



**ONDRAF/NIRAS**

Belgian agency for radioactive waste  
and enriched fissile materials

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# Towards the sustainable management of radioactive waste

Background to the SAFIR 2 report

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## Foreword

The long-term management of radioactive waste in Belgium has until now been conducted in a rigorous manner in line with the view that, until recently, society had of risk management. This management has essentially been based on notions of the scientific assessment of risk and its prevention.

Nonetheless, it is increasingly acknowledged that this approach – which has lost none of its validity – reaches its limits when it is necessary to make a decision in a situation in which there are many uncertainties (uncertainties as to the nature of the risk, uncertainties as to the scale of the risk, uncertainties as to the materialization of the risk,...) and that as a result the prevention of risk itself becomes speculative. Seen in this context, the decision to take the risk – though it must of course remain based on solid scientific argumentation – effectively takes on the form of a social issue, for the resolution of which society itself has to create the mechanisms that lead to a solution accepted by the greater majority. The public should not be exposed to risk, but instead should be placed in a position to be able to decide whether or not to accept them in full knowledge of the cause.

At this moment in time, it is the concept of sustainable development, in which the principle of precaution is an essential element of risk-taking situations in the face of high levels of uncertainty, that leads the way: it enables the public and those responsible to put the processes and methods in place for making choices in full knowledge of the cause and also to refuse – justifiably – if the uncertainty remains too great, or even excessive for justifying taking the risk.

Against this background, the SAFIR 2 report provides the most comprehensive review of the current state of knowledge concerning the long-term management of high-level and long-lived waste and develops the basic conceptual elements for one of the potential solutions: deep disposal in the Boom clay formation with, as an alternative to the host rock, the Ypresian clay formation. It systematically presents the elements that support the safety of the solution under study and identifies the various uncertainties associated with this solution.

However, the work undertaken up until now can only really be validated when it is presented in and supported by a decision-making context adapted to the risk management modes of a modern society. This context does not exist at present and should be put in place if one wishes to arrive at a socially accepted solution; the concept of sustainable development and in particular the principle of precaution are the essential elements leading to its development.



## Summary

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# 1 Introduction

## 1.1 Historical overview of decisions concerning the long-term management of high-level and long-lived waste in Belgium.

The problem of the long-term management of high-level and long-lived waste has, over the last 25 years, regularly been the subject of discussions at the highest level in Belgian (government, parliament) and international institutions, and in particular as a result of the:

- publication of the report by the Nuclear Energy Assessment Committee (1976);
- publication of the report "Elements for a new energy politics" by the Ministry of Economic Affairs (1979);
- work of the parliamentary committee on nuclear power production in the aftermath of the Chernobyl accident (1987);
- work of the SAFIR Assessment Committee (1990);
- publication of the report by the Nuclear Safety Information and Investigation Committee (1991);
- work of the Committee concerning mixed-oxide fuel and the options for managing spent nuclear fuel (resolution of 22 December 1993);
- publication of the European Union Council Resolution on radioactive waste management (19 December 1994);
- publication of the "*Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*" (International Atomic Energy Agency, Vienna, 1997), which Belgium signed in December 1997;
- publication of the report by the Commission for the Analysis of Electricity Production Modes and Energy Redeployment – AMPERE (2000) and the "*Assessment of the Ampère commission report by an international peer review group*" (2001).

One notes that each time the major initial options aimed at discovering and developing a safe and preferably definitive solution have been confirmed, or recommendations have been formulated for future research. More precisely, this concerns the repeated confirmation of the wellfoundedness of the disposal option, and in particular the fact that in the Belgian scientific program, disposal in a deep layer of poorly indurated clay is an option of considerable value that deserves closer consideration and which has a great deal of scientific credit at international level.

The SAFIR 2 report is naturally in keeping with this approach.

## 1.2 The Belgian context compared with other countries

Nearly all countries confronted with the problem of finding a definitive solution for the long-term management of their radioactive waste have developed, within their own political, legislative and cultural context, their own methods for implementing specific disposal solutions.

In the case of the long-term management of low-level and short-lived waste (category A waste), most European countries have an operational disposal solution. This is the case in particular in Germany, Finland, France, Spain, the United Kingdom and Sweden.

As for medium and high-level long-lived waste (categories B & C waste), the majority of countries are still at the research stage, even though progress in research and the acceptability by society of the solutions under consideration differ considerably from one country to another. Mention should also be made of the existence of deep disposal in a layer of salt for long-lived transuranic waste of military origin; this facility, the Waste Isolation Pilot Plant (WIPP), is located in New Mexico (USA).

