Exam 3: NE533: Nuclear Fuel Performance

1. Determine the total change in the fuel volume given: αth=10x10-6, fission rate = 8x1014 fiss/cm3-s, Tf=1400 K, Tref=300 K, Δρ0=0.01, BD=5 MWD/kgU, ρ(UO2) =10.97 g/cc, t=200 days. (16 pts)
2. What is the total creep in a RXA zirconium cladding given a von mises stress of 250 MPa, a temperature of 650 K, a LHR of 150 W/cm, and a time of 1.5 years? (12 pts)
3. Two fuel pellets have been irradiated and are being post-irradiation annealed for 30 hrs at 1600 K. One fuel sample has a grain size of 10 microns and the other has a grain size of 25 microns. How much more fission gas is released in the smaller grained fuel pellet? (10 pts)
4. List and describe the three stages of fission gas release? (10 pts)
5. What performance effects result from the High Burnup Structure? (5 pts)
6. What are the five types of fission products that form in the fuel? List a role each plays in fuel performance. (10 pts)
7. List three benefits of using Zr cladding. (6 pts)
8. What are the four conditions that must be met for SCC? Briefly describe how each is met in PCI. (10 pts)
9. What irradiation effects impact thermal conductivity degradation in UO2 fuels? (6 pts)
10. Describe the irradiation growth of hcp Zr due to point defects. (6 pts)
11. Describe the three stages of zirconium cladding creep in a fuel rod. (6 pts)
12. Name three properties that vary as a function of stoichiometry in UO2. (3 pts)
13. What are the two types of mitigation strategies to limit PCI? (5 pts)