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NUCLEAR ENERGY AGENCY  
RADIOACTIVE WASTE MANAGEMENT COMMITTEE

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## Expert Group on Preservation of Records, Knowledge and Memory across Generations

### Progress Report of the Project on Preservation of Records, Knowledge and Memory (RK&M) Across Generations

March 2012-March 2013

*This report represents a status of the RK&M project from March 2012 to March 2013.*

*The 'Workshop Observations' have been updated as agreed at RK&M Project Meeting, 16-18 April 2013.*

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## THE RK&M PROJECT OF THE NEA/RWMC

### Introduction

Various NEA member countries are currently developing and constructing deep geological disposal projects for high-level and/or long-lived radioactive waste and spent fuel. These take decades to develop and implement, and the facilities are to operate passively and safely for millennia. Although different countries are in various stages of development with regard to their programmes for final radioactive waste management (RWM), for all countries with nuclear waste the question arises which relevant records, knowledge and memory should be preserved, why, how, by whom, and for how long?

Consideration of this question has led to the launching of the OECD NEA Project on the “Preservation of Records, Knowledge and Memory (RK&M) across Generations” by the RWMC in March 2011. A Collective Statement and a Vision Document have been prepared and released with RWMC approval. A project web-site has been created <http://www.oecd-nea.org/rwm/rkm/>. The project counts representatives from 16 organisations in 12 countries, plus the IAEA, and the support of the European Commission. Most organizations provide a financial or in-kind contribution to running of the project.

Within the RK&M Project, 2012-2013 was designated for improving our understanding and reaching out to outside experts. Multi-disciplinary studies have been encouraged from the start, since preparing the project in 2010<sup>1</sup>. Six surveys have been completed<sup>2</sup>, the analysis of the bibliography is being conducted, a glossary of key terms has been produced and is being refined, a catalogue of regulatory requirements is being produced, and two workshops have been held. A methodology for creating the ‘Menu Driven Document’ has been identified, a Project meeting will be held in April 2013 and a further workshop is planned for September 2013.

The project was presented to the UNESCO Conference of the Preservation of Digital Memory, which gave rise to new areas of research and collaboration, e.g., with the CoData task group on Data at Risk. Links established at the workshop will be developed further, e.g., with the builders of a 10 000 year clock - the Long Now Foundation<sup>3</sup> - and the DoE Legacy Management department.

The key general questions, as identified in the Vision Document, for the project in general are:

- Which records need to be maintained?

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<sup>1</sup> This followed the significant interest in the project shown at a Topical Session, held at the 44th Session of the Radioactive Waste Management Committee, in March 2010.

<sup>2</sup> 2010 Survey on Status and Needs, 2011 Survey on Responsibilities, 2011 Survey on Examples of Memory Loss, 2012 Questions of Regulatory Significance, 2012 A: Safeguards, 2012 B: National Archives.

<sup>3</sup> <http://longnow.org/>.

- For what purpose?
- Over which timescales?
- By whom?
- For whom?
- What can be done now – from a managerial, technical, legal, regulatory viewpoint – to provide maximum continuity of records, message, and accessibility?
- How much effort, and of what kind, is it reasonable to invest, now or later?

The priority at this stage of the project is to complete the scoping work so far by finalizing it into written documents. Furthermore in 2012-2013, the following meetings and activities have taken place or are under consideration:

- A project meeting was held in April 2012.
- A second, open workshop was held in September 2012.
- A further project meeting will be held in April 2013.
- The third open workshop will be held in September 2013.

As stated in the Vision document, the RK&M project will work towards a ‘Menu-driven document that will allow people 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 new suggested follow-on activities in this field. The release of this ‘Menu driven document’ is foreseen in 2014.

### **The September 2012 workshop**

The workshop titled “The Preservation of Records, Knowledge and Memory (RK&M) Across Generations: Improving Our Understanding” was organised to further contextualize and delimit the field, to learn from different practitioners. The overarching goal of the workshop was to improve our understanding of the questions pertaining to the project, and the wider culture of RK&M preservation. The workshop encouraged the discussion of experience and research from project members, the wider field of radioactive waste management, and beyond that field into academia, archiving, art, and others. The underlying assumptions of the project were reconsidered and the availability of different mechanisms and models for RK&M preservation were discussed. The fundamental need for social engagement with RK&M Preservation ran through all of the themes discussed.

