such requirements may not have much of an effect.

- ***Decisions about adopting a generic technical concept appear to be more acceptable when relevant natural analogues can be referred to for supporting claims about repository performance.***

  An example of an analogue is the presence of elemental copper nodules in some million-year-old granitic formations. This presence of un-oxidized copper suggests that metal's resistance to corrosion under conditions likely to be found at some potential repository sites.

- ***Decisions about a generic technical concept also seem to be more acceptable when there is broad agreement among experts.***

  Such agreement can be manifested through peer-reviews conducted by credible international organizations, such as the IAEA and the NEA, or through *ad hoc* independent reviews, such as the one that was commissioned by the Swedish implementer for its KBS concept or by NIRAS/ONDRAF for SAFIR.

- ***Uncertainty about repository performance drives public concerns that can arise during the site-specific stage of the process. Considerations highlighting robustness can mitigate those concerns thus increasing public acceptance.***

  There is an impact on society due to uncertainties on technical factors. Demonstration of robustness of technical options, in particular in underground research laboratories (URL's), can reduce these concerns but should ideally be accompanied also by social robustness of solutions proposed and can be supported by evidence on historical analogues. In e.g. Sweden, Belgium and Finland, considerable efforts have been made to develop a robust safety case for increasing public acceptance. In the United States, the safety case is largely made through very elaborate probabilistic performance assessments. On the one hand, the IAEA and NEA have criticized one particular performance assessment for being overly conservative; on the other, the State of Nevada has criticized all of them for being overly optimistic. Social robustness approaches seem to be needed as well and integrated in technical convincing approaches. Risk indications based on abstract non measurable concepts as doses over long term periods however had limited significance for public opinion. Consequently, a study on more comprehensive indicators of system robustness was developed in order to better illustrate long term system capacity to the public. The Belgian concept had to be reconsidered after 25 years of development in order to allow reconciliation of economic and handling feasibility of particular waste forms and by taking into account new corrosion concerns.

  The technical experts and implementers could show more humility on limitations of their knowledge by systematically stating uncertainties and their impact on system robustness and by forwarding needs for further research and development in an attempt to improve transparency on the global state of the art and its potential impact. Put somewhat differently, the underlying assumptions of technical aspects and their uncertainties should be clearly communicated in a comprehensive way and the message adapted to the level of understanding of each relevant actor, allowing them to make relevant comments on the outcome. The soundness of technical work undertaken in Canada in the nineties was not generally questioned but the level of understanding by the general public was lacking. This underlines the requirement of good comprehension and adequate communication which is by definition a bi-directional process, which could be systematically improved through indicators set up in dialogue processes with all relevant actors including the public.

5.2. Structural factor

Considerations associated with the structural factor include the liability of the waste producer, and the identification of the respective roles of authorities, governmental and non-governmental bodies. These considerations also include specification of the scope of the programme, how it will be funded, and how sites eventually will be selected. The final consideration associated with the structural factor is whether broader questions of energy policy, especially the role of nuclear power, greatly affect views on radioactive waste management.

Decisions on whether to create in due time a relatively complete institutional and legal framework may or may not affect public acceptance during the generic stages of the process.

— ***Failure to establish an effective framework in the global context of energy production seems to reduce public acceptance once the process enters the site-specific stage.***

The case of Sweden suggests that creating a relatively complete institutional and legal framework facilitated public acceptance from the very beginning because it was perceived as reasonable. In other countries, like the United States and Japan, there does not appear to be strong evidence that the mere creation of this extensive framework early on, increased public acceptance of waste management programmes in these countries during the generic stages of the process. Obviously, a fairly high level of political acceptance is needed to create this framework. Still other countries, such as the United Kingdom have decided not to create much of an institutional and legal framework. It does not appear that these countries' choices directly decreased public acceptance, but such decisions may reflect however a low level of political support.

The situation appears to change once specific sites are investigated. In Germany, for example, the choices regarding funding arrangements and authority/responsibility allocations were points of contention that seemed to reduce public acceptance during deliberations over the Gorleben site, which also was too closely associated with reprocessing. In the United States, what appeared as a neutral site-selection rule became a major source of controversy once an effort was made to implement it by choosing sites for both the first and second repositories.

— ***Ensuring the independence of the regulator from the implementer appears to be the structural factor with the largest effect on increasing public acceptance.***

In establishing the institutional and legal framework, most countries, including France, Sweden, Finland, and the United States, chose to assign repository development and implementation's responsibilities to one organization and regulatory oversight and control responsibilities to another. The two bodies typically do not report to the same authority, except at top governmental level. It is generally recognized that this formal independence increases public acceptance at least somewhat during the generic stages.

