

Safety assessment studies for near surface disposal of short-lived low and intermediate level nuclear waste

Context

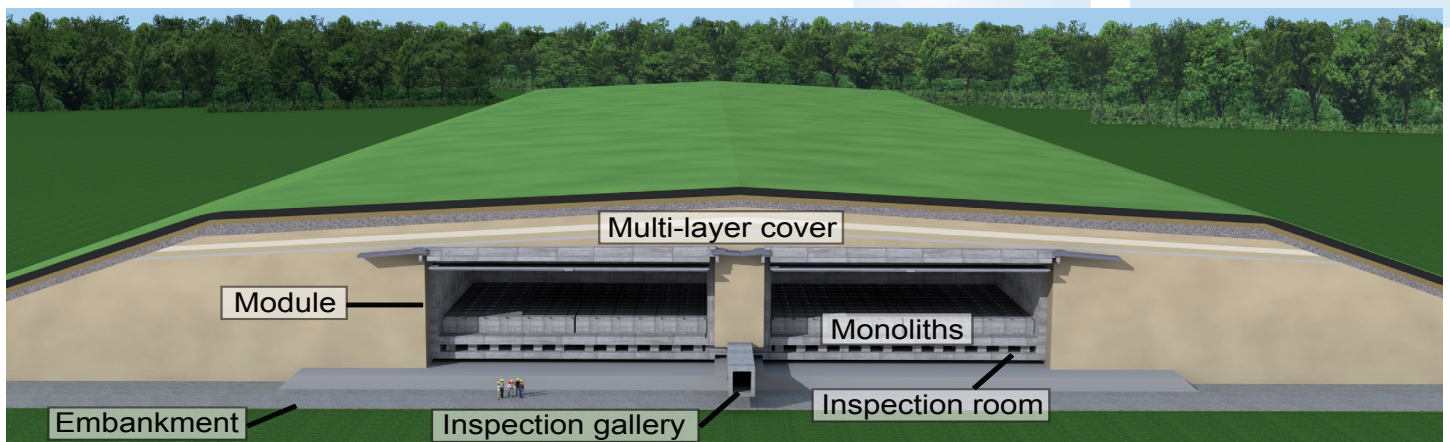
The Belgian short-lived low and intermediate level radioactive waste (category A waste), is originating from the operation and decommissioning of past and future nuclear facilities, and from industrial, medical and research applications. To deal with it, in Dessel a near surface disposal facility will be developed by ONDRAF/NIRAS, the Belgian Agency for Radioactive Waste and Enriched Fissile Materials. Technical studies are being carried out to prepare different license applications with a view to enter the construction phase within a few years. The long-term safety of such radioactive waste disposal facilities is demonstrated with the support of a safety assessment. This typically includes modelling of radionuclide release from a multi-barrier near-surface disposal facility to the geosphere and biosphere.

Objectives

The main objective of the overall work is to support ONDRAF/NIRAS in ensuring a safe, permanent and sustainable solution for the management of category A waste in Belgium.

To do so, supporting long-term research is carried out including:

- modelling of the disposal installation (near field modelling);
- characterization and modelling of groundwater flow (geosphere modelling);
- assessments of the long-term durability of concrete;
- development and testing of biogeochemical simulation models (environmental systems modelling).



Cross-section of a repository for short-lived low and intermediate level radioactive waste (category A waste). (Courtesy: ONDRAF/NIRAS).

Main activities

Near field modelling

Disposal facilities for radioactive waste comprise a series of engineered barriers whose primary purpose is to concentrate and contain radionuclides and other contaminants until their hazard level has decreased to acceptable levels. The goal of near field modelling (also performance assessment or in a broader context, safety assessment) is to quantitatively evaluate long-term (up to several thousand years or more) radionuclide behaviour under conditions of gradually degrading engineered barriers. At SCK•CEN we develop and implement state-of-the-art models to deal with processes of water flow and radionuclide migration within the engineered components of the disposal facility.

Geosphere modelling

Geosphere modelling is concerned with the identification and quantification of pathways for radionuclide migration in groundwater. Typically hydrogeological models are developed for simulating groundwater flow in the vicinity of the disposal facility and for simulating radionuclide migration from the disposal site to a nearby biosphere receptor such as a drinking water well or a river.

Concrete durability assessment

Cement and concrete are used for many purposes in the disposal of (radioactive) wastes: for encapsulation/solidification of the waste, as backfill and as construction material. Assessment of concrete durability requires a coupled description of migration of water and mass, geochemical reactions and physical-mechanical damage processes. The objective of this research is to develop and evaluate an integrated model able to simulate the long-term durability of cement-based materials used in (radioactive) waste disposal facilities.

Environmental systems modelling

We develop and evaluate biogeochemical transport models to address migration of radionuclides and major and minor elements in the environment, for example in the surroundings of a near surface disposal site. Analysis of radionuclide and heavy metal migration is also done for areas contaminated as a result of uranium mining and milling activities, or for soils receiving surface-applied chemicals such as fertilizers.



Proposed location for the Belgian near surface disposal facility for short-lived low and intermediate level radioactive waste (category A waste). (Courtesy: ONDRAF/NIRAS).

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