50 participants from 11 countries representing national governments, universities, waste management agencies, safety authorities, community groups, and specialists in both the technical and social sciences, and three international organisations - OECD NEA, IAEA & UNESCO - were present at the workshop. They set of participants formed a pluralistic mix of implementers, regulators and other relevant practitioners (e.g. officials from national archives and regional public works) and academics from the social sciences and humanities (e.g. sociology, archaeology). In total 31 talks were delivered, each followed by time dedicated for Q&A, and 8 plenary discussions took place.

The workshop provided a fruitful forum for multidisciplinary reflection and discussion and delivered a large amount of information and ideas. Key learning from the workshop is as follows:

### **Regulation**

1. RK&M is not a regulatory requirement for long-term safety. The Safety Case, however, typically has the implicit assumption that RK&M will be preserved for some centuries - for example, in order to protect the repository from human action. The RK&M project is substantiating how this preservation of RK&M can be accomplished – for example, through the identification of the multiple national and supranational mechanisms that already exist.
2. The Regulatory Catalogue is a good addition to the RK&M project materials. However, regulation cannot be seen as the only solution to the problem – especially if regulation stops at the simple requirement to ‘keep any relevant records’.
3. The preliminary analysis of the Regulatory Catalogue shows that there is currently no emerging trend to be seen in how to regulate the preservation of records, knowledge and memory for the final disposal of radioactive waste.
4. From a regulatory point of view, there are requests from the EC to detail post-closure memory preservation plans. The upcoming guidance by the ICRP (document ICP-122) is based on the concept of oversight, which relies on RK&M preservation

### **Bibliography**

5. Within the project, the analysis of the RK&M bibliography is progressing. The early indication is that a number of areas have received relatively less attention. Namely, the question of establishing costs and funding for activities that may be required for ongoing preservation of RK&M; the role of NGOs in RK&M; the role of monitoring in both creation and preservation of RK&M; security and safeguards as motivations for preserving RK&M; questions about actions that might be taken in the long term to preserve RK&M and/or to mitigate loss of RK&M; and the role RK&M preservation might play in ensuring the existence of future expert knowledge needed to help preserve and interpret factual data and metadata in the longer term.

### **Records and Archives**

6. Current archiving requirements are very general – asking, for instance, for ‘all relevant information’. Also, there is a prevailing preference for analogue material. The necessity to keep archives in more than one location is mentioned in legislation, but rarely put into practice as of yet. It was questioned whether National Archives are the best place to preserve nuclear records. There may be benefits in having a specialised National Nuclear Archive, as being developed in the UK.
7. Technical developments in this area – such as the ‘Sapphire Disks’ – should be noted.
8. The principles of durability, readability and retrievability were identified in the CEA presentation as good practice for record keeping in decommissioning.
9. The principles of durability, readability and retrievability will be important to the development of the Minimal Set of Records. This work area has identified that a Minimal Set of Records would be a useful tool in the medium term and long term, and that there needs to be a prioritisation and justification of key records.
10. The survey and analysis of examples of the loss of records in the case of hazardous waste facilities indicates that (lack of) human action is the most important factor – principally in

terms of regulatory enforcement, followed by economic factors (lack of funds). Technological failure plays a third role according to the study presented.

### **Oversight and Monitoring**

11. Oversight is a fundamental concept in the upcoming ICRP guidance on geological disposal. The concept was introduced initially by the R&R project.<sup>4</sup> Oversight requires the presence of man and covers activities such as regulatory supervision, societal involvement in the project, preservation of RK&M, and the verification of land use restrictions.
12. According to ICRP there must be willingness to continue Oversight activities of the repository beyond closure. However, there is concern that these activities will be seen as compensation for lack of intrinsic safety, or even that some forms of monitoring could interfere with the technical safety of the repository.
13. An initial survey on behalf of the RK&M project observes that more than half of the respondents indicate that there is an interest in local communities on the issue of preserving RK&M of the radioactive waste management facility for time periods beyond closure. When asked whether any actors in the national context acknowledge that local communities could play a role in monitoring and RK&M preservation, the responses are positive in almost two thirds of the cases.
14. There are three main drivers for post-closure monitoring of geological disposal facilities: technical, societal and safeguards. All of these will contribute to oversight and therefore to RK&M. More specifically, the following reasons have been given for post-operational monitoring: safeguards ; understanding the evolution of the near-field; determining the post-closure evolution of the geosphere; evaluating the impacts of the repository on the surface; confirmation of performance assessment assumptions; aid to decision-making, e.g. for retrieving the waste or ending the institutional control phase; public acceptability and confidence; and legal requirements.
15. The DOE Office of Legacy Management has 'Oversight' experience that will be valuable for our NEA project. Initial lessons are:
  - a. The conditional re-use of sites enhances the concept that the site is sufficiently safe; it's a way to create memory and a sense of ownership in the community.
  - b. Oversight may be carried out by others than the original regulator (of transfer of responsibilities from actual licensing body to a new oversight body). The new oversight body will be happy to have reasonably complete records; it should be remembered that what is considered complete may change – for example, if regulatory requirements change.
  - c. The regulatory concept of Risk-based Closure does not close debates about risk in the rest of society and it is a deterrent to transferring site responsibilities.

