(20.3) In the Chernobyl accident, reactor output increased from ~20% to 100 times full power in about 4 seconds. Assume a constant reactivity excess during this time. a) What was the average reactor period? b) How much energy was released during this time?

$GJ := 10^9 \cdot joule$ $P_0 := 20 \cdot \%$ $P_1 := 100$ $\Delta t := 4 \cdot sec$

(a) $t_{per} := \dfrac{\Delta t}{ln\left(\dfrac{P_1}{P_0}\right)}$ From eqn. (19.28) $t_{per} = 0.64 \cdot sec$

(b) $P_{th} := 3000 \cdot 10^6 \cdot watt$ $P_{init} := P_{th} \cdot P_0$ $P_{init} = 6 \cdot 10^8 \cdot watt$

$$Q_{tot} := P_{init} \cdot \int_{0 \cdot sec}^{\Delta t} exp\left(\frac{t}{t_{per}}\right) dt$$

$Q_{tot} = 1.927 \cdot 10^{11} \cdot joule$

$Q_{tot} = 193 \cdot GJ$

Comments:

$TNT := 1 \cdot 10^9 \cdot cal$ $\dfrac{Q_{tot}}{TNT} = 46.027$ *i.e*. almost equivalent to the energy from explosion of 46 ton TNT (but a slower burn)