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Abstract

In the previous decades many research programmes on the disposal of radioactive waste have been completed in the Netherlands. The experts involved have reconfirmed their view that deep underground disposal in suitable geological formations would ensure a safe and prolonged isolation of the waste from the biosphere. Both rock salt and clay formations are considered to qualify as a suitable host rock. In 1993 the government in a position paper stated that such a repository should be designed in a way that the waste can be retrieved from it, should the need arise. In an attempt to involve stakeholders in the decision-making process, a research contract was awarded to an environmental group to study the ethical aspects related to retrievable disposal of radioactive waste. In their report which was published in its final form in January 2000 the authors concluded that retrievable disposal is acceptable from an ethical point of view. However, this conclusion was reached in the understanding that this situation of retrievability would be permanent. From the concept of equity between generations, each successive generation should be offered equal opportunities to decide for itself how to dispose of the radioactive waste. Consequently, the preferred disposal option is retrievable disposal (or long term storage) in a surface facility. Although this view is not in conformity with the “official” position on radioactive waste disposal, there is a benefit of having established a dialogue between interested parties in a broad sense.

1. INTRODUCTION

The disposal of radioactive waste in the Netherlands has a long history. Already in the late seventies the suitability of salt formations in the deep underground in the northern part of the country was investigated for this purpose. Several model studies have been carried out and comparative safety assessments of different repository designs have been made. The preferred disposal option is still a mine type of repository with spatially separated compartments for low — and intermediate level waste on one hand and high level waste on the other hand. However, due to opposition of the local population and environmental groups the suitability of these salt domes could not be confirmed by site investigations. Exploratory research of the salt domes was postponed as well as any further decision on a disposal site. As a temporary solution the government decided for long term storage in an engineered facility operated by the national waste management organisation, COVRA.

In 1993 year the government published its policy on disposal methods for highly toxic wastes, including radioactive waste in a position paper [1]. It stated that non-retrievable storage and disposal methods for highly toxic wastes, including radioactive waste, are not in accordance with criteria for sustainable development and should, consequently, be rejected. Since that year in which also the suitability, in principle, of deep underground salt formations
for disposal of radioactive waste was reconfirmed after discussions in Parliament, the concept of retrievability for radioactive waste and other highly toxic wastes has been the cornerstone in the Dutch waste management policy.

2. RADIOACTIVE WASTE QUANTITIES

The storage facility of COVRA is designed for a capacity of 200 000 m$^3$ LILW and 2000 m$^3$ HLW. This capacity was based on estimates made for the waste generated by the two nuclear power stations (NPS) in operation and two additional NPS of 1000 MWe which was the envisaged nuclear energy programme before the accident in Chernobyl occurred. For the high level waste the estimates have to be adjusted downwards, because the extension of the nuclear capacity never happened. The estimates of the LILW are still largely valid due to the need to safely manage new types of radioactive waste, mainly from the process industry.

Currently there is about 10 000 m$^3$ conditioned LILW kept in storage at the COVRA establishment. A separate building for storage of HLW is under construction.

3. RESEARCH PROGRAMMES

3.1. The OPLA research programme

Research on the permanent underground disposal of radioactive waste has been carried out under the OPLA programme. This programme focused on the examination of the possibility of long term disposal of radioactive waste in salt formations. Although it is envisaged that an underground disposal facility would accommodate both high and low/intermediate level radioactive waste, the safety studies focused on the integrity of the galleries containing high level waste. In 1989 phase 1 of the OPLA programme was completed. The feasibility of an underground disposal facility for radioactive waste in rock salt formations was demonstrated. In order to validate the approach used in phase 1 with comparable studies abroad, a Review Team consisting of experts from the NEA, EC and some specialised institutes was invited to review the programme. The Review Team was, in its report in 1989, favourably impressed with the progress made and stated that this it is a first step in an iterative process, leading to a robust safety case. The Team recommended that further studies should focus on a reduction of existing uncertainties in the models and emphasised the need for the acquisition of site-specific data to validate the assumptions made.

After completion of phase 1, phase 1a of the OPLA programme was commissioned taking into account the recommendations of the NEA Review Team, except that no approval was given for an in situ examination of the properties of the specific salt domes envisaged as possible hosts for the radioactive waste. This phase of the study was completed in 1993. It was concluded that from a safety point of view there are no prohibitive factors in connection to deep underground disposal of radioactive waste in salt. The more ethically-oriented question whether the underground may be used for the disposal of waste and thus withdrawing it from other possible uses is still a moot issue.