### **Knowledge and Knowledge Management**

16. Knowledge can evolve from having been broadly spread to be carried by only a few hands and can also jump between different social and cultural categories. In Sweden, for instance, the most prominent carriers of the knowledge of how to manage and ride horses are no longer either land-owning farmers, or nobility, but schoolgirls and their instructors. Also, knowledge can slowly transform so that original practitioners may not be able to recognize the current practices or their followers of today.

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<sup>4</sup> The OECD NEA Reversibility and Retrievability Project - <http://www.oecd-nea.org/rwm/rr/>.

17. In order to allow future generations to make sense of the repository, there is a tension between the desire to provide a 'full context' and the need to 'cull' information, so that only the essential is retained and is accessible and understandable. This tension could be resolved through innovative knowledge management. The knowledge we need to preserve may be defined and retained through a management strategy.
18. Sellafield, UK, is currently using a knowledge retention strategy to conceptualise the preservation or discard of records and knowledge over a hundred year period by mapping knowledge and defines when it will be needed and how it should be managed – that is, if it should be 'consolidated', 'forgotten', 'mothballed', and so on. The reliability of these methods over longer timescales needs to be researched.
19. ONDRAF/NIRAS uses safety and feasibility statements, as a structuring tool for the safety case. These act as a consistency check between system requirements and components, serve as guiding tool for the requirements of technical specifications for construction of the repository and its components. This increases the consistency between the safety and feasibility cases, helps to prioritise research and constitutes a basis for dialogue with stakeholders on safety aspects and design. They may be used for identifying RK&M needs, at least at technical level and through full licensing of the facility.

### **Engagement**

20. It is not just institutions that can change over the timescales under discussion. Concepts such as monitoring and archives are societally determined, and may therefore evolve and be superseded. The regeneration of artistic elements on the site could provide a mechanism for continuous oversight. Another related approach is the ANDRA investigation into the use of rituals to foster memory in the medium term.
21. Concepts such as the 'sacrificial layer' and "regeneration" are useful in understanding how people develop and change their heritage. A 'sacrificial layer', as identified by the Long Now Foundation, is an apparently valuable element of a monument or artefact which can be lost without losing the monument itself. For example, the pyramids were originally plastered; this has been lost, but the pyramids remain. These concepts can help us understand how the creation of a point of engagement – such as a monument or a ritual – need not be created to withstand a changing environment but should be expected and designed to engage with the generations as its means of survival. The project can investigate these ideas further, e.g., through collaboration with organizations such as the DoE's Office of Legacy Management.
22. In considering the transmission of the messages that programmes want to preserve, we should create 'Sense Making' strategies – that is, strategies which allow future generations to make sense of the cultural and symbolic messages that we leave (through written records, artefacts, ect.). We can aid future generations in better making sense of the past through providing a rich context of sources that cross-reference one another.
23. "Sense making" is limited to time scales of a few thousands of years. For the longer term, strategies for information transfer should eliminate the idea of using cultural and symbolic messages. If we take the idea of 'talking to extraterrestrials' to model these ideas, we see that we are considering communication that cannot assume any common understanding of cultural symbols. One answer to this challenge is perhaps to use the physical existence of the waste (rather than its records or the symbolic meaning of it). Could the waste be a means of transmitting cultureless signals, such as mathematical code, which bypasses the need for cultural interpretation?
24. The success of RK&M preservation cannot be judged only by whether they last for one thousand or ten thousand years – the success is in whether the attempt establishes the need

and responsibility in the minds of regulators, operators, stakeholders and the general public, and <sup>2</sup>whether that need and responsibility is understood and passed on to the next generation.

