(19.12) What amount of tritium (Bq) is produced in the Würgassen nuclear plant assuming that ^{3}H is only produced through capture in the deuterons of the original cooling water, the amount or which is 50% of the core volume? Data on fluxes, cross sections, and releases are given in Table 19.4. Neglect the tritium decay rate.

Data, constants and units:

$Bq := sec^{-1}$ $\quad N_A := 6.022137 \cdot 10^{23} \cdot mole^{-1}$ $\quad barn := 10^{-28} \cdot m^2$

$M_H := 1.008 \cdot gm \cdot mole^{-1}$ $\quad M_O := 16.00 \cdot gm \cdot mole^{-1}$ $\quad M_D := 2.014 \cdot gm \cdot mole^{-1}$

$\sigma_D := 0.00053 \cdot barn$ $\quad V_w := 38 \cdot \frac{50}{100} \cdot m^3$ $\quad x_D := 0.0155 \cdot \%$

$\rho_{H2O} := 0.742 \cdot gm \cdot cm^{-3}$ From Handbook of Chem. Phys. 62:nd Ed. for water at 285^{o}C (outlet temperature).

$m_{H2O} := V_w \cdot \rho_{H2O}$ $\quad t_{halfT} := 12.323 \cdot yr$ $\quad t_{irr} := 1 \cdot yr$

Calculations:

$N_H := \frac{m_{H2O}}{2 \cdot M_H + M_O} \cdot 2 \cdot N_A$ $\quad \lambda_T := \frac{ln(2)}{t_{halfT}}$ $\quad N_D := N_H \cdot x_D$

$\phi := 4.4 \cdot 10^{13} \cdot cm^{-2} \cdot sec^{-1}$

$Rate := \phi \cdot \sigma_D \cdot N_D$ $\quad Rate = 3.41 \cdot 10^{12} \cdot sec^{-1}$ of T-atoms