As mentioned in the introduction, in the same year the government published its position paper on the disposal of highly toxic wastes in deep underground repositories and committed itself to a policy that demands that no irreversible steps will be taken. In other words, disposal of radioactive (and other toxic wastes) should occur in repositories designed such that the waste can be retrieved if and when deemed necessary.
Consequently, many projects in the subsequent research programme focused on different aspects of retrievable disposal.

3.2. The CORA research programme

CORA is the national research programme overseeing and co-ordinating all research related to radioactive waste disposal. Its terms of reference are the following:

- To broaden the scope to other relevant host rock materials. In particular the suitability of tertiary clay which is an abundant host rock material in the Netherlands is to be taken into account.
- To further explore the impact of the principle of retrievability of radioactive waste from a repository and in particular to focus attention on:
  - feasibility of construction of a retrievable repository in different host rock materials and time-dependence of the structural requirements.
  - safety implications of various retrievable options on the long term containment function of the repository.
  - additional investment cost and maintenance costs of retrievable repositories in different host rocks.
- To investigate the possibilities of extended surface storage of radioactive waste.
- To maintain and possibly intensify the international co-operation in research related to radioactive waste disposal by participation in international projects.

A diagram representing the main areas of research as well as the interdependencies of the different research projects is given in Fig. 1.
3.3. The METRA project

Although it was not envisaged from the outset, it was recognized in the course of the CORA research programme that in order to find a solution for radioactive waste at all, it is necessary to also involve in an early stage stakeholders representing groups outside the energy sector or the regulatory body. There was reason to believe that the attitudes of the local population and of environmental groups could be more responsive towards retrievable disposal than towards non-retrievable disposal. It was therefore decided to extend the programme with a social/ethical module under which the METRA study was conducted. The contract for that study was awarded to an environmental group originating from the northern part of the country which in the past had been considered for the disposal of radioactive waste due to the presence of geological stable, underground salt domes. The group had opposed vehemently against such disposal and against any on site exploratory research aimed to assess the suitability of this salt formation as a host rock for a radioactive waste disposal facility.

The METRA project had two main objectives:

- to identify the social and ethical considerations underlying retrievable disposal; and
- to interview a number of environmental organisations with the aim to record opinions and feelings that play a role in the acceptance of retrievable disposal.

The METRA study was completed in May 1999 with the submission of the final report to the steering committee of CORA [2].

4. ETHICAL CONSIDERATIONS RELATED TO (RETRIEVABLE) DISPOSAL

The report of the METRA study is organised such that discussions of social and ethical aspects are conducted on the basis of a limited number of main themes as specified below:

- Can (past) production of waste be justified?
- Can disposal of waste be justified for the current generation?
- Can disposal of waste be justified for future generations?
- Are nuclear energy and radioactive waste sustainable?
- Is retrievable disposal a more ethical solution than definitive disposal?

It should be stated that the contents of the report do not necessarily represent either the view of the members of the CORA steering committee, or from the government of the Netherlands. Without prejudice to any future position of the government with regard to the conclusions arrived by the authors on each of these themes in the METRA report, these conclusions will nonetheless be represented in this paper and be compared with either national policies or with consensus statements drawn from publications of intergovernmental organisations. It is, however, believed that the discussion on radioactive waste disposal would benefit from openness and transparency of the arguments of all stakeholders and that a solution for radioactive waste which has broad support in the population can only be achieved if all arguments have been addressed and all possible options have been considered.
4.1. Can (past) production of radioactive waste be justified?

The view of the authors in the METRA study is that radioactive waste can not be considered in isolation but only as a phase in the process which generated it. This means that it is not possible to answer the question of justification of existing waste without also bringing into the discussion the justification of the practice that generated the waste. This requires that the perambulatory question whether the generation of nuclear energy is justified has to be answered first. According to the authors nuclear energy is a burden which causes harm. There are insufficient benefits (electricity generation) associated with nuclear energy to make up the detriments (possibility of serious accidents, non-sustainable resource, generation of long lived waste) and there is an unequal distribution of benefits and detriments in space and time.

Some environmental organisations interviewed even take the position that any cooperation to a solution for the radioactive waste problem is denied as long as the government has not put a ban on nuclear energy. They expressed fear that a consensus on radioactive waste disposal would clear the way for a reintroduction of nuclear energy.

