Example

Constant swelling $\varepsilon_{tot} = \varepsilon_{th} + \varepsilon_D + \varepsilon_{SFP} + \varepsilon_{GFP}$

$\dot{F} = 2\times10^{13}$ fiss/cm³·s $T = 1400$ K $T_{ref} = 300$ K

$\Delta\rho_0 = 0.01$ $B_0 = 5$ MWD/kgU $\alpha_F = 11\times10^{-6}$ 1/K

$N_u = 2.45\times10^{22}$ U/cc

$t = 2$ weeks

$\varepsilon_{th} = \alpha\Delta T = (11\times10^{-6})(1400-300) = 0.0121$

$\varepsilon_D = \Delta\rho_0\left(\exp\left(\frac{\beta \ln 0.01}{C_0 B_0}\right) - 1\right)$

$\beta? = FIMA = \frac{\dot{F}t}{N_u}$

$\beta = \frac{(2\times10^{13})(2\times7\times24\times3600)}{2.45\times10^{22}\ U/cc}$

$\beta = 9.87\times10^{-4}$

C_0? $T > 750$ C

$\rightarrow C_0 = 1$

$B_0 = 5$ MWD/kgU $\rightarrow \approx 0.005$ FIMA

$\varepsilon_D = 0.01\left(\exp\left(\frac{(9.87\times10^{-4})\ln 0.01}{(1)(0.005}\right) - 1\right)$

$\varepsilon_D = -0.006$

$\varepsilon_{SFP} = 5.577\times10^{-3}\,\rho\beta = (5.577\times10^{-3})(10.97\ g/cc)(9.87\times10^{-4}) = 5.98\times10^{-4}$

$\varepsilon_{GFP} = 1.96\times10^{-32}\,\rho\beta\,(2800-T)^{11.73}\exp(-0.0162(2800-T))\exp(-17.8\,\rho\beta)$

$\rightarrow \rho\beta = 0.0108$ $T = 1400$ K

$\varepsilon_{GFP} = 0.002$

$\varepsilon_{tot} = 0.0121 - 0.006 + 5.98\times10^{-4} + 0.002 = 0.008$

0.8%