An analysis of the situation concerning programmes for the long-term management of category B & C radioactive waste in countries such as Canada, Finland, France, Germany, the Netherlands, Spain, Sweden, Switzerland, the United Kingdom and the United States clearly shows that it is increasingly accepted that the search for a solution to the long-term management of radioactive waste cannot be regarded solely as a technical issue. The socio-political dimension is just as important and should be considered having the same value. However, the approach to the matter differs from one country to another. There also appears to be a constant process of innovation in the methods of dialogue and the procedures for the participation of the relevant target audiences, which has been favourably received both by the people responsible and by the general public. It is worth noting here that it is generally accepted that the necessary time should be devoted towards this end.

In fact, one can confirm that there is now a broad consensus about the need for the active participation of the "stakeholders" and the transparency of the decision-making process, but the practical realisation of these is still the object of very divergent visions. Attempts to improve transparency and to increase public participation in the procedures for selecting disposal sites vary according to the cultural, historical and social context of each country, as well as the stage that the site selection process has reached. However, it is generally stressed that the term "transparency" is not limited to a simple explanation of "technical solutions" to the "stakeholders" and the general public. In addition to the technical and scientific elements, the decision-making process always involves valuable items that cannot be concealed or hidden behind so-called objective statements made by experts. These factors also play a key part in the importance of public participation. One of the reasons why it is important to involve the public in the decision-making process is precisely to highlight the governing values in a society. There is also a political reason: public participation reinforces the legitimacy and stability of the decision taken. Moreover, the knowledge available to these "stakeholders" is an important reason for urging them to

participate. The public should be involved because its knowledge complements that of the experts and politicians. This outsider knowledge is essential, if only because it helps to increase the knowledge base. When one considers the local implications of a project, local inhabitants often have important information that might otherwise be ignored by regional or national authorities.

Another important lesson to be drawn from foreign programmes is that progress is chiefly made in those countries that apply legitimate procedures rather than legitimising procedures for consultation purposes. Procedures used to select a disposal site in which certain fundamental aspects of social values concerning the durability of long-term radioactive waste management solutions have not been addressed beforehand may ultimately encounter serious difficulties with respect to legal and public acceptability, as was the case in the United Kingdom, Germany and Canada. Countries that appear to make progress via ingenious political stratagems such as France and the United States also run this risk.

Countries that give priority to social values through different forms of dialogue and public participation are those that make the most consistent progress. This, of course, raises the question of knowing how much of a role cultural, historical and political factors play at this level.

Another conclusion to be drawn from this analysis is the interest documents such as "Strategic Environmental Assessment" or "Environmental Impact Assessment", concerning both decision making and completely transparent consultation, generate on the part of the various parties concerned.

## 2 Towards a participatory decision-making process

### 2.1 Societal change

The willingness of societies to make an effective contribution to the choices shaping their development has become increasingly evident in recent decades. Two fundamental requirements have emerged to create a serious challenge to the traditional decision-making processes. First of all, society itself seeks to make a critical appraisal of everything that is presented as being "necessary" or "obvious". Secondly, to be able to direct the choices to be made according to a democratic process in which the information, expert knowledge, decision-making and control capabilities are expanded to include all parties.

Society has the right to choose "in good faith" how to organise the way it develops: from this point of view, science is no longer regarded as the instrument or the only means for decision-making. Of course, the experts are still responsible for setting the stage, but they are no longer entitled to decide by themselves how those choices are effected. The part experts play in decision-making has therefore fundamentally changed: on the one hand, the field of expertise has increased, in particular because of the inclusion of social factors and, on the other hand, the expertise has assumed a pluralistic dimension and is now available to all the parties concerned.

Society exercising its right to make its own choices creates two types of problems. On the one hand, creating a basis for mutual dialogue amongst the various parties (stakeholders) in order to be able to choose between various possible options. On the other hand, establishing the legitimacy of the process: this involves creating institutional ways and means for ensuring that the dialogue (from the original survey through to decision-making, implementation and control) results in a balanced decision that respects the different interests involved. In other words, what is needed is to go beyond the stage of optimisation carried out under certain technical constraints that are predetermined by experts who owe their legitimacy to science or to their specific position in society.