The government position on waste in general, including radioactive waste, is laid down in several official documents [3,4]. The gist of this policy is sustainable development, which means satisfying the needs of the present without compromising the ability of future generations to meet their own needs [5]. This concept translates in a more practical sense into integrated life-cycle management of industrial processes. In this context waste is an undesired commodity and processes should be geared as to prevent the generation of waste. Waste which can not be prevented should, to the extent possible, be recycled or reused under the condition that such recycling or reuse can be performed in an environmentally responsible way. If recycling or reuse of waste is not possible, disposal is the preferred option, but only as a last resort. Waste disposal facilities should be designed such that the waste is isolated from the biosphere for sufficiently long periods of time.

4.2. Can disposal of waste be justified for the current generation?

In the METRA study a distinction is made between ethics of utilitarianism and ethics of justice. The former approach uses economic tools such as weighting and discounting which makes it possible that detriments are valued differently when incurred at different places or at different times and that detriment can be compensated by offering other benefits. The latter approach demands that all detriments are valued equally and that no discounting should be allowed. The METRA study assumes the ethics of justice approach as the preferred option. The consequence of this approach for present generations is that there is no justification if the persons receiving the detriment of waste disposal (the locals living in the vicinity of a waste repository) are different from the persons receiving the benefits (the users of electricity generated by the nuclear power station having generated the waste), which is usually the case. Compensation offered by the government to balance any inequalities in detriment in the population can be regarded as bribery, and should be rejected according to the approach of ethics of justice.

The position of the government in this respect, although it is not specifically stated in any national policy document, can be derived from the radioactive waste management principles 1-3, contained in the IAEA Radioactive Waste Fundamental [6] a publication endorsed by the government (Box 1).
4.3. Can disposal of waste be justified for future generations?

In trying to answer this question the METRA study again refers to the ethics of justice which demands that future generations should not be in a worse position than we are today. This requires that our generation should bear full responsibility for their actions also if these have an impact in the far future. Radioactive waste is considered to constitute a potential hazard in the future by the risk of uncontrolled release in the environment and thus exposing future generations which obviously have not had any benefit from it. The time scale for radioactive waste to be a potential hazard amounts to as much as hundreds of thousands of years which is beyond comprehension. It is unrealistic to expect that the present generation can take responsibility for such long periods. Consequently, from an ethical point of view radioactive waste is a difficult issue.

Again the government position aligns more or less with the principles 4 and 5 of the IAEA Safety Fundamental on radioactive waste (Box 2).

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<tr>
<th>Principle 1</th>
<th>Protection of human health</th>
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<td>Radioactive waste shall be managed in such a way as to secure an acceptable level of protection for human health.</td>
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<th>Principle 2</th>
<th>Protection of the environment</th>
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<td>Radioactive waste shall be managed in such a way as to provide an acceptable level of protection of the environment.</td>
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<th>Principle 3</th>
<th>Protection beyond national borders</th>
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<td></td>
<td>Radioactive waste shall be managed in such a way as to assure that possible effects on human health and the environment beyond national borders will be taken into account.</td>
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It also is in close agreement with the concept of the “rolling present” as introduced by the NEA in its Collective Opinion on the environmental and ethical basis of disposal of radioactive waste [7]. This concept advocates a postponed decision on disposal of radioactive waste. During a period of reflection the waste is stored in a retrievable way in order to keep it accessible and available in a form that enables to process it with more advanced technologies. Not only the waste form is passed on to a next generation, but also the resources and the technical abilities to manage the waste in an environmentally responsible way.

4.4. Are nuclear energy and radioactive waste sustainable?

In the METRA study eight different criteria were defined which should be met in order to comply with requirements of sustainability (Box 3). When assessing nuclear energy and nuclear waste against each of these criteria, the authors of the METRA study concluded that none of these criteria were met. It is not clean, because waste is generated. It is not safe, because accidents with serious consequences cannot be excluded. It is not considered efficient
in combating the greenhouse effect, neither is it affordable due to the high cost of safety requirements and waste management. The resources of uranium are not infinite and consequently not sustainable. Finally nuclear technology will not be provided to some undemocratic regimes. It goes without saying that the views on these criteria can be completely opposite to the conclusions arrived at in the METRA study, depending on the assumptions made.

