NUCL 40200 Engineering of Nuclear Power Systems

Assignment 3

(1) A research reactor power is being increased in steps and then shutdown.
   a) If the reactor reached a power of 3 MW in 30 minutes from initial power of 1 MW, how much reactivity was introduced to the reactor to increase the power?
   b) Now when the reactor was operating at 3 MW it was scrammed and the power dropped to 1 W in 20 minutes. How much reactivity was introduced when the reactor was scrammed?

(2) A PWR is to be controlled by 58 cluster control assemblies, each assembly containing 22 black rods, 1.2 cm in diameter. The reactor core is a cylinder 350 cm in diameter. The average thermal diffusion length (L_T) in the core is 1.4 cm, the thermal neutron diffusion coefficient ($\overline{D}$) is 0.25 cm, and the macroscopic total cross section (Σ_t) in the core material is 2.5 cm^{-1}. Calculate the total worth of the rods.

(3) Now it is proposed to use the cruciform rods (instead of PWR standard cluster rods) for the control of PWR described in above assignment problem 2, with blades of 13 cm in total width and 0.4 cm thick. The parameters for the core are L_T =1.3 cm, and $\overline{\Sigma}_a$ = 0.21cm^{-1}. How far aprt should these rods be placed in order to provide the same total worth as the cluster rods in the assignment problem 2?

(4) The overall temperature coefficient of a ^{235}U fueled reactor is -2.5 x10^{-5} per ^{o}C and is independent of temperature. How does the reactivity of the system change when its temperature is increased from room temperature (20 ^{o}C) to the operating temperature of 330 ^{o}C. Plot your results in percent and dollars as a function of temperature.