NUEN 601, Homework 6

Due Date Nov. 5

1 Custead

A slab lattice is made up of 1 cm slabs of fuel separated by 1 cm of graphite. The fuel is natural Uranium at a density of 19.1 g/cm^3, and the graphite has a density of 2.2 g/cm^3. Use values for microscopic cross-sections from Stacey Appendix A, and $\nu = 2.43$ for both ^{235}U and ^{238}U to answer the following questions. Assume $\sigma_a = \sigma_f + \sigma_\gamma$ for the uranium isotopes and that σ_{tr}^{micro} is the same for ^{235}U and ^{238}U.

1. What are σ_a, σ_f, and D for this type of lattice?
2. Can one make a critical reactor out of this type of lattice? If so, what is the overall slab thickness?

2 Chang

A cylindrical reactor with $\sigma_{tr} = 0.0362$, $\sigma_a = 0.1532$, and $\nu\sigma_f = 0.1570$ (all in inverse cm). For this reactor $H = 400$ cm and $R = 200$ cm.

1. A control bank is inserted from the top of the reactor. The effective absorption cross-section in the region where the control bank is inserted goes to 0.2 cm^{-1}. Compute the critical insertion depth for the control bank in this reactor.
2. If instead you make the reactor just critical by adding boron to the water ($\sigma_a^{micro} = 755$ b per nucleus at a density of 2.45 g/cm^3), how much boron do you have to add (in grams)?
3. Compute the axial power peaking factor at $r = 0$ for the solution in part 1 and part 2 of this problem.

3 Cavaluzzi

Compute and plot the spectrum $\phi(E)E$ for a homogeneous reactor comprised of graphite, and 10 atom-% enriched uranium. There are 5 ^{238}U atoms for every 1000 graphite atoms. The reactor is operating at 290 K and you can assume the neutron temperature is also 290 K. Explain the dips in the spectrum.

Use `http://www.nndc.bnl.gov/exfor/endf00.jsp` for your data.