Simulation of the burnup in cell calculation using the wimsd-5b code considering five nuclear data libraries

D. Y. S., Tavares[1], Z. R., Lima[2]
e-mail: desireeyael@gmail.com , zrlima@ien.gov.br

[1] *UCB*
[2] *SETER, IEN*

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This work proposes to implement the cell calculation considering the fuel burning using the WIMSD-5B code. The cell calculation procedure allows determining the nuclear parameters present in the multi-group neutron diffusion equation and for this purpose the neutron transport theory is used in a problem with dimensional reduction, but in contrast is considered a large number of groups associated with the neutron spectrum. There are a variety of reactor physics codes that determine the nuclear parameters by solving the neutron transport equation applied to an equivalent cell representing a fuel element. The WIMSD-5B code is a deterministic code that solves the transport equation using collision probability method. The simulation of fuel burning in the cell calculation took into account different nuclear data libraries.

The Winfrith Improve Multigroup Scheme (WIMS) is a deterministic code based on the transport theory to calculate the flux as a function of the energy and position in the cell, performing calculation for different geometries, providing the physical parameters necessary for the development of reactor designs nuclear of various types. Since the 60's it has been successful in its results, in addition it is widely accepted internationally, being one of the most used in the management of core nuclear reactors. More recently, with new updates, the code now has libraries with up to 172 energy groups or more. Among the various available libraries may be cited the following: WDN29, ENDFB-VII.1, ENDFB-VII.1GX, JENDL3.2, JENDL3.2GX, JEF2.2, JEF2.2GX, JEFF3.1, JEFF3.1GX, IAEA and IAEAGX. The WIMSD code develops the calculation of cells in four different geometries: homogeneous cells, cylindrical plates or bars, bar or plate arrays (cluster geometry) and multi-cells. In this work the calculation was made from the data of a one-dimensional cell (Slab).

In order to simulate burning using the WIMSD-5B code, it was considered the MTR-IAEA research reactor of the benchmark problem conceived by the IAEA and the following nuclear data libraries were used: IAEA, ENDFB-VII.1, JENDL3.2, JEFF3.1 and JEF2.2, for 69 energy groups and formatted by WLUP, WIMS Library Update Project.

The burnup was simulated over a period of 400 days, which corresponds to a 50% reduction in the initial ^{235}U concentration. The variations of the concentrations of some nuclides for the five nuclear data libraries evaluated were plotted in graphs and can be consulted in Figure 1. The variation to 78 nuclides can be found in [1]. Figure 2 the graphic of the k_∞ variation as a function of burnup for each nuclear data library is shown.

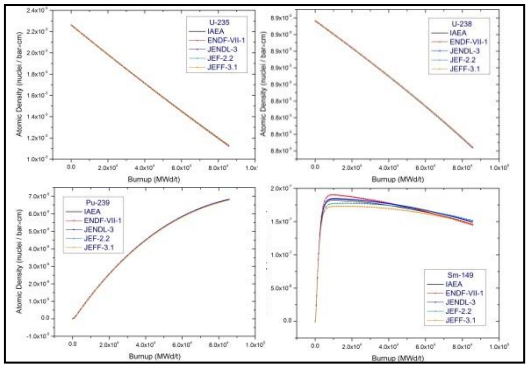

Figure 1. Variations during the burnup of the concentrations of some nuclides.

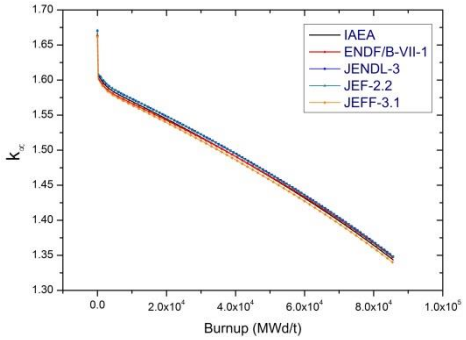

Figure 2. Infinite multiplication factor.

It was observed that in most cases the concentrations of nuclides presented practically the same result independently of the nuclear data library used. It is seen that the variation of k_∞ is similar for each adopted library. Future work will consider libraries for 172 energy groups.

References

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