Against this background, the fact that the decision concerning the management of high-risk situations results from a choice made by society is from now on indiscutable. Three basic considerations support this conviction:

- **Scientific argument alone is not enough to justify the democratic decision.**

In any risk management strategy, the idea that we can move on from the estimation of a risk (seen as a combination of a probability of occurrence and the resulting damage) to its assessment according to a quasi-mathematical process of deduction is unfounded. In fact, the assessment is based on the concept of value that is invariably associated with a given social and cultural context that determines the way in which the risk is perceived and that can result in a risk accepted by one group of individuals being rejected by another, or in a risk accepted for one practice but not for another even though it presents the same or even less risk. A risk is thus accepted or rejected. In this context, the acceptance or rejection of the risk may only be the result of a collective, carefully thought-out decision.

- **Scientific knowledge does not rule out any doubts.**

The traditional opposition between "rational" science and social dialogue regarded as being "subjective", "irrational", etc. is a long way from being a suitable basis for managing risk situations. In fact, the submission of this type of question to the scientific method presents a number of inescapable problems. These include:

- the inhomogeneity and sometimes inconsistency of the data available,
- the difficulty of drawing reliable conclusions via extrapolation, particularly over very long periods of time,
- the impossibility in many cases of an a posteriori verification,
- the difficulty of developing representative experiments, which restricts the scope of laboratory experiments and the relevance of the data generated by research,
- the importance of residual uncertainties that may prove to be insoluble below a certain level,
- the difficulty of exhaustively identifying all the risks and quantifying their consequences,
- ...

Consequently, risk management often involves the "hypothetical" or "potential" domains, where scientific assessment may prove inconclusive in the sense that objective proof may be an impossibility or not within reach. Effective risk management is thus also synonymous with managing the doubts brought up by the uncertainty.

- **Science faced with value judgements.**

It has to be acknowledged that some scientific findings, even when neutral as such, make a real sociological impact once they confirm or contradict the position of a given party (stakeholder). On the other hand, the scientific actors are themselves social protagonists involved in various networks, which may exert an influence on their own view of things.

It is therefore absolutely essential that all the choices of society are based on an approach that is as multidisciplinary as possible: broadening the scope of interpretation and scientific questioning guarantees the objectivity of scientific opinion.

To conclude, it is now becoming obvious that a risk management decision can only be conceived and have a chance of being implemented if it is supported by society and if the various stakeholders fully involved in decision-making have genuinely been able to express their will and influence the decisions. Society debate is indispensable in the early stages and throughout the decision-making process if one wishes to guarantee the support and cohesion of the social body necessary for long-term management of the problem.

## **2.2 Sustainable development and radioactive waste management**

Belgium is fully committed to the path of sustainable development on the basis of the 5 May 1997 law on coordinating the federal policy of sustainable development. Based on the implementation of this model, an initial plan was drawn up for the 2000-2004 period and published in the form of a royal decree.

The plan highlights five sustainable development principles taken from the list of 27 principles agreed upon during the Rio Conference (1992). These principles are listed below:

- **Principle of common but differentiated responsibilities (principle 7 of the Rio declaration) :**

States shall cooperate in a spirit of global partnership to conserve, protect and restore the health and integrity of the Earth's ecosystem [...]. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command.

- **Principle of intra- and inter-generational equity in the fulfilment of the right to development (principle 3 of the Rio declaration) :**

The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations.

- **Principle of integration of the elements of sustainable development (principle 4 of the Rio declaration) :**

Environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it.

- **Precautionary principle, and recognition of scientific uncertainty (principle 15 of the Rio declaration) :**

In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

- **Principle of participation, and good governance (principle 10 of the Rio declaration) :**

Environmental issues are best handled with the participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes. States shall facilitate and encourage public awareness and participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided.

As these principles are fairly new, they could not be applied in a systematic and structured way to the long-standing question of long-term radioactive waste management in Belgium. Nonetheless, an international code of conduct for the long-term management of this waste was adopted several decades ago. This codification drew its initial inspiration from the general radiological protection principles set out by the International Commission on Radiological Protection (ICRP) and the way they apply to the specific case of radioactive waste. Other general environmental protection principles were integrated very early on as part of radioactive waste management, this is the case for the internalisation of the environmental costs or the “polluter-pays” principle and the notion of equity between and across generations.

