

Preservation of Records, Knowledge and Memory Across Generations. An emerging Multidisciplinary Work Area and an NEA Project – 12218

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ABSTRACT

Disposal in engineered facilities built in stable, deep geological formations is the reference means for permanently isolating long-lived radioactive waste from the human biosphere. This management method is designed to be intrinsically safe and final, i.e. not dependent on human presence and intervention in order to fulfil its safety goal. There is however no intention to forgo, at any time, knowledge and awareness either of the repository or of the waste that it contains. The preservation of Records, Knowledge and Memory (RK&M) is seen as an integral part of radioactive waste management, supporting lengthy and complex socio-technical processes across pre-operational, operational and post-operational lifetimes. Long-term preservation of RK&M is an emerging multidisciplinary work area in which much learning is expected over the coming years. Novel methods are being sought that are least vulnerable to both natural degradation and to changes in socio-economic conditions. Progress has been made in individual countries, but there is a need to internationalise the thinking, compare approaches, investigate potential solutions and share decisions. This is the task of the NEA RK&M project. A major outcome of the project will be a 'menu-driven document' that will allow people to identify the main elements of a strategic action plan for RK&M preservation.

INTRODUCTION

Deep geological disposal is today broadly considered as "the safest and most sustainable option as the end point of the management of high-level waste and spent fuel considered as waste" [1, also 2, 3]. Although this management method is intrinsically designed to be passively safe and final, i.e. not dependent on human presence and intervention in order to fulfil its permanent safety goal, there is no intention to lose track of the repository. As national repository developments are heading towards implementation, several programmes are preparing means for indirect oversight once the repository is closed, including monitoring, applying safeguards according to international agreements, maintaining records, and, ultimately, preserving memory. Institutional arrangements are integral to these provisions, as the continuity of oversight will in the first place require identifying a chain of responsibilities. At the same time, provisions that are less vulnerable to changes in socio-economic conditions and may be less reliant on institutional presence should also be investigated.

These considerations led to the creation of the OECD NEA Project on the Preservation of Records, Knowledge and Memory (RK&M) across Generations [4], which is documented at www.oecd-nea.org/rwm/rkm/.

METHOD AND KEY QUESTIONS

The RK&M project participants include representatives from 15 organisations from 12 countries, plus the IAEA and the European Commission. The national organizations provide a financial or in-kind contribution for the running of the project; the work is co-ordinated by the NEA Secretariat and steered by the RWMC Bureau; one or more consultants to the Secretariat are hired; findings are reported and discussed within the project and at RWMC meetings and thereafter documented. Member organizations also engage themselves to perform in-house work as agreed within the project.

The RK&M project is generically driven by the following interconnected questions: for what purpose do we need and want to preserve RK&M about radioactive waste on the long-term; which records and what kind of information need to be maintained; over which timescales; by whom and for whom; what can be done now and later to provide maximum continuity and accessibility of RK&M, and how much effort is reasonable to invest, now or later?

It was accepted that trying to master all these questions in an exhaustive manner, i.e. the whole system of RK&M preservation in its entirety, is too ambitious a task. The system of RK&M preservation over the various time scales of interest is a task that requires a large degree of abstraction that, in turn, can only take inspiration from a well-established practice, which does not exist today. In organising the programme of work, it was agreed that the project would focus first on an in depth scoping of the issue of preserving RK&M across generations, through initial project meetings, surveys and literature review. Consequently a series of workshops are organised, to gather additional contributors and audiences to those in the project and to further investigate specific themes. This requires project members to prepare documents and presentations in view of those workshops, sometimes working in sub-groups. Distilling lessons is done in consequent project meetings, for which consultants help prepare the relevant documents and discussions.

The project will be practice-oriented where possible:

- Current experiences should be examined with a view to identify strengths, weaknesses and knowledge gaps;
- Practical suggestions such as peer reviews, joint memory networks, etc. should be considered;
- Agreed results / statements are important deliverables;
- Concrete recommendations are sought;
- Visibility of products vis-à-vis all publics is important.

The main, tangible final deliverable of the project will be a 'menu-driven document' that will allow actors to identify the elements of a strategic action plan for RK&M preservation. This document will contain recommendations to countries on useful practices as well as suggestions for follow-on activities for the project.

