

Background

Near-surface or deep repositories of radioactive waste are being developed and evaluated all over the world. Also, existing repositories for low- and intermediate-level waste often need to be re-evaluated to extend their license or to obtain permission for final closure. The evaluation encompasses both a technical feasibility as well as a safety analysis. The long term safety is usually demonstrated by means of performance or safety assessment. For this purpose computer models are used that calculate the migration of radionuclides from the conditioned radioactive waste, through engineered barriers to the environment (groundwater, surface water, and biosphere – see below). Integrated safety assessment (ISA) modelling addresses all relevant radionuclide pathways from source to receptor (man), using in combination various computer codes in which the most relevant physical, chemical, mechanical, or even microbiological processes are mathematically described.

SCK•CEN organizes training courses in ISA modelling that are intended for individuals who have either a controlling or supervising role within the national radwaste agencies or regulating authorities, or for technical experts that carry out the actual post-closure safety assessment for an existing or new repository. Courses are organised by the Department of Waste and Disposal.

Course content

The customized training courses on integrated safety assessment modelling address many issues, including:

- Methodology of safety assessment, analysis of Features, Events, and Processes (FEPs) and development of scenarios
- Basic principles of water flow, radionuclide transport, and heat flow in saturated or unsaturated media
- Site characterization and evaluation; data collection and quality assurance
- Development of conceptual and numerical models for surface or deep geological disposal
- Deterministic consequence analysis by integrating calculations from near field, geosphere, and biosphere models
- Stochastic uncertainty and sensitivity analysis for near field, geosphere and biosphere using Monte Carlo simulation
- Issues of gas generation and transport due to anaerobic corrosion of steel (multi-phase fluid flow)
- Issues of chemical toxicity for non-radiological waste components
- Analysis of human intrusion scenarios
- Derivation of waste acceptance criteria
- Model verification and model benchmarking.

Relevant experience and international outlook

Since several years training courses are being organised with the support of several international and national organisations, including IAEA, the European Commission, and the Belgian Ministry of Economic Affairs. Training courses are usually organised on demand and typically last for one up to two weeks and were attended by experts from Central and Eastern Europe, Russia, and Asia. Courses organised in 2006 covered following issues:

- General course on safety assessment for low-level waste disposal (National Agency for Radioactive Waste-ANDRAD, SCN & CITON, Romania, 1 week)
- Site characterization and numerical modelling to support developing geologic repositories (Slovak Geological Survey & Lithuanian Geological Survey, 1 week)
- Near field and host rock modelling for a generic disposal facility (Lithuanian Geological Survey & Lithuanian Institute of Geology & Geography, 1 week)
- Integrating site characteristics into a near field and host rock transport model: conceptual model building, scoping calculations and the role of modelling in optimizing site investigations (Slovak Geological Survey & VUJE Inc., 1 week)
- Integrated safety assessment modelling for a low-level waste surface disposal facility (Philippine Nuclear Research Institute, 2×1 week)
- HYDRUS-PHREEQC-HP1 training course (modelling general flow and transport, geochemistry, and coupled geochemical transport) (fee-based, 34 participants from 16 countries, 3 days)
- Developing and reporting the Special Safety Analysis Report for a low-level waste surface repository (Agency for Radwaste Management-ARAO, Geological Survey & ZAG, Slovenia, 1 week)

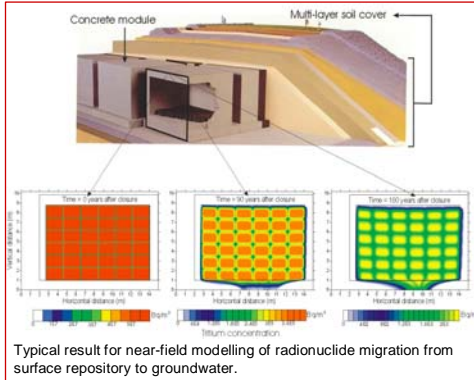
Main contact person

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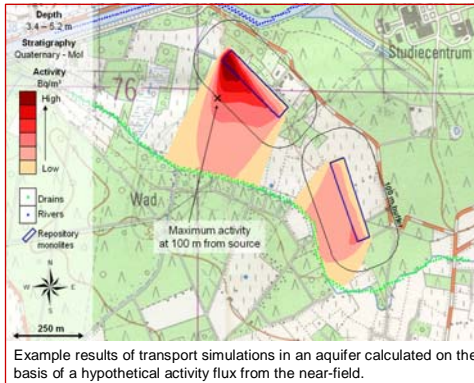
www.sckcen.be/sckcen_en/activities/research/radiowastecleanup/performancestudies/

Surface disposal

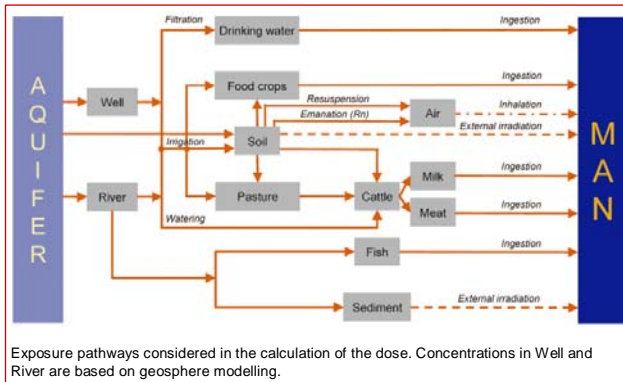
Near Field Modelling (Example: Surface disposal of Low-level waste)



Geosphere Modelling (at the Local Scale)

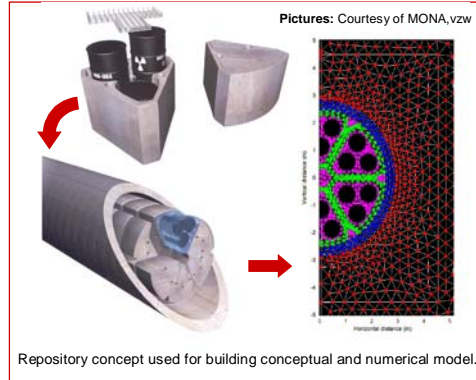


Biosphere Modelling

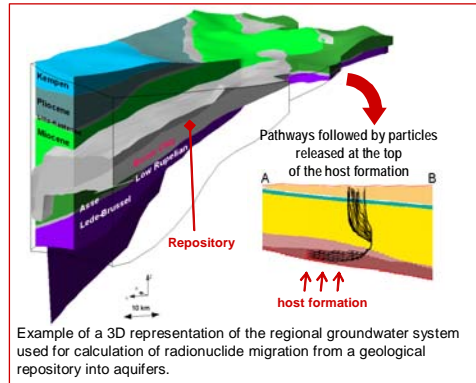


Deep disposal

Near Field Modelling (Example: Deep disposal of Low-level waste)



Geosphere Modelling (at the Regional Scale)



ISA uses a suite of state-of-the-art commercially available or public domain computer codes:

- HYDRUS 1D / 2D
- PORFLOW
- MODFLOW with various interfaces
- TOUGH 2
- PHREEQC 2.4
- HP1 (Hydrus 1D + PHREEQC 2.4)

Examples of integrated safety assessment modelling for surface and geological disposal.