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STUDY ON THE DEPENDENCY OF MATERIAL AMOUNTS ON BURUP IN PB-HTR BY PERTURBATION ANALYSIS

The most important issue in the material accounting of the pebble bed high temperature reactors (PB-HTRs) is to determine the amounts of the key material isotopes such as the isotopes of uranium and plutonium from the fuel burnup values obtained via calculations or measurements. The major approach to determine the production and loss of nuclear materials in the PB-HTR fuels is the burnup calculations and simulations over the actual fuel recycling process in a PB-HTR, since there is no practical isotope examination on the irradiated fuel elements of PB-HTR by now. In this work, the correlations of material amounts and the burnup values are evaluated by using the perturbation analysis on the previous results based on Monte Carlo simulations of the depletion process of the HTR-PM, the demonstration plant to be deployed in Shandong Province, China. Small perturbations are applied on the Monte Carlo simulations by adjusting the fuel recycling parameters slightly. The dependencies of material amounts of uranium and plutonium isotopes on the burnup values are concluded upon the expectation values of the stochastic distributions of the parameters mentioned above, based on the perturbed results of the Monte Carlo calculations. Furthermore, the perturbation analyses are performed on the Monte Carlo calculations for different fuel pass numbers, providing the dependencies upon the whole burnup range. The uranium isotopes present regular evolutions along with the increase of burnup values, while the plutonium isotopes present much more complicated behaviors of dependencies on burnup. The errors from the depletion calculations upon the averaged fuel composition can be avoided by using the method presented in this work.

State

China

Gender

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