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Sensitivity and Uncertainty Analysis for Radiotoxicity Estimation of the Halden BWR Spent Fuel

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The main objective of the study is the theoretical estimation of long-lived actinide and fission product inventories by combining depletion calculations and non-destructive measurement techniques (measuring of gamma-ray emitting fission products). This is important on account of possible leakage from long-term disposal of spent nuclear fuel. Identification of the most radiotoxic actinides and fission products in different cooling times (especially at long-term) and their behaviour from radiological protection aspects is discussed in the study. The solubility and mobility of long-lived actinides and fission products in underground waters, rocks and soil is very important for the accurate prediction of environmental impacts in the case of leakages from long-term disposal facilities. The results of this research are expected to improve the estimation of long-lived alpha emitting actinides, which is usually measured by destructive methods.
The inhalation and ingestion radiotoxicities are calculated along with the concentration, radioactivity, thermal and gamma power, and neutron and gamma spectra in different cooling times (up to 106 years). Different parameters were varied, such as fuel enrichment, fuel temperature, burnup history, length of cycles, and local irradiation environment, in order to determine their influence on inventories. Variations of operational conditions and local irradiation environment during irradiation have a significant impact on isotopic inventories for the Halden reactor.
Investigation of inhalation and ingestion toxicities of specific actinides and fission products revealed that the larger variations are seen between 3000 –100000 years, which is relevant time frame for the postulated leakage from the long-term disposal according to the reported results from previous studies. Preliminary results of this study have shown that the long-lived actinides, such as 239Pu, 240Pu, 241Pu, 242Pu, 241Am, 243Am, 245Cm, 236Np, 237Np, 235U and 238U and fission products, 79Se, 99Tc, 129I and 135Cs are the important radionuclides in the terms of radiotoxicity, as well as solubility and mobility.
The 6.0 % enriched Halden driver fuel irradiated up to 60 GWd/tUO2 is chosen for this study and is modelled by using SCALE-6.1 codes system. TRITON code is used for the building of Halden driver fuel specific cross section libraries and ORIGEN-ARP is employed for the depletion analysis. The 238-group ENDF/B-VII.0 neutron library is used for the calculations.

Do you wish to enter the YGE SFM19 Challenge?

Yes

Country or International Organization

Azerbaijan

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