IRIS PIN CELL AND FUEL ASSEMBLY BENCHMARK INTERCOMPARISONS

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Validation plays a central role in the improvement of reactor physics codes and associated nuclear data libraries, as well as in the assessment of the accuracy of calculations. The nuclear data libraries can be sometimes adjusted to reduce the discrepancies. However, for the adjustments to be generally valid it is important to demonstrate that the numerical methods and physics models provide an accurate treatment of all the complexities of the systems. Estimates of the uncertainties arising from approximations in the methods used in different nuclear data processing and neutron transport codes can be obtained by intercomparing calculations made using different code systems. Depletion calculations made for simplified reactor configurations using both deterministic and stochastic methods, with different degrees of refinement in the modelling, could be intercompared using the same source of nuclear data. In this way, the accuracy of the different methods used at various stages, ranging from nuclear data processing systems to neutron transport calculations, can be assessed

This study is based on four depletion code systems: (a) MCNP-4C and ORIGEN2.1 interfaced by the MOCUP driver; (b) recently developed procedure based on KENO-V.a and ORIGEN2.1; (c) design-oriented procedure based on the SAS2H control module from SCALE-4.4a and an structured approximate geometrical model, which uses a simplified unit fuel within an infinite lattice for the fuel burnup analysis; and (d) WIMSD5 with recently released multigroup libraries.

The major advantage of using KENO-V.a/ORIGEN2.1 procedure is the decrease in computation time by a factor of about 20 as compared with MOCUP. In both, the MCNP-4C/ORIGEN2.1 and KENO-V.a/ORIGEN2.1 reference procedures, the same fuel burnup model was applied, i.e., the model with 95 most important fission products. Also, in the both reference procedures an improvement of radioactive capture (n, g) reactions with a product nuclide in an excited (metastable) nuclear state for all light-elements, actinides and fission products was inserted.

This paper presents a detailed study of the differences between depletion analysis results for the IRIS light water reactor pin cell models obtained using the four code systems. The leakage has been assumed to be zero, but a cell with leakage treated by means of a buckling has also been analysed. Cases at different temperatures have been calculated and the temperature coefficient calculations are also compared. Differences in the results between square and cylindrical cell boundary conditions have been studied and shown to be important.

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