In proposing this document as its main deliverable, the project acknowledges the suggestion by the RWMC [2] that an action plan for the preservation of RK&M across generations is likely to be an important management tool that all institutional actors will need to develop at one time or another. The RK&M project will support the development of such an action plan. Additionally, it is expected that national programmes will benefit from the shared, broad-based and documented understanding that will be achieved regarding the range of available methods, concepts, ideas and projects on the preservation of RK&M across generations. Such understanding – technical, managerial, institutional, societal and cultural – could be used as a reference for national programmes involved with siting and licensing repositories, or with other long-term projects. Regardless the actual stage of repository development, such understanding will also foster the development of more robust strategies and regulations for national radioactive waste management programmes that account for the importance of stakeholder confidence.

WORK AND RESULTS SO FAR

Phase–1 (2010 – mid 2011) and the first part of phase–2 (mid 2011 – mid 2012) of the project have been dedicated to scoping the issue of RK&M preservation and improving our understanding with the help of outside specialists. It included the following actions:

- Three surveys¹ have been distributed among and completed by the project members;
- A glossary of terms has been started, to support project activities by means of a common vocabulary. A set of terms is agreed upon already; more need to be defined still;
- Relevant literature on the topic of the long-term preservation of RK&M in the field of radioactive waste disposal has been collected into a project bibliography. A preliminary analysis of this bibliography has been conducted and will be continued;
- A draft collective statement has been produced on fundamental questions that are faced in this area, in order to build agreement amongst technical specialists and organisations in the radioactive waste area. This two page text serves as a manifesto of the project. The collective statement also shows that the technical people are realistic in their approaches and expectations and are listening to public voices; both reasons for and against RK&M keeping are to be recognized, and challenges are to be acknowledged;
- A first, interdisciplinary workshop was organised in October 2011, the proceedings of which are currently being finalized;
- A draft progress report is in preparation.

As mentioned before, the RK&M project is generically driven by the following interconnected questions: For what purpose do we need and want to preserve RK&M about radioactive waste on the long-term (: why)? Which records and what kind of information need to be maintained (: what)? Over which timescales (: when)? By whom

¹ 2010 Survey on Status and Needs, 2011 Survey on Responsibilities, 2011 Survey on Examples of Memory Loss and lessons learned.

and for whom (: who)? What can be done now and later to provide maximum continuity and accessibility of RK&M and how much effort is reasonable to invest, now or later (: how)? The project has scoped and commenced to deliver preliminary answers to all of these questions.

How?

The project title, 'Preservation of Records, Knowledge and Memory', may seem unduly long, but with good reason. The issue under consideration is not only about keeping data and information, but about preserving such data and information through media accompanied by the appropriate context and structure for later uses (: Records). Moreover, records in itself are meaningless without the ability to understand and utilize the data and information they carry (: Knowledge). In order for this combination of records and knowledge to be transferred across generations, in whatever form and detail, there needs to be awareness of their existence, which requires a broader awareness of events, people, places and levels of knowledge in the past (: Memory).

RK&M project members thus acknowledge that preservation of RK&M is not only about outcomes (the records we collect, the things we know, the memories we have) but as much about processes (recording, knowing, memorizing) [see also item 10 of 5].

Combining both, it has been agreed that future systems for preserving RK&M will need to be flexible and adaptable over time, complying with technical, managerial as well as social demands. A 'systemic' approach should be engaged whereby the various components of the system complement each other, provide for redundancy of message communication, and maximise the survivability of a recognizable message. This approach refers to the necessity to set up a system relying on simultaneous, redundant and independent pathways in order to ensure records and, ultimately, message survivability.

As part of such a systemic approach, project members agree that the idea of a 'dual-track' approach deserves further attention. A dual-track approach relies on both direct and indirect transmission of records to a future receiver. In the case of direct transmission, the presence of intermediaries (a 'transmission chain') is not foreseen and the record is conveyed directly from the present time to the future receiver. Markers form a good example of a means of direct transmission. A marker is a record meant to reach out to future generations in the medium to long term. Any marker is conceived to be immobile (i.e. in permanent association with a site), robust (in order to maximize survivability in a passive manner), and to provide a set of messages that are likely to be readable and understandable across generations.

In the case of indirect transmission the record is passed on from one generation to another, by means of a transmission chain of whatever kind. If archives are kept up to date, they form an example of a means of indirect transmission. Although some inspiration may be found from other current practices and from low and intermediate level radioactive waste management approaches, e.g. communication centers, local partnerships, etc., this area clearly requires further investigation.