These principles form the framework according to which the current management of radioactive waste has been organised in the course of time. This is why, despite the novelty of the concept of sustainable development, radioactive waste management is already geared towards this concept in many ways, as is underscored by the following examples:

- From the early 1970s, the Nuclear Research Centre in Mol cooperated closely with the European Commission to gain an insight into the high-level waste issue. This means Belgium decided at a very early stage to assume its responsibility as a developed nuclear nation commanding major human and infrastructural resources.
- In the mid 1970s, when exploitation of the current nuclear power plants (Doel 1 and 2, and Tihange 1) began, research was started that would lead, in accordance

with international recommendations, to giving priority to the option of disposal within a deep geological formation and the creation of the underground laboratory in Mol. Since then, a very large body of knowledge has been created which is available to help present and future generations seek solutions to the problem.

- ONDRAF/NIRAS (the Belgian agency for radioactive waste and enriched fissile materials) was established in 1980 to guarantee a safe national system for the long-term management of radioactive waste, free from any pressure.

It ensures the continuity of scientific research on ways of protecting human beings and the environment from the potentially harmful consequences of this waste. In particular, it acts as the society's guarantor for the long-term respect of the environment in the solutions it proposes.

Further, a Long-Term Fund has been set up, which gradually gathers the financial means for implementing the solutions chosen; this fund is at the disposal of future generations.

ONDRAF/NIRAS also has the overall task of informing the public; every year since 1991 it has presented parliament with a report on its activities and it also publishes its research findings at regular intervals.

- The research ONDRAF/NIRAS has so far carried out has helped identify the uncertainties inherent to the deep disposal of category B and C waste in a poorly indurated clay formation; to date, it has not been possible to reduce these uncertainties sufficiently, i.e. to a level where decisions can be taken.

Research is carried out within a multidisciplinary context, the findings of which regularly undergo a scientific assessment (for example, the SAFIR committee established in 1990 by the Minister in charge at the time, the SAFIR 2 review committee set up in 2000 by the ONDRAF/NIRAS board of directors, the international review by the Nuclear Energy Agency (NEA) commissioned by the government. It should be pointed out that research into an alternative host rock was undertaken at the request of the SAFIR commission.

- Since the early 1970s, successive governments and parliament have taken care to regularly include the radioactive waste issue in the agenda, as is underscored by the numerous official publications issued by the government and parliament. These talks invariably confirm the validity of the technical reference option of deep disposal within a poorly indurated clay layer.
- Finally, within the scope of the management of category A waste, the government's decision of 16 January 1998 commissioned ONDRAF/NIRAS to resolutely seek dialogue with the local populations.

These few examples show quite well that the issue of long-term radioactive waste management was acknowledged very early on in Belgium and that an increasingly structured and responsible approach has been adopted towards the environment and future generations.

Of course, this does not concern a systematic approach to sustainable development, but does feature several components of a precautionary approach. The subsequent stages will therefore consist in consolidating these achievements.

### 3 Towards a sustainable management of radioactive waste

Any sustainable management approach should respect the principle of equity between present and future generations and promote economic development, whilst ensuring environmental protection and social well-being. Any sustainable development policy must include the following three dimensions.

#### 3.1 The economic dimension

The aim of sustainable development is to maintain or enhance all the assets handed down to future generations. In the case of radioactive waste, this aim is reflected in the basic requirement to avoid passing on excessively heavy burdens to future generations; the latter would indeed be called upon to finance the long-term management by their own means should the resources set aside for this purpose turn out to be unavailable or insufficient. This implies that the necessary funds must be provided for as long as the economic actor responsible for the production of the waste exists and that a check has to be made every so often to ensure the resources provided tally with the implementation of the planned solution(s). These concerns are echoed on the one hand in the creation of the Long-Term Fund and on the other hand in the 12 December 1997 law on the inventory of nuclear liabilities.

The status of spent nuclear fuel, however, has yet to be decided. The two options, potential natural resource or waste, are still open. Consequently, two technical options are theoretically available in the present circumstances: long-term storage for use at a later date (reprocessing or another innovative nuclear option) and deep disposal as waste. Closer consideration within the framework of sustainable development leads to the conclusion that the second option raises the question of the retrievability level required for such disposal, as future generations will not necessarily make the same choices as the present one, any decision in principle being revisable.

On the other hand, if the fuel is not supplied to ONDRAF/NIRAS as waste, the funding hypotheses for the Long-Term Fund will have to be drastically revised to guarantee the smooth implementation of the solution envisaged for the waste already transferred to ONDRAF/NIRAS.

