**Integration Group for the Safety Case (IGSC) Symposium 2024***MOVING TOWARDS THE CONSTRUCTION OF A SAFE DGR – GETTING REAL*

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| **Abstract Title: Development of an integrated realistic radionuclide migration model for the entire geological disposal system** | |
| **Abstract (300-500 words):**  In the post-closure safety assessment, radionuclide migration behaviours from the wastes to the biosphere are assessed, considering a variety of spatial domains of the repository system components and long timescales over several hundred thousand years. In NUMO’s generic safety case (NUMO-SC), NUMO developed a realistic near-field (NF) radionuclide migration model, taking into account the features of specific design of engineered barrier system (EBS) and disposal tunnels of a deep geological repository (DGR) and the surrounding host rock for a 100 m scale region, which is characterised as follows [1]:   * 3D porous media model is applied to represent the buffer of EBS and backfilled tunnel and 3D discrete fracture network model (DFN) is for fractured host rock. * Mass transport simulation with 3D random walk particle tracking method is conducted by PARTRIDGE [2] code on the hydraulic conditions derived from 3D groundwater flow simulation by using the computer code FEMWATER [3].   This NF scale realistic model is used to develop a reasonably conservative 1D radionuclide migration model to carry out dose calculation for the whole repository.  The methodology developed for the NF scale realistic model has been improved to apply for larger scale of the space with temporal evolution of a DGR system. For extension of simulation region, two approaches are adopted. One is to replace FEMWATER with PFLOTRAN [4] which is an open source and designed for massively parallel computing architectures to increase computing power. The other is adoption of “nested model” describing DGR system in the form of a series of nested representations on different scales from “Panel scale (1 km × 1 km)” up to “Regional scale (tens of kms × tens of kms)” and levels of resolution to reduce computational load (see the left figure in Fig.1).  For the evolution of DGR system due to long-term cyclic sea level change along with climate change and uplift and erosion, mass transport simulation method is developed with a time series nested model, considering the evolution of ground water flow system caused by geomorphic change due to uplift and erosion (see the right figure in Fig. 1). Here, the evolution of groundwater flow system is simulated with the time series nested model by changing rainfall recharge and shoreline as boundary conditions.  This paper discusses the improved method for large scale realistic migration modelling and challenges in the simplification of the large scale realistic migration model to a 1D radionuclide migration model.    Fig. 1. Mass transport simulation for a hypothetical GDR based on NUMO-SC (see the text for more information)  References  [1] NUMO (2021): The NUMO Pre-siting SDM-Based Safety Case, NUMO-TR-21-01.  [2] NUMO (2011): Development of safety assessment technologies for geological disposal projects (II): Advances in the radionuclide migration analysis model, NUMO-TR-10-10 (in Japanese).  [3] Lin, H.J., Richards, D. R., Yeh, G., Cheng, J., Cheng, H., Jones, N.L (2001): FEMWATER, A Three Dimensional Finite Element Computer Model for Simulating Density-Dependent Flow and Transport in Variably Saturated Media, Version 3.0, Reference manual.  [4] Hammond, G. E., Lichter, P. C., Mills, R. T (2014): Evaluating the performance of parallel subsurface simulators: An illustrative example with PFLOTRAN. WATER RESOURCES RESEARCH, 50(1):208--228 | |