The two tracks may address different target audiences and consider different levels of detail, different technical means to achieve message survivability, and different timescales.

Although the RK&M project focuses on what could be referred to as a managerial or organisational level, practical, technical and material considerations are also shared, e.g. related to the types of software for archiving or to the choice between digital recording or permanent paper.

When?

With regard to the timescales of RK&M preservation, the overall consensus is: as long as possible. Nevertheless project members agree that different time frames entail different RK&M frames, and that it is useful to make a differentiation between various phases. The following timeline, developed within the Reversibility and Retrievability project of the NEA (see its Final Report at <http://www.oecd-nea.org/rwm/rr/>), was found useful:

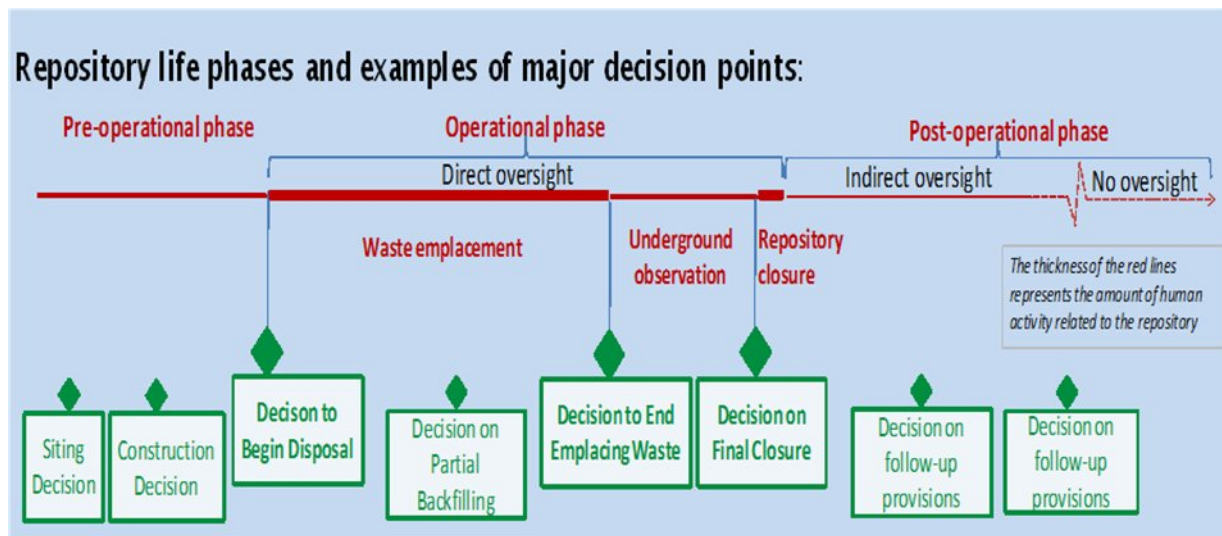


Figure 1: Repository life phases and examples of associated decisions

RK&M project members defined 'the very short term' as a period of time consistent with staff stability in role, cycles of organisational change, and regulatory expectations of periodic safety reviews. Typical time scales are 10 to 20 years.

In connection with figure 1, the 'short term' is referred to as the period of time that ends with repository closure. This period includes both the pre-operational and the operational phases of the repository. Timescales are of the order of 100 years.

The 'medium term' refers to the period of time of indirect oversight activities that would follow repository closure.² Time scales are of the order of a few hundred years.

Finally, the 'long term' is defined to refer to the period of time with no repository oversight. This period extends over the time addressed in the safety regulations, typically many thousands of years.

² At that time environmental and repository monitoring may still be ongoing, even if surface facilities may no longer exist.

What?

Clearly, different audiences in different time frames have different RK&M needs. Data will need to be culled as time progresses and one moves from a repository phase to another. The following information has crystalized as a minimum set of enduring, long-term data:

- Location of the facility
- Design of the waste management system (containers, barriers, facility structure, ...)
- Hazard of its content – radioactivity, toxicity

Apart from such factual information, the importance of ‘meta data’ is acknowledged, e.g. why the disposal is there and not somewhere else, where the waste comes from, why we consider it waste, why we decided to bury it, This means that contextual information has to be provided that explains decisions that lead to the permanent geological disposal as it is.

Overall, agreement exists about the fact that simply warning people to stay away will not do. Long term RK&M preservation should be not only about creating awareness of danger, but about creating understanding of risks through information.

