

Preservation of RK&M in the long term: Project findings

“Constructing memory”, Verdun, 17 September 2014

Anne Claudel, Section Head, Information Management, Nagra
on behalf of the RK&M project

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Long-term and oversight: Glossary definitions

- **Long-term:** Period of time with **no repository oversight**, extending over the time of concern in the safety regulations, typically over hundreds of thousands of years (HLW)



- **Oversight:** general term for «watchful care», referring to society «keeping an eye» on the technical system and the actual implementation of plans and decisions.
 - regulatory supervision (such as control and inspection)
 - institutional control (e.g. monitoring)
 - preservation of societal records (such as archiving)
 - societal memory-keeping of the presence of the facility (importance increases as time goes by)

RK&M preservation in the long-term

- Lack of oversight = lack of / decreasing memory-keeping and awareness of the facility

Therefore:

Media and mechanisms still in place at the time of loss of oversight must generate awareness and draw attention to the facility
→ initiate a new period of oversight

- The facility is designed to contain and isolate the waste and be safe by itself

However, this “regeneration of awareness” is desirable, as oversight will reduce the probability of inadvertent intrusion and favour taking informed decisions about the facility

→ no intention to forget!

(but we must prepare for the time of lack of oversight)

As a reminder...

- RK&M Guiding Principle:

“There is no single best means of RK&M preservation over all time scales. All available communication channels should be envisaged”

Therefore:

We need a system whereby, within a strategy of **mediated** or **non-mediated** transmission of RK&M, the various elements are **linked** to each other, act as **indexes** to each other, and **reinforce** each other by offering redundant functions

→ “**systemic approach**”

Markers: A much-discussed topic

- «Marking a site»: often presented as the main method to **preserve memory and deter human intrusion**
- Extensive **literature** exists (1990's / 2000's, mainly but not only US)
- Recurring topic in the discussions surrounding geological disposal (and within the RK&M project)
 - Should markers be used at all?
 - When should we start preparing for them?
 - When should we construct them?
 - Need for further evaluation and development of the corresponding **regulatory guidance**
 - However: Use of markers foreseen only in Swiss legislation and US regulations

Markers: Glossary definition

- A marker is... «A **long-lasting object** that indicates an area of influence, power or danger, [...] placed strategically at or near the site (surface / subsurface) for immediate recognition or for discovery at a later time»
- Any marker is conceived to be
 - **immobile** (i.e., in permanent association with a site)
 - **robust**, in order to maximize survivability on its own
 - providing messages that are likely to be **understandable** across generations.
- A markers system can range from a simple stone to a contrived and monumental multi-component system

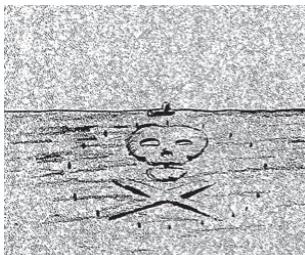
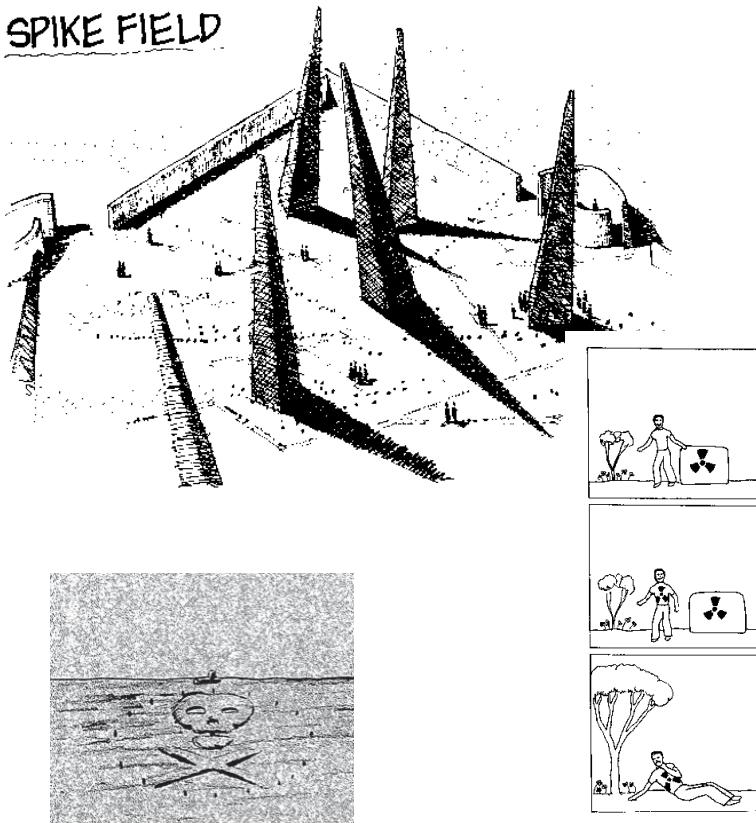


