A New 3D Consistent 1D Group Constants Representation Scheme

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Abstract

A 1D group constant representation scheme employing tables having independent variables of control rod tip position, fuel temperature, moderator density, and boron concentration is presented. This table functionalizes the current conservation factors (CCF) as well as the conventional 1D collapsed group constants. To test the 1D kinetics model with this 1D group constants representation scheme, steady state and transient calculations for the NEACRP A1 benchmark problem and a SMART bank withdrawal event are performed and compared with 3D reference values. Results show that the errors in k-eff are reduced to about one tenth when using CCF without significant computational overheads. The error in the power distribution is decreased to the range of one fifth or tenth at steady state calculation. During transient, the 1D result shows much closer results to the 3D values than the conventional linear 1D group constants representation. It is expected that the proposed 1D kinetics model with the 1D group constants representation scheme can be used in many practical applications requiring fast execution such as operator supporting system and coupled real time simulation of the system with significantly enhanced solution fidelity.