25. Access to information about a place or object increases the value in which it is held. Existing mechanisms for memory preservation such as the UNESCO World Heritage Register show that official recognition of the societal value of a place or object is a powerful way to create a wider and more enduring respect and interest in that place or object. This access to information must be proactively created.

### Costs

26. The PIC programme of WIPP and the decommissioning experience provide useful models to begin thinking about how to identify the issues of costs and pragmatic organization of RK&M preservation. Ultimately, the concept should be “practicable”.
27. The WPDD survey and the CEA presentation identified that a key point for RK&M loss was at the transfer from operation to decommissioning, because operational data was collected without thought to how the data needs would be different for a site undergoing decommissioning. *‘There will be significant financial consequences if there is inadequate documentation to support decommissioning’.*
28. The ANDRA Memory Programme bases the assessment of costs with the *date and nature* of the cost. There could also be created sources of revenue, such as museum visits or scientific research. It may be necessary to develop a dedicated fund for RK&M, e.g., building on lessons learnt from the Nobel Foundation.

### Mechanisms

29. A number of supranational mechanisms are being analysed with a view to understand their viability over the medium term..

**There exist many independent mechanisms and requirements for environmental monitoring, memory preservation, of which nuclear RK&M programmes should be aware and take advantage of.**

### Developing the concept of a “Minimal set of Records”

At the project meeting in April 2012, it was agreed that the concept of a ‘Minimal Set of Records’ should be developed. That is, the most concise collection of records with which future generations would be able to make sense of a repository.

A project task group was set up to identify a way forward, who presented their initial findings at the September 2012 Workshop. The key point identified was to find a criteria which with to select a Minimal Set of Records. It was agreed that the criteria for the records would be their use to future generations. In other words, what is it that future generations will need to know? What is the message which the records should substantiate?

This question needs to be answered without trying to ‘guess’ what future societies will be like, and without selecting a list of criteria without an empirical or philosophical basis.

In order to do this, an alternative question has been developed – that is, instead of asking what future generations want to know about us, we ask what we would want to know about a past society. This question will be the basis of interviews with a broad range of interested parties, from radioactive waste

management circles, academia, and civil society. The results of these interviews will be analysed with a view to creating a message, or messages, which can be substantiated by a minimal set of records. Findings will be presented at the September 2013 Workshop.

### **Project studies under way**

Six studies have been commissioned by the project, all of which have recently been or will shortly be completed and submitted to the Secretariat for review, in discussion with the project group.

#### *1. Analysis of the Project Bibliography – Richard Ferch*

The bibliography analysis will provide rewritten abstracts of the references, a database analysis of the content of each of the references, and a textual analysis of the entire bibliography. This will make the bibliography more usable and will provide a gap-analysis, showing where areas of interest to the project are under-researched. Work is being completed in two phases. Work on the second phase has begun, and the complete study will be presented at the project meeting in April 2012.

#### *2. Literature Study on Markers at Geological Repositories - Marcos Buser*

BfE commissioned this study in 2010. The project group has reviewed and edited the study, with the assistance of the original author. It will now be published as NEA document ('R' report) and used as a reference for the discussion of Markers within the project.

#### *3. Technical Monitoring of Geological Disposal Facilities - Lumír Nachmilner*

An internal version of the document Technical Monitoring of Geological Disposal Facilities has been developed. The 50 pages text consists of a summary of monitoring activities in the national programmes as well as in international disposal documents, overview of monitoring goals and projects, outline of a logical scheme for developing a monitoring programme, and overview of the main monitoring challenges. The document will be finalised after the MODERN conference (Luxembourg, 18-21 March 2013), whose outcomes and observations will become the part of the text.

Selected issues from the document were presented at the RK&M Workshop (Paris, 12-14 September 2012), 14th IGSC meeting (Paris, 8-10 October 2012), and 13th FSC meeting (Prague, 23 October 2012): feedback from these events will be incorporated in the final version of the document

The document has been one source for the NEA paper to be delivered at this Modern conference (Claudio Pescatore, Lumir Nachmilner, Meritxell Martell, Claire Mays: Oversight of a Deep Geological Repository and the Role of Monitoring – Some preliminary findings within the RK&M Project of the NEA).