Recent decisions in Germany and Japan to separate to a greater degree the implementer from the regulator appear to reflect this recognition. Once the process moves into the site-specific stages, as it has in Sweden, Finland, and the United States, the degree of actual as opposed to formal independence of the regulator is likely to affect significantly public acceptance.

With respect to developing and implementing a programme for geologic disposal, the distribution of power between central and local or regional authorities can affect public acceptance.

— ***Clear responsibilities and competencies and adequate coordination at the appropriate level is needed. Negotiations at different levels are further required to get a fair and balanced distribution of (dis-)advantages in a community and to agree upon transfers of responsibilities to the next generations.***

One model of democratic decision-making holds that when issues are national in scope, choices about them need to be made at the national level. A second model holds that when issues disproportionately affect a single locality, that locality should be given a disproportionate say in choices about them, even if the issues are national in scope. Because of their national political cultures, Member States differ in terms of whether they subscribe to one model or the other or to some combination of the two. Many national programmes provide for a de facto local veto over siting, which may be either strong (as in the case of Sweden and Belgium) or weak (as in the case of the United States), depending on how easily in practical terms authorities at a higher level can override it. It appears that, all other circumstances being equal, the more power is distributed in favour of the central government, the greater will be the likely acceptance by the public nationally. And all other circumstances being equal, the more power is distributed in favour of a local government, the greater will be the likely acceptance by the public in that particular community. Consistent with its national political culture, each nation will decide how it balances the requirements for acceptance by the public at different levels but coherence related to the policy matter of relevance such as energy policy could favour to overcome the associated problems.

— ***The broader debate over energy policy and sustainable development, and especially the role of nuclear power, is a complex issue for political or public acceptance of a programme for developing and implementing a geologic repository.***

The role nuclear power plays in producing electricity for a nation or a continent is often subject to intense controversy and debate. In some countries, such as Germany, nuclear proponents believe that maintenance or expansion of that role requires the development of geologic repository. A number of nuclear opponents believe that their objective of contraction or elimination of that role could be furthered by opposing the development of a repository. Others consider that nuclear development can only be reconsidered if HLW disposal is adequately solved. Acceptance of a geologic repository by politicians or (organised) members of the public appears to be largely determined by their stance on or conditions for nuclear power. But not all cases can be given this pattern.

5.3. Process factor

Considerations associated with the process factor include the criteria for moving from one stage of the repository development and implementation process to another, the type and amount of public involvement, and the provision of incentives and benefits.

Many countries with long-standing repository development and implementation programmes have had to reconsider and reassess fundamental decisions that often were made decades earlier.

— ***Reassessment can become necessary because past decisions were not reached through a socially acceptable process.***

Several examples support this conclusion. Prior to 1991, France had used a relatively closed and technocratic approach to make decisions about the long-term management of radioactive waste. Similar terms are used in case studies in this report to describe the original German and Swedish programmes. The Seaborn Panel in Canada explicitly made the distinction between the technical and social acceptability of the AECL's generic disposal concept. However countries which had developed an early URL with gradual feedback of experiences towards a step by step approach had more continuity and coherence in a number of stages of the decision making process.

Most of the countries that have had to reconsider their programmes as well as those Member States that are just beginning to establish programmes typically have opted for a repository development and implementation process that emphasizes broad public involvement in decision-making. For the most part, however, it is premature to conclude whether such a choice ultimately will lead to increased public acceptance.

— ***Lessons learnt from failures followed by broad public involvement can allow to improve social robustness of proposals and can result in added value.***

The lessons derived from long-standing programmes that were forced to reassess fundamental decisions, the success of the Swedish programme in securing several volunteer sites and establishing positive and productive relationships with localities, and specific national events, such as the denial of Nirex's application to construct a URL, likely led to this emphasis on broad public involvement. Building on the Swedish model in particular, efforts are being made or will be made in most Member States to encourage non-specialists to take part in the development of waste management approaches, to involve individuals, NGOs, and communities in determining how much risk or what level of safety is socially acceptable, and to promote continuity in dialogue instead of just one-shot interactions.

Because this emphasis on broad public involvement is relatively recent, it is premature to conclude that the new approach ultimately will increase public acceptance in a wide range of countries. In some Member States, such as Canada and the United Kingdom, the new approach has not yet been adopted but is only proposed. Moreover, even in those nations where it has been embraced, it has only be tried out in the earliest generic stages of the process, where public acceptance issues tend to be less central than in the subsequent site-specific stages. Examples here include Belgium, Japan, and China.

