

# Using COMSOL for Optimal Design of Engineering Barriers of Nuclear Waste Repositories

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## Abstract

The Swedish Nuclear Fuel and Waste Management Company (SKB) operates the final repository for short-lived radioactive waste, the SFR, located in Forsmark. The waste is packaged in metal or concrete containers and stored at a depth of 50 metres in rock vaults (Figure 1). As part of the safety assessment for the facility, the evolution of groundwater flow within the repository needs to be quantified using computer simulations. In this context, modeling is also used to screen different options for the design of the engineered barriers in the repository rock vaults. The objective of this work is to study the effect of material selections for the barriers surrounding the nuclear waste, as well as materials used to backfill the rock vaults after the operational phase. The safety assessment for the SFR involves several models for groundwater flow. A regional model accounting for different climate scenarios is simulated using the Finite Volume software Darcy Tools [1]. For each climate scenario the regional model provides boundary conditions to a repository scale model set up and solved in COMSOL Multiphysics. This refined model provides the detailed groundwater flow in the repository near field (Figure 2). For certain predefined control volumes the mass flows are being calculated automatically using the flexible COMSOL's Java API. The simulation results are used to calculate the flow direction and the amount of flow in and around the repository for the different scenarios. On a more detailed level, the different mass flows entering and leaving specified control volumes are calculated to study the effect on specific waste packages. The repository scale flow simulations performed using COMSOL Multiphysics provide an increased understanding of the performance of the engineering barriers. Detailed information about the flow through specific waste packages can be studied using the control volume mass flows.

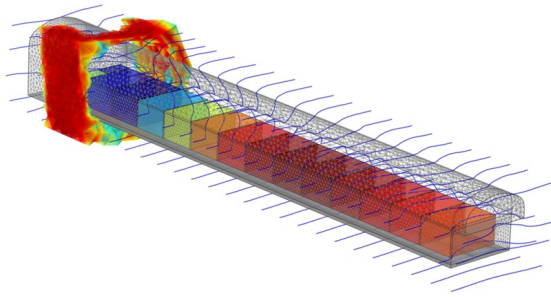
## Reference

1. Svensson U, Kuylenstierna, H-O, Ferry M, 2010. DarcyTools version 3.4. Concepts, Methods and Equations. SKB report R-07-38.

## Figures used in the abstract



**Figure 1:** Illustration of the SFR Waste Repository vaults and tunnel system (SKB).



**Figure 2:** Results of the flow simulation through one of the tunnels. The effect of the fracture crossing the tunnel on the left can be clearly seen (SKB).