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Technical issues associated with deep repositories for radioactive waste in different geological environments

Science summary SC060054/SR1

A new report produced for the Environment Agency explores the technical issues that could be important to the safety of a geological repository for radioactive waste if it were built in the various geological environments found in England and Wales. The report focuses on the post-closure phase and only considers construction and operational issues if they could affect the ability of the repository to meet satisfactory safety standards in the long term.

The aim of the study was to select a set of geological environments to represent the range of plausible repository host environments in England and Wales, and identify the main technical issues that would need to be considered when evaluating the safety of a repository in each environment. We would regulate disposals of radioactive waste to any such repository, and we commissioned this work to help us identify any gaps in our knowledge of the issues that could arise and so plan our future needs.

The work was carried out in two phases, each of which included a workshop attended by experts from outside the main project team. The experts helped to define and refine the list of geological environments and associated technical issues.

Nine geological environments were identified:

- hard fractured rock to surface;
- fractured hard rock overlain by relatively high-permeability sedimentary rocks in which advective transport dominates;
- fractured hard rock overlain by a sedimentary rock sequence containing at least one significant low-permeability formation in which diffusion dominates solute transport;
- evaporite host rock;
- siliceous host rock;
- indurated mudrock host rock;
- plastic clay host rock;
- carbonate host rock;
- non-evaporitic rock with hypersaline groundwater.

The following technical issues were identified:

- influence of different wastefrom types on the design of the engineered barrier system (EBS);
- interactions between engineered components;
- interactions between the EBS and the host rock;
- impact of groundwater/porewater on EBS materials (including the impact of saline water);
- duration for which EBS materials maintain their function (durability);
- interactions between gas and groundwater (or porewater);
- characterising the site adequately;
- demonstrating long-term stability;
- impact of resaturation of the repository.

Specific aspects of these technical issues, including their relevance and importance to repository concepts in different geological environments, are discussed in more detail in the report.

The report concludes that the design of a repository needs to be carefully matched to the characteristics of its host geological environment in order to optimise safety, keep the costs reasonable and avoid undue difficulties in technical implementation.

When designing a repository, it is necessary to take into account the highly coupled nature of many processes. Most issues associated with the performance of EBS materials under repository conditions are reasonably well understood. There remain, however, significant uncertainties relating to:

- the extrapolation of experimental studies to real-life conditions;
- the extrapolation of information from overseas programmes to conditions in England and Wales;
- the application of repository concepts to environments different from those in which they have been tested;
- the application of repository concepts proposed elsewhere, but not yet thoroughly evaluated.

The overall conclusion of this study is that a wide range of technical issues need to be addressed by any programme to build a geological repository in England and Wales. Some of these are being addressed at a generic level, but some depend on the geological environment and can only really be addressed when a site has been chosen. The nature of the waste inventory that will ultimately be placed within the repository will also be a significant factor.

Work has been carried out in the UK or by other disposal programmes to address the majority of technical issues. However, further work may be required to extrapolate the results from other countries to conditions in England and Wales.

We will use the results of this study to help us in our regulatory scrutiny of work being done now and in the future to address these technical issues both at a generic level and, once potential sites for a geological disposal facility are identified, at a site-specific level.

This summary relates to information from Science Project SC060054 reported in detail in the following output:

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Project manager: David Copplestone

Research Collaborator: Richard Metcalfe, Sarah Watson

Research Contractor: Quintessa Limited, The Hub, 14 Station Road, Henley-on-Thames, Oxon. RG9 1AY

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E: enquiries@environment-agency.gov.uk.

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