Finally, it is well recognized that Sweden's national political culture places a high value on reaching social consensus. Will expanding opportunities for public involvement lead to public acceptance in national political cultures that are less committed to reaching social consensus?

— ***The rationale for using a "step-wise" process is that it allows society to move forward or to reassess at a comfortable pace. If this rationale holds, then public acceptance may increase.***

Many Member States use or intend to use a "step-wise" process for developing and implementing a programme of geologic disposal. It is unclear what qualifies, or more importantly, what does not qualify a "step-wise" process. Any process, by its very nature, involves stages. What seems to distinguish the "step-wise" process for its advocates is the size (small) and number (large) of the stages and whether many and intense activities occur before a programme moves from one stage to another. The case that seems to provide the strongest support for this proposition is probably the Swedish one, although it is difficult to disentangle the effect of a "step-wise" process from other elements of the programme that increase public acceptance. This effect was also nicely illustrated in Switzerland by comparing the negative experience gained regarding the LILW repository programme where the step-wise process was not respected with the support more recently provided to the deep geological disposal programme. However, it is still probably premature to conclude that a using a "step-wise" process increases public acceptance, especially once it enters the site-specific stages.

5.4. Behavioural factor

The behavioural factor refers to how implementers and regulators conduct themselves as they interact with the members of the general public and their representatives. Considerations associated with the behavioural factor include openness, transparency, accountability, fairness, respect for the values and interests of others, and perception of technical competence.

— ***Implementers and regulators are requested to be open, transparent, respectful and fair.***

Most of the countries that had to reassess their programmes as well as countries that are just beginning to establish programmes typically have opted for a repository development and implementation process that requires implementers and regulators to be open, transparent, respectful, and fair. For the most part, however, it is premature to conclude whether such behaviours, even if displayed consistently, ultimately lead to increased public acceptance. A generation ago, many of those responsible for developing and implementing programmes for geologic disposal were often perceived, fairly or not, as being arrogant and intolerant of questions from non-specialists. Their attitudes and behaviour were the polar opposite of the guiding maxim of today's Swedish program: "There are no silly questions." In some countries, such as the United Kingdom, these attitudes and behaviours persisted until relatively recently. Once a new emphasis was placed on broad public involvement, it was quickly recognized that the attitudes and behaviours that formerly dominated would likely become counterproductive. Thus, in Japan, there is a commitment to "respect the initiative of the municipalities" as well as to ensure transparency in information disclosure. In Canada, the principle of sustainable development is used to advance a set of attitudes and behaviours that are highly valued: technical soundness, social acceptability, environmental responsibility and economic feasibility.

— ***Technical competence remains condition sine qua non for acceptance.***

Beside transparency and coherence, once a nation's waste management programme becomes increasingly open and accessible, more people are able to form direct impressions about the implementers and the regulators. If expertise is not viewed as technically competent, public acceptance is likely to decrease. Technical competence takes on an expansive meaning in this context: it includes not only knowledge of a subject, but also the ability to explain complicated matters in a way that can be understood and processed by a wide audience. It includes empathetic listening to questions and formulating responsive answers. Indeed, a technically competent individual looks forward to participate in efforts such as the so-called "stretching exercises" conducted in some Swedish communities by which the detail and justification of the logic underlying a particular approach. When an individual is not viewed as technically competent, doubts are more likely to crystallize. Doubt is often accompanied with distrust and the prospect of acceptance typically fades. Experience in virtually every national repository programme appears to support this conclusion.

It appears still premature to make claims about the effect of the main considerations associated with the behavioural factor on public acceptance as discussed here-above, even if most of them seem today straightforward. The reasons for this turn out to be identical to reasons listed earlier: changes in behaviour have just begun in many Member States. Most countries have not yet reached the site-specific stages of the process where public acceptance issues are the most problematic. National political cultures differ greatly. Patterns of interaction that are effective in one Member State may not be easily exported to another.

5.5. A final observation

The historical experience in developing and implementing programmes for geologic disposal in a number of Member States can suggest lessons learnt. But it may not always be precisely clear what the lessons are, and how they might be applied in other places and at other times. For this reason, this report has refrained from trying to advance prescriptions about what countries ***should*** do as they wrestle with the complex issue of securing, sustaining, or re-creating public and political acceptance. Instead, the aim of this report is much more modest. It hopes to provide insights that may prove relevant to all those interested and affected by waste management programmes. Only they can know what to do with those insights.

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