Markers and marking strategies

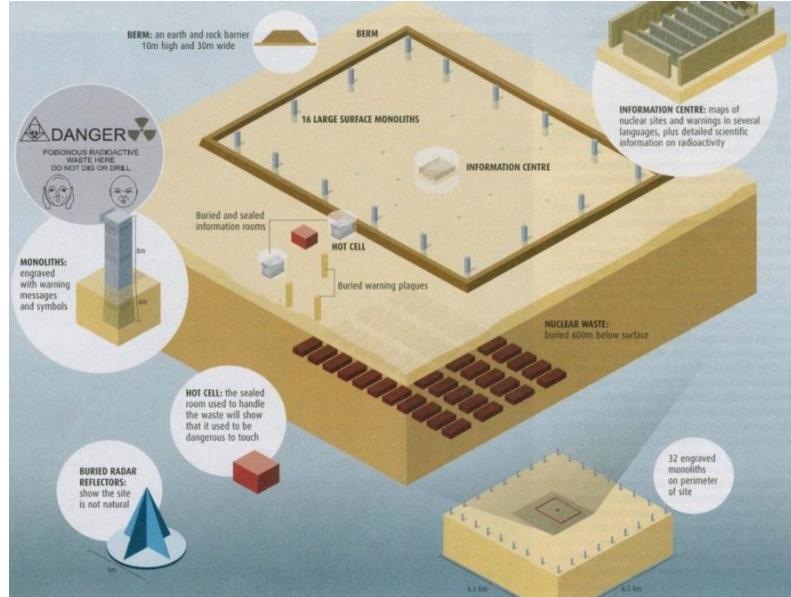
- «Literature Survey on Markers and Memory Preservation for Deep Geological Repositories»
(originally commissioned by the Swiss Federal Office of Energy)
- Many ideas, technologies, materials, such as:
 - Surface (e.g. large monuments, berms) and subsurface markers (e.g. small ceramic tokens)
 - Adaptation to the natural environment and / or use of non-recyclable and non-reusable materials
 - Residual surface features (e.g., retaining walls built to preserve visual amenity, altered water courses or access routes for road and rail)
 - «Self-marking»: message based on radioactivity or on other physical properties of disposal components, e.g. gravitational magnetism
 - «Cultural» marking through site names
 - New concept: «time capsules»

Some examples

SPIKE FIELD



DANGER
POISONOUS RADIOACTIVE  WASTE BURIED HERE
DO NOT DIG OR DRILL HERE BEFORE A.D. 12,000



However...

- There are, at present **no straightforward, conclusive answers** to the objectives, messages and methods of marking
 - Even if markers remain intact and traceable over time...
 - They can be **moved or destroyed**
 - Cultural and aesthetic interpretations or even deliberate falsification can **alter the meaning** of messages
 - They may **attract intruders** rather than deter them
- more specific studies on existing marking strategies are needed



Case study on tsunami stones

- «Markers – Reflections on Intergenerational Warnings in the Form of Japanese Tsunami Stones»
- Potential longevity and continuity demonstrated:
 - up to 1000 years / old stones replaced by new ones
- Historical and cultural significance may accrue over time, but original function may not be retained
- Messages not always heeded
 - Lack of awareness or understanding,
 - Reliance on other, more modern warning systems
 - Deferring responsibility to the authorities
 - Pursuit of short-term economic interests

→ Warning function more likely to survive in relatively small rural communities that have continuity, an oral history tradition, and a more limited access to, or confidence in, the latest technologies

Markers and beyond

- Factual information can be transferred more easily than warnings, memory more easily than knowledge
 - However: Knowledge, not memory, saves lives
- Strategy to foster learning / understanding and therefore knowledge
 - Leave traces to arouse curiosity and desire to learn more
 - Network of redundant markers placed strategically, acting as pointers to other sources of information
- Avenues for further enquiry
 - What type of markers should be emplaced?
 - What kind of information/message could they carry?
 - Where should they be placed? How should the network be structured?
 - What is the potential of time capsules within a marking system? What can we learn from other long-term endeavours (such as the “10,000 year clock” of the Long Now Foundation)?
- Effectiveness depends on the care exercised during previous periods

Conclusions

- There is no single best means of RK&M preservation – markers in isolation may not be fully effective
- We need to investigate the specific function of markers within a systemic approach
 - Markers in relation with time periods
 - Potential interactions with other RK&M preservation and transmission methods
 - Potential benefits of international standardisation

For more information...

<http://www.oecd-nea.org/rwm/rkm/>

thank you
for your attention
nagra.