The document will be presented at the RK&M project meeting in April 2013 and will be shared with other NEA working parties.

#### *4. Supranational Mechanisms to support Records, Knowledge and Memory Preservation over the medium term - Thierry Schneider, Sylvain Andresz, Cynthia Reaud - CEPN & NEA Consultant.*

The aim of this analysis, performed with the support of NEA, is to investigate the organisation of existing supranational mechanisms and their multi-level governance on the basis of available documents in order to identify their possible contribution for records, knowledge and memory preservation in the medium term (post-closure) for radioactive waste management. For this purpose, a particular attention is

devoted to pointing out the strengths and weaknesses of the supranational mechanisms related to their contributions to ensuring that future generations can base their decision on relevant and pertinent data and to promoting awareness on past activities. 11 supranational mechanisms set up through UNESCO, UNECE (United Nations Economic Commission for Europe), IAEA and EC (European Commission), were analysed with two main objectives: identifying the key components of the organisation of the supranational mechanisms and analysing the contribution of those mechanisms to the preservation of records, memory and knowledge.

The final report was delivered to the secretariat for review in January 2013.

*5. Study of local communities' position on monitoring and the preservation of knowledge and memory and the relationship to confidence - Meritxell Martell*

A Preliminary compilation and review of FSC and RWMC RK&M literature on monitoring, records and knowledge preservation has been completed, and a Survey of local communities was undertaken and is under way. Further interviews are scheduled. The initial findings were presented in the September 2012 Workshop and the FSC meeting in Prague in October 2012.

A paper has been written for the MoDeRn Workshop, in conjunction with Lumir Nachmilner.

A draft report was submitted in February 2013. The final report and main findings will be finalised following the MoDeRn Workshop in Luxembourg, 19-23 March 2013.

*6. Exploratory investigation into the loss of memory on conventional landfills and contaminated sites of the past - Marcos Buser*

The RK&M project seeks, among other things, to gain know-how and experience on loss and recovery of knowledge and memory preservation in other areas than nuclear wastes. One area with similar characteristics - and therefore rather well-suited for comparisons - is that of landfills and old industrial or disposal sites for hazardous wastes.

This study is an exploratory investigation into the loss of memory – through the loss of information, records and knowledge – on conventional landfills and contaminated sites of the past. This small case study aims at identifying key factors in the loss and recovery of knowledge by analyzing selected examples of landfills and contaminated sites in Europe and other industrialized nations.

More than 20 different carefully selected cases on loss of information, records, knowledge and memory on conventional landfills and old industrial or disposal sites for hazardous wastes have been analyzed. With few exceptions, it can be shown that the source of oblivion is directly related in one or the other way with human errors. Therefore, human factors appear to be determinant for knowledge and memory loss. Interestingly, technical or environmental factors seem to have the smallest impact of all analyzed factors. Knowledge and memory loss can sometimes be related to the loss of archives, but is directly linked, as it could be shown, to human deficiencies. What stands out more is that the handlings of waste, as well as the handling of information about wastes and old contaminated sites, are typical contemporary phenomena. Whether in the U.S., Europe or now in emerging markets: during the industrialization process the response of participants is more or less equal to the challenges and the limits of the time.

As a result, findings for the handling of information, records and knowledge in the field of nuclear waste could be gained. These findings are summarized in a 30-page report. This was delivered to the Secretariat for review in February 2013 and for discussion and adoption by the whole group in April 2013.

### **April 2013 project meeting**

The next project meeting will take place in April. The agenda will likely include the following items:

- Annual progress report
- Report from RWMC meeting of March 2012
- Proceedings of the September 2012 workshop
- Main findings of the September 2012 workshop
- Updated glossary
- Update on the Regulatory Catalogue
- Results of the commissioned studies:
  - Bibliography Analysis
  - Monitoring and Memory: Stakeholder Demand
  - Monitoring and Memory: Practical Possibilities
  - Supranational Mechanisms
  - Memory Loss and Recovery
- Discussion of the proposed research project to establish a rationale for selecting a Minimum Set of Records
- A demonstration and discussion of the Wiki design for the Menu-Driven Document
- Discussion of other proposals, e.g., for work on rituals, markers, and historical examples of RK&M preservation. Colleagues are asked to make proposals.

The content of the September workshop will be elaborated at the project meeting in April.