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Investigation of the homogenization effect in sodium void reactivity in PGSFR

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Korea Atomic Energy Research Institute (KAERI) has been developing an SFR to aim at specific design approval of a Prototype Gen-IV Sodium-cooled Fast Reactor (PGSFR). In the PGSFR, a metal fueled, blanket-free, pool type SFR concept is adopted to acquire the inherent safety characteristics and high proliferation-resistance.
The metal-fueled SFR such as the PGSFR is known to be inherently safe at unprotected events due to the low operating fuel temperature and negative reactivity feedback mechanism. Several important tests of the EBR-II reactor support these characteristics based on a measurement of the integral reactivity. However, these inherent safety characteristics of a metal-fueled SFR depend on the uncertainties of various reactivity worth and reactor design. Hence, validation of the each reactivity worth, generated by the core neutronics design code system, is an essential work for specific design approval.
Validation of various reactivity worth, or in other words, validation of the core neutronics design code system can be divided by two parts: 1) validation of the cross-section and 2) validation of a modeling error. Validation of the cross-section will be finalized at 2017 based on the several physics experiments. In this paper, validation of the modeling error in a SVR (Sodium Void Reactivity) of the PGSFR core was examined by comparing PGSFR core design procedure (multi-group homogeneous MC2-3/TWODANT/DIF3D-VARIANT) and explicit Monte Carlo modeling (continuous-energy heterogeneous MCNP6) based on the ENDF-B/VII.0 library. SVRs were obtained by direct calculation in both of the MC2-3/TWODANT/DIF3D-VARIANT and MCNP6 calculations for core central and peripheral regions.

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