The status of spent fuel and what the future holds in store for it should be specified if we wish to guarantee a sustainable management of radioactive waste.

#### 3.2 The environmental dimension

The production of radioactive waste is regarded as one of the major environmental risks associated with the use of nuclear power and radioactive substances in general.

Although there is no argument of any kind to favour a rapid disposal of high-level waste (this would anyway be possible only after a cooling period of at least 50 years), the temporary storage solution is inconsistent with the principles of sustainable development because waste stored in this fashion represents a perpetual burden on future generations. Consequently, the need to meet environmental concerns requires a policy based on moving towards a final solution or one destined to be final.

The kind of solution now being contemplated for high-level waste involves isolating them from the biosphere. This means confining them in a stable geological formation so that the radioactivity can decrease over time (several tens of thousands of years), and the waste is no longer a threat to human beings and the environment. The host formation currently being investigated is the Boom clay formation with the alternative being the Ypresian clay formation.

The SAFIR 2 report gathers the scientific and technical knowledge accumulated so far in support of this solution. It confirms the validity of this approach, whilst identifying the uncertainties that have to be dispelled or reduced in order to make it possible to take a decision.

It is true that the confidence of the various actors in the long-term safety of such a solution is not necessarily as great as that of the scientists or engineers tasked with its development. Among other things, in view of the timescale involved (several tens of thousands of years), the feasibility and safety of this solution does not necessarily have the force of "evidence" for the general public.

In order to be able to continue this approach, it is necessary to first show that the alternatives are either equivalent or less effective in terms of environmental friendliness or else that they do not offer decisive economic or social advantages. Society has to be convinced that the solution offered has been carefully thought out before giving its verdict. The basic instrument supporting such a decision is the strategic assessment of the environmental implications.

Secondly, it must be guaranteed that the solution chosen will be implemented in stages and in a flexible way. During the early stages, a sufficient capacity for retrieving the waste must be ensured and once the disposal operations are complete, there has to be a period of monitoring intended to allow the future to be faced in a cautious and progressive manner.

### **3.3 The social dimension**

The human capital, in the form of knowledge, currently involved in settling the question of the long-term management of high-level waste, is still very important today. Belgium has at its disposal a nuclear energy research centre (CEN•SCK) and a radioactive waste management agency (ONDRAF/NIRAS) charged with developing solutions. The safety authority (AFCN) and its technical support (AVN) are now well structured and are developing the required expertise. Nonetheless, the universities have failed in recent years to continue encouraging nuclear research in general, apart from the social sciences faculties where the issue is regarded as an exemplary case for debates to be held on the new decision-making processes.

On the international front, cooperation is being encouraged and given structure by specialised agencies (IAEA, NEA). The European Union takes the view that the long-term management of radioactive waste is a major issue for its future and has earmarked sizeable budgets under its joint research programmes.

The scientific and technical skills may be available now, but there is no certainty they will continue to be of the same standard in the future. The various levels of authority should take steps, on the one hand, to ensure the continuity of the basic training required to keep R&D programmes at the appropriate level and, on the other hand, to develop or at least

maintain a level of expertise that is genuinely independent of the institutional actors (CEN•SCK, ONDRAF/NIRAS, AFCN, etc.). This is a necessary condition for guaranteeing the credibility of a decision-making programme with heavy public involvement. What is required first and foremost is to meet the fundamental requirement for sustainable development – the transfer of knowledge – but also the requirement for good governance otherwise public participation will lose its significance.

The establishment of genuine dialogue and a climate of mutual listening between the stakeholders and within society is necessary to build the confidence required for taking decisions and implementing them; it is therefore indispensable to enlarge the political decision-making space to include the stakeholders and the general public. It is indeed obvious that public support for a decision, whatever it may be, can be achieved and maintained only if the decision is the outcome of a dialogue conducted by a transparent procedure and accepted by all, and that the results of this dialogue are incorporated in this decision. Three key elements govern the possibility of launching a constructive dialogue, one that has to be prepared with the utmost care. This involves:

- clearly defining the parties involved in the dialogue (stakeholders),
- establishing the organisation and the terms of the dialogue,
- specifying the aims of the dialogue.

First of all, the dialogue reinforces the transparency of the information, then it helps create the conditions for the appropriation of the problem by society, which is a necessary condition for achieving an acceptable solution.