4.5. Is retrievable disposal a more ethical solution than definitive disposal?

According to the earlier mentioned ethics of justice embraced by the authors of the METRA study there should be no difference in detriment between the present generation and future generations. If for the present generation retrievable disposal is the preferred option, this should also be applicable to future generations. Consequently, this approach calls for permanent retrievability. Each new generation should take on the task to take care of the waste which is inherited from the previous one. An irreversible situation is thus avoided. Permanent retrievability is considered less unfavourable than final disposal. Because of the requirement of permanent retrievability rock formations such as salt and clay whose physical properties (plastic deformation) tend to fill the space between the disposed radioactive waste and the host rock, are considered to be less obvious. Therefore a permanent retrievable disposal facility at the surface is the recommended option. It is recognised that both the stability of the institutions charged with the management of the waste and the stability of the society as a whole are questionable for the long term and that deliberate or inadvertent human actions may lead to a release of radioactivity from the facility. However, no solution is offered for that.

Although the government has not taken any formal position in this matter, the main objection against a surface disposal facility for high level waste is that it offsets the main advantage of an underground repository i.e. that negligence to manage the waste properly will at least lead to an inherently safer situation.

5. CONCLUSIONS

There continues to be fundamental differences of view on the ethics regarding disposal of radioactive waste between the regulator (representing the official position) and representatives of environmental organisations. In one view it is considered ethical to emplace the waste in a (retrievable) underground repository in order to create a fail-safe situation. In the other view it is found more ethical if each successive generation would decide for itself what the best disposal method is, manage the waste such as to keep all options open and pass on the know-how, the technology and the resources to enable that.
On the principle of retrievability itself there seems to be an agreement between the "official position" and the authors of the METRA report to the extent that it is acceptable from an ethical point of view. However, no consensus exists yet on a practical implementation of this concept. Permanent retrievability is an illusion if one accepts that long term safety conditions of the repository should not be compromised.

Another observation that can be made is that this study has proved that there is a beginning of a dialogue between the official bodies and persons representing environmental and social organisations and that at least a significant part of the latter groups have shown a determination to remain involved in the further discussions.

A comparison with experiences in other countries in which such discussions have been held may be useful to identify the factors which are relevant for the establishment of an atmosphere of openness and confidence which are a prerequisites for a fruitful discussion.

Given the need to work towards one or another solution for the radioactive waste which has been generated in the past, a fact which is also acknowledged by most of the environmental groups, a stepwise process towards disposal may be agreed upon as a result of a broad discussion, consisting of a series of public hearings in which all stakeholders involved should participate.

REFERENCES


QUESTIONS (Q), COMMENTS (C) & ANSWERS (A) AFTER THE PRESENTATION

Chair: One of the interesting things is the clear description of the arguments and the line of reasoning behind what has led different groups to quite different lines of action for the nuclear waste. It is important to have that picture at a meeting like this.

Q: What would your government do with respect to publishing the METRA study or taking a stance on it? You claimed that sustainability is the common theme that you both agree on. But the criteria for sustainability in the METRA study will not be satisfied by any technology ever in any universe. It should be 100% clean, 100% safe and last for ever!! Do you know if the government, which is also interested in the issue of sustainability, intends to make these things clear?
A: The METRA study is part of the CORA research programme, which is officially not yet finished. I guess that the documents will be published but I doubt if they will be immediately followed by a formal statement by the government.

Q: Do you have any idea on how the people behind the METRA study think that energy should be generated in an industrial society? All the criticism they have on nuclear energy is also applicable for the main alternative energy sources, such as fossil fuels. Those are even worse — based on these criteria.

A: Certainly they have their favourable methods of energy generation and that means that there is a focus on renewables. The other stance they take is that we should try to conserve energy much more than we do now.

C: I just wanted to point out that we did invite the authors of the METRA study to attend this seminar and to defend their own views. Unfortunately, they felt unable to attend. So we apologize, in a sense, to Henk Selling, for actually having to answer the questions on their views.

Q: According to the presentation, the METRA study does not give any alternative solution of its own. Is this because of the clay — salt situation or do you think they might have had different views if granite or tuff were available?

A: It is mainly because of the availability of clay and salt in our country. A quotation may illustrate their view: "Permanent retrievable storage in salt or clay formation is less obvious because of its creeping properties. Thus permanent retrievability can not be guaranteed. Therefore we conclude that above ground retrievable storage is the ethically less unfavourable choice. However, this calls into question the stability that have to control the nuclear waste and the durability of buildings and location. This remains a dilemma without any real solution".