

LONG-TERM MANAGEMENT OF HIGH-LEVEL WASTE: DEFINING NATIONAL STRATEGIES AS A SOUND APPLICATION OF THE PRECAUTIONARY PRINCIPLE

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There is a wide consensus, internationally, for considering that countries generating radioactive waste, either from power generation or in the course of industrial, medical or research activities, are responsible for ensuring that this waste is appropriately managed. This position is shared, in particular, by the signatories to the Joint Convention of Vienna of 1997 [1] and by the EU Members States, as stated in a Council Resolution adopted on 16 December 2008 [2].

In practice, the day-to-day management of low and intermediate-level short-lived waste appears to be well in hand in most European countries, and long-term management solutions for such wastes are already implemented in several countries or expecting commissioning in several other countries [3]. The situation is comparable in Japan and the United States.

By contrast, the management of high-level and/or long-lived waste and of spent fuel is generally a lot less advanced and varies widely from country to country. High-level and/or long-lived waste and spent fuel¹ are currently being safely stored on an interim basis. However, the United States is the only country so far to have implemented a solution for the long-term management of some of this waste, i.e., the geological disposal in a salt formation of long-lived transuranic waste from military facilities. Other countries, such as Canada, Finland, France, Germany, Japan, Sweden, Switzerland and the United Kingdom, are committed, through government policy, to disposing of their high-level and/or long-lived waste in a geological repository. Germany is close to launching the geological disposal of intermediate-level long-lived waste in an ancient iron mine located under an argillaceous formation. Other countries, such as Belgium, Italy, Lithuania, the Slovak Republic and Spain, have not yet established a policy regarding the long-term management of their high-level and/or long-lived waste. In other words, they have not “closed down” the long-term management options for those types of waste.

“Closing down” long-term management options, that is, deciding on the solution that will eventually be implemented is essential. The final destination of the waste must be known if one is to optimise various upstream aspects of its management, such as treatment and conditioning processes, dismantling policies, applied research and development activities directed towards long-term management, and the provisioning of sufficient financial means to cover long-term management costs. In addition, it is of strategic importance for countries who wish to carry on using nuclear energy to have solutions in hand for the long-term management of their radioactive waste.

¹ Spent fuel considered as radioactive waste, and thus to be managed as such, is considered to be covered by the designation “radioactive waste” in the remainder of this paper.

An appropriate solution for the long-term management of radioactive waste is a sustainable solution

EDRAM Members share the view that any solution for the long-term management of high-level and/or long-lived waste be a sustainable solution, where a sustainable solution is seen as a solution that takes account of the following four dimensions:

- the technical and scientific dimension,
- the environmental and safety dimension,
- the financial and economical dimension,
- the societal and ethical dimension.

In other words, any solution for the long-term management of high-level and/or long-lived waste

- should be technically feasible to implement, based on sound knowledge and understanding of system components behaviour and their interactions;
- should protect man and the environment against the potential hazards associated with high-level and/or long-lived waste for as long as necessary, and thus in particular ensure long-term radiological and non-radiological safety in compliance with relevant national regulations and with international principles, standards and recommendations issued by such organisations as the ICRP, the IAEA and the NEA/OECD;
- should be affordable and be financed according to the “polluter pays” principle;
- should benefit from an appropriate societal support and respect, in particular, the principle of intergenerational equity, entailing that the burdens and responsibilities for taking care of radioactive waste should not be passed on to future generations. The intergenerational equity principle entails in other words that (1) current generations must take the necessary steps to be in a position to implement as soon as reasonably possible solutions for the long-term management of their high-level and/or long-lived waste and that (2) current generations must secure sufficient financial provisions for that implementation.

Disposal in a stable geological host formation in a facility designed to be intrinsically safe, which has been under investigation for decades now in many countries, is generally considered within the international scientific community as a solution that is technically feasible. Provided that geological settings are carefully selected and matched with appropriate facility design and engineered barrier system, it can ensure long-term safety, while being a priori definitive, hence avoiding to shift heavy technical burdens on to future generations [4, 5]. This position is supported by the massive amount of knowledge and understanding around geological disposal available worldwide.

Solutions other than geological disposal have been envisaged for the long-term management of high-level waste. However, none of them has the profile of geological disposal. Some do not meet international legal provisions or cannot be proved to be safe, others are unaffordable. Others still, such as indefinite storage of the waste in adequate surface facilities, shift heavy burdens and responsibilities on to future generations: active controls as well as the maintenance of industrial, regulatory and security infrastructure required to ensure long-term safety cannot be guaranteed indefinitely. Wait-and-see policies shift the burden of deciding on the future of the waste and of managing it on to future generations.

Important to note is the wide consensus among radioactive waste management agencies and electricity producers for considering that, whatever the developments of the advanced nuclear fuel cycles and of partitioning and transmutation [3, 4, 5, 6], there will always be some existing and future high-level/long-lived waste to be safely managed in the long term. In addition, advanced reactors will not be operational for decades, and fuel cycles integrating partitioning and transmutation could need many more decades of operation to lead to significant reductions of the radiotoxicity of waste, which is their stated objective [7].

The existence of remaining uncertainties is no reason for not choosing a management solution

Programmes around geological disposal distinguish themselves from all other types of industrial programmes by their duration. With activities of research, development and demonstration stretching over decades, and construction, operation and closure activities stretching over further decades, geological disposal programmes also entail that key decisions are spread over far longer periods than the time horizons society is used to. By comparison, the time span between the launch of the space conquest soon after the end of World War II and the landing on the moon was of only about twenty years.

