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# Sensitivity of Nuclide Release Behavior to Groundwater Flow in an HLW Repository

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## 1. Introduction

Evaluation of the dose exposure rate to human being due to long-term nuclide releases from a high-level waste repository (HLW) is of importance to meet the dose limit presented by the regulatory bodies in order to ensure the performance of a repository.

During the last few years, tools by which such a dose rate to an individual can be evaluated have been developed and implemented for a practical calculation to demonstrate the suitability of an HLW repository, with the aid of commercial tools such as AMBER[1] and GoldSim[2], both of which are capable of probabilistic and deterministic calculations with their convenient user interface.

Recently a migration from AMBER based models [3-7] to GoldSim based ones has been made in accordance with a better feature of GoldSim, which is designed to facilitate the object-oriented modules to address any specialized programs, similar to solving jig saw puzzles and shows more advantage in a detailed complex modeling over AMBER.[8]

Recently a compartment modeling approach both for a geosphere and biosphere has been mainly carried out with AMBER in KAERI, which causes a necessity for a newly devised system performance evaluation model in which geosphere and biosphere models could be coupled organically together with less conservatism in the frame of the development of a total system performance assessment modeling tool, which could be successfully done with the aid of GoldSim. Therefore, through the current study, some probabilistic results of the GoldSim approach for a normal situation that could take place in a typical HLW repository are introduced.

## 2. Methodology and Illustrations

For an HLW repository currently being designed in Korea, which has a similar concept to the Swedish KBS-3 HLW repository[9], a GoldSim model by which a total system performance assessment could be carried out, has been developed. Fig. 1 shows a conceptual modeling scheme for the GoldSim modeling partially shown in Fig. 2.

Once a leakage from a damaged canister through tiny holes happens, nuclides will spread out through the buffer material surrounding a canister as well as the backfill region in the tunnel before transporting farther into the flowing groundwater in the fractures of the far-field area of the repository. And then the nuclides will finally reach to the human environment by passing over the geosphere-biosphere interface for an exposure to human bodies.

Especially in the near-field of a repository, before meeting the fractures with a flowing groundwater or the fracture zones with a rather stagnant groundwater in the surrounding host rock, both in a buffer and a tunnel backfill, diffusive transports are assumed to be dominant due to a low permeability, whereas in the fractures, an advective and a dispersive transport could mainly occur in the groundwater flowing fractures with a matrix diffusion into the stagnant groundwater in the rock matrix pores. Sorption behavior onto both the fracture wall and matrix surfaces, and a decay and ingrowth are also accounted for.

And also some portion of the canisters is directly in contact with the fractures where the groundwater flows: The flow could be upward from the deposition hole to the tunnel or Vice Versa, or sometimes might be stagnant thus affecting the nuclide release behavior into the near- and far-field of the repository.

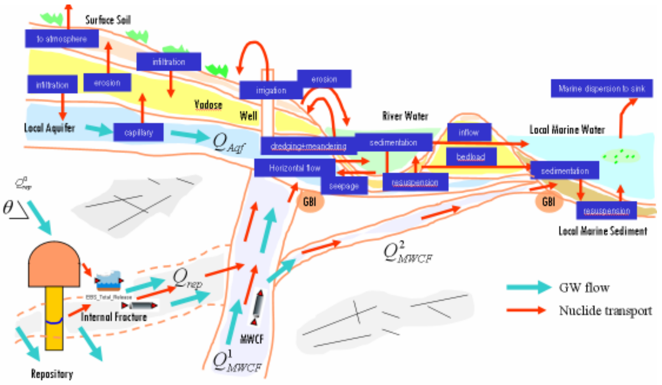


Fig. 1. **Conceptual Modeling Scheme for *GoldSim* TSPA Model**

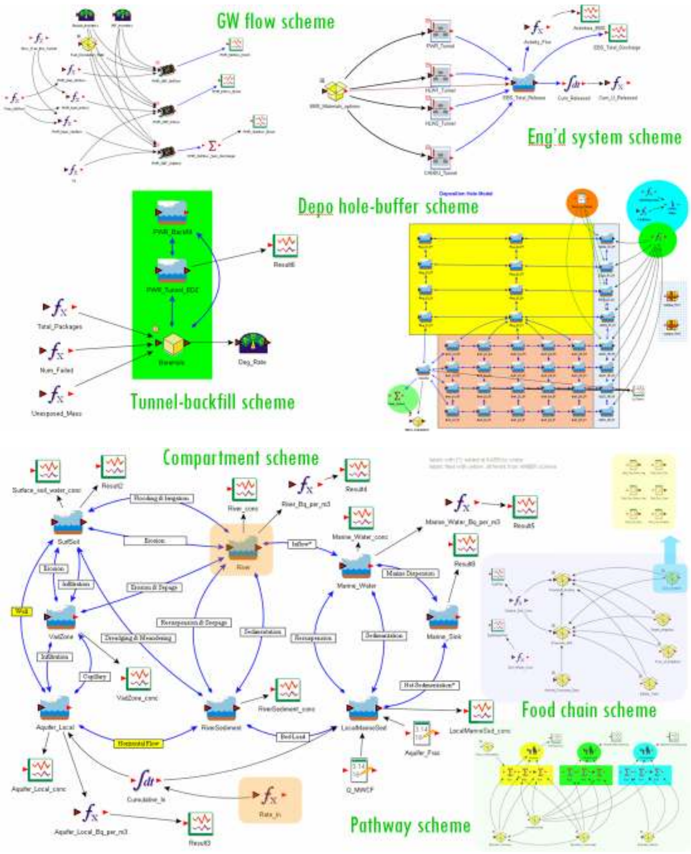


Fig. 2. GoldSim Model

A illustrative result to show the sensitivity of the exposure rate to humans due to a nuclide release from an HLW repository due to such a groundwater flowing feature in and around a repository is shown in Fig. 3, from which we could see that around less than 40% of the canister remains intacted with the flowing groundwater, the peak dose turns out not to be that sensitive to a contact of the flowing groundwater even though the groundwater flow rate per canister steeply increases.

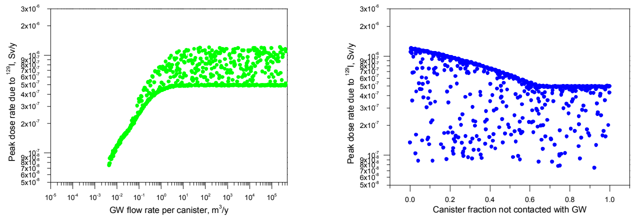


Fig.3. Scatterplots of Peak Dose Rate due to $^{129}$I When Varying Flow Rate per Canister and Canister-GW Contacting Fraction Together

## REFERENCES

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