Prompt Time Constants of a Reflected Reactor

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Time eigenvalue of transportation equation, alpha, is defined to describe all neutrons' time behavior (increasing or decreasing) in a nuclear reactor. Its number reflects the criticality also. The time constant, especially prompt time constant, had been studied for 60 years. Lots of reflected reactor's experimental data *cannot be satisfactorily explained using the standard point kinetic model* [1]. And multiple decay modes near delayed critical were also observed, which of course cannot be described by standard point kinetic model.

The existing numerical transportation codes, such as MCNP4C [2] and TART [3, 4] , can do the job well with only the fundamental mode calculated. By using alpha static criticality method, MCNP4C is a good tool if k_{eff} is close 1, which means the reactor is near delayed critical. But MCNP4C's calculation may be very difficult and time-consuming if the reactor has more negative reactivity or reflector contains hydrogen, or both.

In the region of analytical method, many works contains too much mathematics, which are not easy to calculate and compare with experimental data. G. D. Spriggs' one-group, two-region kinetic model based on Avery-Cohn model is simple, calculable. The model introduces *simple probability relationships essential to calculating the coupling parameters between core and reflector*,[1] and derives the reflected-core inhour equation which contains multiple decay modes. However, Spriggs model cannot well describe multiple time constants of the thermal reflected reactor. In this kind of reactor, thermal neutrons with long lifetime contribute much to the time constant. Because of importance of thermal neutrons in such fast-thermal reactor, we present a simplified two-group, two-region kinetic model (2G2R) based on Spriggs model, and rewrite the reflected-core inhour equation. With the help of MCNP code, we calculated the coupling parameters, neutron lifetimes and first and secondary time constant of a spherical benchmark reactor, PU-MET-FAST-024.[6] Because we don't have experimental data, the results of time constants are also compare with 3 different models, MCNP time fitting method, alpha static method (MCNP4C), and Spriggs model. The results of 2G2R model agree well with MCNP time fitting method which can be thought as an experiment in computer.

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