It is clear that the organisation of such a dialogue – up until now an uncommon exercise in our society, particularly in Belgium – demands a substantial investment of time. This time is needed to guarantee the solidity of consensus around the chosen solution, whose subsequent implementation will cover 100 years or so; not taking this time will probably force a stalemate or a solution that is barely or not at all democratic.

For the risk to be managed in an acceptable and consistent way, institutional procedures are required to involve all stakeholders in a sustainable development strategy. A process involving the public in decisions taken by the various authorities and, in the final analysis, by the government, therefore has to guarantee that all the successive decisions have received all the necessary public support. The state should, however, not be "relieved" of its sovereign task of guaranteeing the requisite level of safety.

At this level, sustainable development involves not only scientists and technicians but also the general public, stakeholders and the relevant authorities.

The involvement of the various key actors is a prerequisite for decision-making in favour of responsible development and its correct implementation - the two key ingredients of sustainable development. However, it has to be recognised that today nothing indicates that this condition will be sufficient.

It is up to the government to commission ONDRAF/NIRAS with the task of setting the stage for a genuine and effective dialogue leading to a transparent and legitimate decision-making process, allowing it to decide in the last resort.

This process cannot function unless it is given the necessary time and human and material resources.

## 4 Integrating the technical and social factors

### 4.1 The current research programme and its achievements

The deep disposal of category B and C radioactive waste in poorly indurated clay formations represents an innovative project in many ways. Consequently it has to go through all of the stages that characterise a project of this type: fundamental research, methodological research, applied research, defining the components of the technical concept and ensuring their consistency, characterising the host formation and the interactions between the materials of the concept and this environment, developing methodologies for evaluating performance and safety, pilot projects, implementing a preliminary project, applying for authorisation, and so on.

Ever since CEN•SCK launched the research programme, back in the 1970s, major achievements have been made in several of the areas mentioned above. The Belgian programme has also benefited from the construction and operation of an underground laboratory in the Boom clay formation in Mol at an early stage of its development. This explains why certain aspects associated with knowledge of the host formation have been developed beyond the limits of pure R & D.

Without seeking to call into question the basic choice of the Boom clay formation, a few important questions still have to be answered. This means it is still too early to make decisive statements about the technical feasibility of disposal in this host formation or the operational safety of such disposal in the long term. This applies even more to the Ypresian clay formation in Doel (the alternative host formation).

Today, R&D is still of an essentially methodological character; its aim is to establish that a technical solution is possible on Belgian territory for the disposal of high-level radioactive waste. It consists of two principal activities:

- developing and finalising all of the methods required for assessment: waste characterisation, characterisation and assessment of a host formation, performance and safety assessments, identification of remaining uncertainties, etc.
- assessing the feasibility of the solution and the elements supporting its safety, and the development of a disposal architecture, based, by way of hypothesis, on a benchmark case: the Boom clay formation and the nuclear zone in Mol-Dessel.

So far, endeavours have focused on the Boom clay formation in the Mol-Dessel region as the reference host rock and, to a lesser extent, the Ypresian clay formation in the Doel region as an alternative host rock. This work has concentrated primarily on the potential host rock and hence has in no way involved the choice of a site, which involves other technical and non-technical factors. Likewise, work has been restricted to the categories of waste regarded as the most detrimental.

## 4.2 The timescale

High-level category C waste will all have been produced by around 2025 as part of the current nuclear programme, which is restricted to a 40-year operating life of the existing plants. The waste will be stored temporarily in a vitrified form or in the form of spent fuel at existing nuclear sites; the duration of this temporary storage will depend on decisions about their long-term management.

In the case of the disposal of category C waste, this duration is determined by the required cooling time calculated in the safety surveys. This means that the year 2050 is the earliest date on which operations can begin on transferring the waste to the site chosen for final disposal, either in Belgium or abroad. In this case, the various decisions about the long-term management of high-level waste should be taken around 2030 and no later than 2040. If deep disposal in Belgium is opted for, the site has to be confirmed around this date, a period of 10 years being considered necessary to build the underground facilities. Decisions about the long-term management of category B waste may be taken earlier as this type of waste does not have to cool down.

As for vitrified waste originating from reprocessing, which is evidently not a potential resource - this is pure waste - there is no alternative to extending temporary storage until a decision has been made about deep disposal.