Why?

There exists a variety of answers to the question of why we want and need to preserve RK&M in the framework of radioactive waste management. In general, it has been agreed that RK&M is a fundamental aspect of quality in establishing and running any long-term project. RK&M preservation serves to maintain confidence in the safety and security of the system, by allowing for accurate and reliable review by the authorities and providing for visible and transparent oversight of disposal projects across time. Furthermore, it addresses concerns and answers requests from the public, especially local communities, by means of the earlier mentioned function of confidence maintenance and as a communication tool. Another reason, which connects the issue of RK&M preservation to that of reversibility and retrievability, is to ensure that future generations can base their decisions on relevant and pertinent data. This motivation can also be translated in a more ethical sense, namely as supporting the freedom of future generations to act in an informed manner. Another reason for RK&M preservation is more culturally inspired, that is to promote awareness of past activities.

Who?

Preservation of RK&M is the responsibility of many different actors with a different role to play over time. Implementers, regulators and governments carry the main, formal responsibilities. Affected municipalities have voiced a strong interest in this area and may also become long-term actors in the preservation of RK&M. Nevertheless, while

local stakeholders have a legitimate interest, RK&M members agree that final responsibility should rest with the institutional bodies.

Overall, it is agreed that a 'life-cycle approach' should be adopted, which means all actors within the nuclear fuel cycle, from cradle to grave, have a role to play in the preservation of RK&M. Thus broadening the question of who should be involved in the creation and transfer of RK&M beyond formal responsibilities, it is acknowledged that de facto there is a very large variety of actors involved in the issue, including:

- Waste producers
- Waste managers
- Operators
- Regulators / safety authorities
- Scientists
- Governments – local, national, international
- Safeguards inspectors
- National archives
- Land registries
- Local residents
- Historians
- ...

DISCUSSION

RK&M preservation in the field of radioactive waste management is a multifaceted and complex field, with regard to both theory and practice. Therefore, the mission of the OECD NEA RK&M project is not to provide readymade answers to all related challenges, but rather, at this stage, to deliver advanced insights in the issue as a whole and to flag potential knowledge gaps and remaining issues of concern.

For one, it has been broadly acknowledged that RK&M preservation requires a multi-disciplinary approach. This means bridges need to be built between technical, nuclear experts, specialists from the human sciences, and civil society, to examine technical, administrative and social (political, economic, cultural, ...) solutions to preserve RK&M and to avoid its loss.

Furthermore, initiatives for international harmonized practices in order to avoid unnecessary divergence are needed. On the other hand, in light of long-term understandability there may be pro's and contra's related to standardization of messages.

The economic challenges for long-term RK&M preservation must be analyzed, especially with regard to the long term cost, and allowance must be made for them in future programs. Economic considerations also include finding a balance between suiting people's present needs, ambitions and likings, and providing for evolutions to match the potential needs and desires of future generations.

The role of RK&M in regulation for the long-term needs to be investigated further, most notably with regard to the requirements on RK&M for final licensing of the repository. Also in this regard, the connection between RK&M preservation and long-term safety

may need further clarification, as this was also signaled as an issue among the public by some project participants.

Another question relates to the fact that for long-term safety analysis, it is typically assumed that the future human technological capabilities are similar to today's capabilities; should this assumption be the same for the RK&M analysis?

In sum, the preservation of RK&M is a unprecedented task in which technical, scientific and social information is interwoven and needs to be developed and preserved across generations and across specialist boundaries.

Important studies³ have been undertaken in the past decades to explore a variety of approaches to preserving RK&M across different timescales, including archives and markers. The work of the past in this area is useful, but innovative thinking is also needed. Seen from today's perspective, very little work is available on for example the contextualization of data for later use; on the systematic identification of mechanisms for RK&M transfer; on implementing a culture of RK&M-keeping in organisations; and on creating cultural links between the waste disposals and the siting communities. Moreover, international cooperation is recognised as being crucial in providing shared means and meanings for memory transmission over longer timescales. International cooperation has also been identified as a catalyst to ensure that a wide range of approaches and experiences is considered, thus potentially reducing uncertainty related to variations in approach. Overall, multiple approaches, requiring active and less active care, need to be considered from the start of the radioactive waste management programme and refined in the course of time. The RK&M project members want to further investigate and deliver support to fulfil this task.

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