NEW WORKING LIBRARIES FOR TRANSMUTATION STUDIES

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Abstract

Working libraries for fuel depletion codes with new cross sections have been made for both a PWR and a LMFBR. The new cross section data are based on the JEF2.2 file and the EAF-3 file for those nuclides not available from JEF2.2. In total, cross sections for 565 different nuclides have been updated. The library contains self-shielded cross sections for most actinides (about 20) and the most important fission products (about 30 for both the PWR and the LMFBR). Burnup calculations were performed to calculate the resonance shielding for these nuclides at average core burnup. For all other nuclides cross sections at infinite dilution were used. The cross sections of all nuclides were collapsed to one and three groups with the PWR and the LMFBR fuel pin spectra at average core burnup as weighting functions. Three-group cross sections were calculated for use by the ORIGEN-S fuel depletion code, while one-group cross sections can be used by other fuel depletion codes like ORIGEN2. Some data of the new cross section libraries are discussed, with attention focussed on the actinide cross sections for PWRs. Also the results of PWR sample calculations with the new cross section data libraries are given.

1 Introduction

Partitioning and transmutation (P&T) of spent fuel is nowadays investigated as an alternative or as a complementary solution to the high-level nuclear waste problem. Despite the fact that there is consensus on the technical feasibility of P&T, it is often difficult to compare the results of different scenario studies because of many differences between the cross section data used, between the definitions of waste (e.g. should plutonium be treated as waste or not), between the calculational methods and between many other assumptions related to the scenario under investigation. Major problems of scenario studies performed nowadays are the lack of knowledge about the reliability of the outcomes and the sensitivity of the results to the (cross section) data used. These items are very much related to the reliability of the cross section data used. The use of modern data libraries for fuel depletion and transmutation calculations is therefore encouraged.

A comparison of one-group cross sections of the Joint Evaluated Files (JEF1.1 and JEF2.2)\textsuperscript{1}, the old ORIGEN-S cross sections\textsuperscript{2} and recently updated ORIGEN2 cross sections\textsuperscript{3}, has shown that the old ORIGEN-S cross section data libraries contain rather poor data\textsuperscript{4}. Although cross section updates for the most important nuclides can be done by a fuel pin cell calculation prior to the actual ORIGEN-S burnup calculations, only a limited number of nuclides can be included in such cell calculations. Therefore, a cross section update for the bulk of the nuclides remains very useful.

In this paper, new three-group cross section data libraries for the fuel depletion code ORIGEN-S are described, but also one-group cross sections, usable by other fuel depletion codes like ORIGEN2\textsuperscript{5}, can be easily deduced from these libraries, making these new cross section data libraries more generally usable. The new cross section data libraries are based on the JEF2.2 file. For cross sections not available in this file the European Activation File version 3 (EAF-3)\textsuperscript{6} was used, which is a very extensive file containing cross sections for over 700 nuclides.

Cross sections were updated for both a PWR, for which a French N4 reactor was chosen, and a LMFBR, for which the French Superphénix reactor