For spent fuel, which still contains a significant amount of fissile materials and is therefore a potential resource (not final waste), various long-term management options are available (reprocessing, use in an innovative nuclear option, disposal) and it will be up to future generations to decide what to do with the waste, all decisions being by their nature revisable. The waste may be removed from the storage sites as soon as the technical conditions governing their transport are satisfied. Should none of the options available be chosen, there is no longer any alternative to on-site storage until a decision about disposal has been taken.

After 2030, the lack of a final long-term management solution implies *ipso facto* extending the temporary storage periods on the existing sites.

Should a solution be decided upon, however, the elements will have to be available for building the planned infrastructures and the site will have to be chosen and the safety conditions confirmed, whatever the solution.

## 4.3 Social integration

Until now, society has not had many opportunities to interact with the institutional actors in terms of the options envisaged for the long-term management of category B and C waste. ONDRAF/NIRAS has routinely used the ISOTOPOLIS information centre as a communication channel with both the public at large and local communities. The latter's need for information is great considering the large turnout for the open days organised from time to time by the underground laboratory.

This is a first step towards involving the public in the decision-making process. However, in keeping with the principle of good governance, the participation of society should be organised as a true dialogue largely open to all protagonists.

The key aim of the dialogue is to enable policy-makers to make at each decisive stage the best possible decisions from both a technical and social point of view.

This implies having all the parties collectively involved in creating the decision-making components. There can indeed be no agreement about the outcome if there is no joint analysis of the issue at stake and its limits. There also has to be agreement about the decision-making process to follow and the ground rules for preparing the decision.

Consequently, the dialogue is developing along three lines:

- **the aim and outline of the dialogue:**

It is inevitable that at each stage of the decision-making process there will continue to be a number of lingering uncertainties that have not been completely resolved; hence the need to define the uncertainties causing a problem for the various actors and to determine, by common consent, how to address them (an attempt at further reducing the uncertainties, corrective action, exploring new avenues, etc.). In the longer term, there will also be a need to check whether the decision can be taken despite the inescapable uncertainties or whether the option has to be dropped in favour of one or more other options to be agreed upon.

- **identifying the stakeholders:**

The stakeholders represent a very large, heterogeneous group of individuals, associations and institutions who feel or consider themselves to be concerned or challenged by the issue; some have voiced their concerns, others have not. In the present case of methodological decisions, the points of discussion are wide-ranging by nature and the issues at stake do not normally have a local basis, except those sites where B and C waste is temporarily being stored which will have to put up with the consequences of the storage operation until a solution has been found.

- **the decision-making process and its rules:**

It is vital to establish a process of successive decision-making in order to ensure that the decision to actually dispose of the waste is regarded as legitimate. Furthermore, the question to be considered involves ensuring the process is stable over time and unfolds on a continuing basis; the question has to appear regularly on the agenda and not just during periods of conflict.

The concept of sustainable development relies on the precautionary principle to point the way in the decision-making process, given the inescapable uncertainties. The European Commission recently published a communication to set forth its views on this principle and the application procedures. Far from constituting a principle for systematic abstention, it allows for the methodical management of risk situations creating inescapable uncertainties or potentially irreversible damage. The principle therefore acts as a guarantee for all parties that the decision will be taken only after the question has undergone a complete scientific assessment. In this way it is possible

to determine what steps, proportional to the risk incurred, have to be taken for the decision to be accepted.

The precautionary approach initially involves defining the various decision-making stages in terms of their content and the analytical details that have to be provided in support of the decisions to be made.

Launching a social dialogue in keeping with the principles mentioned above requires careful preparation and the backing of a team of experts. In order to get off to the best possible start, the dialogue must be preceded by an exploratory phase in which an initial attempt will be made to define the question, pinpoint the stakeholders and jointly define the decision-making process and its principal stages.

It is vital for the dialogue to underpin the precautionary approach as it has to enable decisions to be made in keeping with the problem to be addressed. This means without any undue haste or delay. The dialogue is also a guarantee of stable decisions that become difficult to rescind once they are taken in this context.

## 5 Towards an integrated action programme

Effective governance of risk problems means addressing the technical and social factors in symbiosis. The action programme has to be designed in the light of this principle. The programme should first of all ensure the various stakeholders are on the same footing, by providing them with all the information they need to guarantee a balanced debate.

### **First stage: a transitional stage**

A major effort is to be made to remedy the de facto lack of any dialogue with the various stakeholders at all levels. The technical initiatives underway have to be continued, whilst the foundations have to be laid for a constructive social dialogue. ONDRAF/NIRAS is pressing on with its internal and external efforts to promote a culture of transparency and openness.

