Reactivity Balance & Reactor Control System

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1 Quiz

1.1 Questions

1. Determine the multiplication factor for a thermal reactor with the following data: p=0.8, ε=1.02, f=0.9, P_L=0.8 and η=1.8.

2. Determine reactivity for the data given in problem 1.

3. The number of neutrons per fission in U-235 is 2.4. Determine the number of prompt neutrons.

4. The movement of control rod resulted in a power increase with a period of 100 s. Using β=0.0065 and l_d=12 s, determine the deviation in multiplication factor from 1.

5. In an experiment, a reactivity of 0.005 is introduced into a critical core. If the temperature coefficient of reactivity is -10e-5 /°C, determine the increase in temperature that will compensate this reactivity.

1.2 Answers

1. Multiplication factor can be determined using the five-factor formula (Equation 2)

$$k= p\eta f P_L \varepsilon$$

k=0.8*1.8*0.9*0.8*1.02 = 1.057536

2. ρ = (k-1)/k = (1.057536-1)/1.057536 = 0.0544

3. Fraction of prompt neutrons = 1-β = 1-0.0065 = 0.9935
Number of prompt neutrons = 2.4*0.9935 =2.3844

4. Let us assume that (k-1)< β; $T=\beta l_d/(k-1)$

$k-1 = \beta l_d/T = 0.0065*12/100= 0.00078$

Since (k-1)<β, the assumption is justified.

Therefore, (k-1) = 0.00078

5. Recall Eq. (8), Temperature coefficient of reactivity = α = ρ/**ΔT**
ΔT = ρ/α = 0.005/10e-5= 50 °