NUEN 647 Final Project

Uncertainty quantification of depletion calculations for specific isotopes using ORIGEN.

I Introduction

Determing composition of irradiated fuel is of importance for a myriad of reasons. Whether for flux calculations, reprocessing, or irradiation history verification, calculating fuel composition requires a Bateman solver, and a means for building a sparse matrix.

Applications using these compositions rarely report the uncertainty associated with results, even when inputs, such as flux shape, fission yield, cross sections, and half-lives have varying degrees of uncertainty. A further source of error in this calculation is due to the multi-group approximation, but will not be explored here.

Several isotope concentrations, of interest to the writer, will calculated as a function of burnup with the depletion code ORIGEN for a thermal and fast system using depleted uranium. The uncertainty of these concentrations will then be determined.

II Objectives

1. Build ORIGEN model for fast and thermal system which calculates concentrations of isotopes shown in Table 1.
2. Determine how to vary fission yields for calculation
3. Determine how to vary cross section and or flux spectrum inputs for calculation
4. Determine how to vary half-life information for calculation
5. Create a sampling space for all possible variations of calculations
6. Determine importance of various uncertain parameters by running the code a number of times randomly sampling the sample space (still not 100% sure how to do this - not even 50% sure how to do this)

Table 1: Isotope solve list.

^{133}Cs	^{136}Ba	^{153}Eu
^{134}Cs	^{138}Ba	^{154}Eu
^{135}Cs	^{149}Sm	^{239}Pu
^{137}Cs	^{150}Sm	^{242}Pu
^{148}Nd	^{106}Rh	^{125}Sb

III Quantities of Interest and Uncertain Parameters

Quantities of interest are shown in Table 1 above. Uncertain parameters are listed below:

- Fission yield
- Cross sections
- Half-lives

IV Prediction

The first major prediction for this project is that half-lives will not have a large impact on results because they are relatively well known. Secondly, ^{125}Sb is notorious for being difficult to calculate, I would would predict that there would be large uncertainties due to uncertainties in the cross section data.