Various Parameter Settings upon Radionuclide Release


We have conducted research and development on the disposal of spent nuclear fuel (SF) in deep geological strata (hereafter “direct disposal of SF”) as an alternative management option to reprocessing followed by vitrification and geological disposal of high-level radioactive waste (HLW). Evaluation of the release behavior of radionuclides (RNs) for direct disposal of SF is very important because the RN release behavior from SF is completely different from that of vitrified HLW owing to different waste matrices and inclusion of gaseous and semi-volatile RNs. There have, however, been only a few studies in Japan on direct disposal of SF owing to the Japanese strategy being that all SF should be reprocessed. Therefore, we collected and compared source-term parameters on RN release from SF in deep geological repositories for selection of the parameters applied to the performance assessment of the Japanese SF disposal system. We picked up the parameters from several foreign safety-assessment reports, e.g., the Swedish SR-Site, the Finnish TURVA-2012, the Swiss EN 2002, the French Dossier 2005, and the Canadian Fourth Case Study (4CS).

There are two types of RN-release behaviors from SF; one is relatively faster release of gaseous and semi-volatile RNs and is parameterized as instant-release fractions (IRFs) of inventory. The other is long-term release that is congruent with dissolution of the UO₂ matrix and other construction materials parameterized as “dissolution rates”. Examples of IRF and cumulative fuel dissolution as a function of time after disposal selected in the foreign safety assessment reports are shown in Figs. 8-24 and 8-25, respectively. It was found that various IRF values were selected owing to a variety of SF properties (e.g., reactor type, fuel type, and burnup).

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References