The length of the road to geological disposal and the existence of remaining scientific and technological uncertainties are not valid reasons for countries for delaying a decision on a policy for the long-term management of their high-level and/or long-lived waste. Principle 15 of the Rio Declaration (1992) [8], more widely known as “the precautionary principle”, states that *“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.”* Instead of the widespread interpretation “When in doubt, do not do anything”, the precautionary principle, applied to the context of long-term radioactive waste management, is in fact an invitation for decision-makers to establish the general orientation – the national policy – and the first implementation steps to be followed for the long-term management of radioactive waste.

EDRAM Members therefore share the view that States who do not yet have a national policy for the long-term management of their high-level and/or long-lived waste should establish one as soon as possible, as well as an adequate funding mechanism. The possibility of future changes in context (knowledge and understanding, legal and regulatory framework, society, etc.) advocates in favour of management policies that allow for a flexible decision-making process, starting with a strategic decision, often called “decision-in-principle”, and aimed to guide necessary developments according to a sound application of the precautionary principle.

National waste management programmes and plans as roadmaps for supporting decisions-in-principle and further decision-making

EDRAM sees national waste management programmes and plans, also known as “waste plans”, as the tool to provide competent national authorities with all necessary elements to define the national strategy for the long-term management of radioactive waste. This view is in line with the views of the EU Member States, who agree in particular on the following principles, quoted from a Council Resolution [2]:

- *“it is essential that each Member State should put in place a national spent fuel and radioactive waste management plan. Such plans should take a long-term view, cover all types of radioactive waste and describe all the stages of implementation. They should at least include an inventory of spent fuel and radioactive waste present in the national territory and the future prospects, examine existing solutions, formulate the R&D strategies deployed to improve existing solutions or to develop new solutions, establish a timetable for putting these solutions into effect, evaluate their costs and funding methods, describe the regulatory framework and the decision-making processes for the implementation of new solutions, and determine the spheres of responsibility. The plans must be made available to the public and be reviewed and, if necessary, revised on a regular basis;”*
- *“policies for spent fuel and radioactive waste management, based on scientific and technological progress, should be implemented through transparent processes enabling the public to be properly*

informed and to be involved in decision-making (especially as regards the location of disposal sites);”

As regards long-term waste management solutions, EDRAM considers that waste plans should address all four dimensions of a sustainable solution in a balanced manner.

- Waste plans should describe the preferred solution, provide an outline of how it is expected to be reached from a scientific and technical point of view, and evaluate possible alternative solutions.
- Waste plans should show how the preferred solution is expected to protect man and the environment against the potential hazards associated with high-level and/or long-lived waste, taking due consideration of the characteristics of the different waste types.
- Waste plans should contain an estimate of the cost of further developing and implementing the preferred solution and evaluate funding methods, whether these exist or have yet to be implemented.
- Waste plans should reflect the values and concerns of society. They should contain a proposal for the decision-making process covering all phases of the long-term waste management programme through to implementation. As this proposal must be perceived as legitimate by the stakeholders, it therefore needs to be agreed upon in advance.

Clearly, waste plans must be fit for purpose and are expected to evolve as long-term waste management programmes progress, new scientific and technical developments take place, and societal or regulatory factors change.

Efficient implementation of long-term waste management policies requires conditions to be met

National policies for the long-term management of radioactive waste must be established at the political level and transposed into a suitable legal, regulatory and organisational framework, in harmony with national cultural views and societal values. The following aspects, in particular, are seen by EDRAM Members as necessary conditions to be fulfilled if national policies are to be implemented efficiently.

- The allocation of roles, responsibilities and rights between all the stakeholders involved (government, waste management agency, regulatory body, waste producers, local authorities, society at large, etc.) must be clear.
- Clear safety criteria and licensing procedures must be made available to the implementer in a timely manner through national legislation or regulatory guidelines and, more generally, the applicable legal and regulatory framework must be clear and complete.
- Dedicated systems for securing sufficient financial resources to cover the costs of long-term management must be in place.
- Public participation through open and transparent processes must be encouraged and maintained.
- The decision-making process must be flexible and progressive enough to integrate new developments and unexpected changes while maintaining a forward momentum.

Of all these aspects, the societal dimension is considered by EDRAM members as the most challenging. Public involvement and support are indeed absolute prerequisites for long-term waste management programmes to progress towards implementation.

Concluding remarks

EDRAM Members share the following views.

- Because of their responsibility to future generations, and whatever the future of nuclear energy, countries need to choose a long-term management solution for their radioactive waste. This also allows more accurate estimates to be made of the provisions necessary for implementing the chosen solution.
- Whatever the future developments of advanced fuel cycles and of partitioning and transmutation, there will always be some radioactive waste, in particular already existing waste, to be managed in the long term. The characteristics of those wastes are such that surface disposal for an indefinite period of time cannot be considered a sustainable solution.
- Waste plans or similar documents, based on a sound comparison of alternative solutions, are an adequate basis to support a strategic decision on the final destination of ultimate radioactive waste.

The main challenges in implementing national policies for the long-term management of high-level and/or long-lived waste are currently seen as follows:

- to ensure the continuity of human knowledge and expertise and of resources throughout the process;
- to move from research and development on to full-scale, industrial implementation;
- to maintain adequate societal support throughout the process;
- to adapt to successive evolutions in the applicable legal and regulatory framework, which reflect, at least in part, important evolutions in society.

References

- [1] IAEA, Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, 1997
- [2] Council of the European Union, Council Resolution on Spent Fuel and Radioactive Waste Management (adopted on 16 December 2008), 17438/1/08 Rev. 1, 7 January 2009
- [3] ENEF Subgroup on the Implementation of adequate nuclear waste disposal, Roadmap to successful implementation of geological disposal in the EU, draft 5 of 21 January 2009
- [4] NEA/OECD, Moving Forward with Geological Disposal of Radioactive Waste, A Collective Statement by the NEA Radioactive Waste Management Committee (RWMC), OECD, 2008
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