

Workshop „Long-term Stability of Remediation Measures“

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The Problem

Intervening in cases of radioactive contamination in the environment generally is grouped into two kind of actions: emergency measures and remedial measures. While emergency measures clearly intend to reduce acute exposure, remedial measures have wider objectives and longer life times. Typically, remedial actions intend to solve a problem, i.e. remove or reduce environmental impacts, once and forever. It has to be realised here, however, that many of the radionuclides of concern in the context of the uranium mining and milling legacy have very long half-lives and that some other contaminants of concern, for instance heavy metals, are persistent. To the contrary engineered structures, such as dams or concrete vaults, have design lives and life expectancies in the order of decades or centuries, depending on the level of maintenance, if any at all. Remedial solutions, therefore, have to be found that either obviate institutional control, i.e. maintenance or land-use control, or that ensure that such control is facilitated over long times scales, i.e. thousands of years.

The magnitude of the problem, that whether one deals with a few thousand cubic metres of waste or millions of cubic meters of tailings will be of crucial importance. Scale will affect decisions, such as whether to stabilise in place or to relocate, the required funding, and the risk reduction options.

Also of importance is, what design life (longevity) of the disposal facility is expected: a few hundred years, thousands of years, or perpetuity?

Objectives

The objective of the workshop was to explore

- Which features would make engineered solutions live longer ?
- What type of system properties could make for a longer ‘half-life’ ?
- How can long-term institutional controls be established ?

Summary

Attendance

This workshop was attended by approximately 35 participants, representing approximately 10 countries. Open dialogue was encouraged with the workshop participants, who engaged in active discussion of the topics presented in this summary.

Defining the meaning of remedial action

Properly defining the terms “remedial action” and “long-term stability” and communicating these definitions to regulatory authorities and stakeholders is important in minimizing negative perceptions. Informing and educating the public and encouraging their participation early in the process, thus making stakeholders an informed public, will establish expectations that have greater potential for success.

Upfront characterization

Understanding a site's geological, hydrogeological, hydrological and climatological environment certainly is a prerequisite for any sustainable engineered solution. This requires a comprehensive site characterisation as well as understanding of the possible interaction with the system to be engineered. Considering the recent widespread flooding in central Europe, the commonly accepted engineering design bases, such as frequency and severity of flood events, have to be subject to serious scrutiny.

Priorities based on urgency

The concept of risk-based design should be introduced more widely. This, however, entails the question of risk acceptability and communication with stakeholders.

Monitoring

It was considered inevitable that, depending on the chosen solution, remediated sites should be monitored periodically to ensure that integrity is maintained and to reassure the public about this. It may also be necessary to review periodically the design base and further remedial measures may be needed as requirements change. However, it seems difficult to institutionalise such review procedures over very long time spans. On the other hand, society seems to continuously 'monitor' the surrounding environment and remedial actions are taken when needed.

Reversible actions

In the above context the subject of retrievability was raised, although this subject belongs more into the realm of deep disposal. It was noted that in principle, any waste disposal facility can be reopened and the waste retrieved and moved to an alternative location or, for instance, the cover can be modified at a later time or. Designing for retrievability must not compromise the function of any barrier system, i.e. by providing preferential migration pathways along access facilities. Risks during retrieval could be reduced by waste segregation.

Record keeping

Closely linked to the issue of periodic review, maintenance and retrievability is the question of record keeping. While it is true that certain archives, monuments etc. have survived for centuries or even thousands of years, their survival is accidental and offset by the loss of many more others. The readability of records beyond a few hundreds or thousands of years may be questionable (see for instance certain Meso-American inscriptions or the Egyptian hieroglyphs). In the US, granite steles with very simplified information are buried with the waste.

Intergenerational equity

A discussion on providing for the long-term durability of remediation solutions exceeding life-times of several generations provokes thoughts on intergenerational equity. While Agenda 21 demands that we should not leave a world to future generations that compromises their ability to live in a way they want, it was noted that in a way we 'are' the future generation and that we cannot know the demands of future generations. Certainly, we do have the scientific insight, the technical knowledge and the resources to leave a world behind that is not worse than the one we inherited. In fact, considering the various remediation and environmental protection efforts around the world, the latter seems to be much better in many areas than it was a generation or two ago. However, it is difficult to know what is better or worse, since we cannot know the requirements of future generations.

Social equity

Akin to the issue of inter-generational equity is the issue of social equity, that is for instance who is to pay for remedial and stewardship measures in less developed countries or regions, where much of the mining took place and still takes place. It was noted that various schemes are currently discussed among the interested parties, including the mining industry, pressure groups, and international organisations. In the case of uranium the issue assumes an additional ethical dimension as this often was/is linked to national defense programmes.

Natural and anthropogenic analogues

Study of natural analogues, such as soil/rock gradations, natural slopes, and vegetation/rock surfaces, can be expected to greatly assist in designing for long-term disposal stability. Although not specifically designed to survive for long times, there are many mining residues around the world and their state and properties could be studied to learn more about the evolution of such residues, that is as 'anthropogenic analogues'.

Conclusions

In summary, workshop participants emphasized the following issues for consideration about the long-term stability of disposal:

- (1) public acceptability of risk and the potential for that acceptability to change over time,
- (2) uncertainty in performance of engineered solutions,
- (3) longer stability time frames that could lead to more difficulty in making accurate predictions,
- (4) required post-remedial action monitoring to maintain confidence with regulators and the affected public,
- (5) no walk-away solution exists for long-term stability (of near surface facilities) because some maintenance required, and
- (6) determination of who pays the costs is often an issue.