- In order to set the scene for dialogue, the content and the outline of the question have to be defined: the options to be compared, the safety reference system, the desired level of flexibility and retrievability and so on are decided on the basis of a consultation process involving all the parties concerned. The process will more likely than not be repetitive. At the same time, the stakeholders will be identified and the structures for arranging their participation in the dialogue and decision-making will be established. The major decision-making steps will be defined according to a precautionary approach in agreement with the stakeholders in order to ensure their legitimacy.
- On the basis of the SAFIR 2 report and the recommendations of the scientific reading committee, as well as the international assessment, the different stages of the technical methodological research programme after 2003 have been defined. This programme includes all the research still required for the options being considered (Boom clay formation, Ypresian clay formation) and those that would be decided upon at the end of the dialogue preparation stage. This research gathers together all the elements required to be in a position to embark on the preliminary design agreed on.

## **Second stage: dialogue underpins research**

- The dialogue with the various stakeholders is conducted on the basis of agreed structures: at a local level, the existence of temporary storage sites (Dessel, Doel and Tihange) and the underground laboratory in Mol are specific items to be dealt with in keeping with the desires of the local actors; the dialogue is maintained by organising the regular participation of the stakeholders and by keeping the issue on the agenda.

This period will continue until the methodological aspect has been completed. The aim is to achieve an initial agreement by the end of this period concerning the site or sites for conducting the preliminary draft studies for the following phase; the process halts as long as no general or local agreement has been reached.

- The research programme agreed upon is then carried out. The aim is to collect all the items required to ascertain the safety of the options being considered and to do so at the required level. In order to decide between the various options, a strategic impact assessment will be carried out, focused on the present options added to those which will result from the dialogue preparation phase (different host rocks, long-term storage, national or international solutions in Belgium or abroad...).

At the end of the period, ONDRAF/NIRAS should be technically prepared to cope with the preliminary design stage.

## **The subsequent stages: towards a solution**

As the methodological activities are completed, these stages are specific to one or more sites for implementing the solutions decided upon by all the parties and should be treated as such according to the methods agreed on at this time. These methods should result from the dialogue conducted up until then. It should be remembered that the building and operating permits relating to the solution or solutions decided upon for category C waste must be ready no later than 2030-2040 (after a cooling period of at least 50 years).

Nonetheless, the R&D programmes obviously have to be continued in order to support the activities carried out, irrespective of the management option or options agreed upon.

## **6 Final thoughts and decisions to be made**

The technical aspect of the long-term management of high-level waste is now well defined. Different categories of waste are stored in buildings designed for this purpose. Moreover, a final solution is under investigation for the option of disposing of the waste in a poorly indurated clay layer, the Boom clay formation in Mol-Dessel, with the Ypresian clay formation in Doel as an alternative. The funds required for implementing this solution are being secured as the waste is being delivered. Important teams of experienced scientists and engineers are busy trying to resolve this question.

Other alternatives that may become available will of course in turn have to undergo the necessary reviews.

At present, there is nothing to suggest that one or more solutions cannot be developed by the time the waste is ready to start leaving its temporary storage sites, i.e. around 2050.

However, there exist no structures of dialogue that allow to define the various options to be decided between for the long-term management of high-level waste in order to reach a decision that is acceptable by all.

Putting this dialogue in place is an urgent prerequisite for conducting research for a solution without running the risk of not being able to implement it. A balance has to be found between the technical and social approaches - a balance that does not exist at present. This also results from the simple application of the principles of precaution and good governance in keeping with the rules of sustainable development.

Hence there are **two decisions** to be taken which involve entrusting ONDRAF/NIRAS with the task of:

- **Preparing and initiating the dialogue at all levels in order to**
  - **bring together the various stakeholders wishing to take part in the dialogue,**
  - **define alternative options or ones that complement those now being considered for inclusion in the programme,**
  - **prepare, in agreement with the stakeholders, a decision-making process consistent with the precautionary approach.**
- **Defining and implementing the methodological technical programme, taking into account the recommendations of the consultative scientific reading committee, by extending it to include the options that emerge from the dialogue. This programme includes the on-site implementation of the PRACLAY experiment.**

Once the methodological programme has been carried out, all of the scientific and social elements will be available to enable the government to make the final decisions about the options chosen and the site or sites where these decisions should be implemented.

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