(21.11) A tank contains 100 m3 5 y old HLLW. Analyses show that a 1 ml sample contains 1.09 GBq of ^{90}Sr, which is the only Sr activity. (a) Calculate the heat production for a waste of composition in Table 21.9 left column. (b) How many 500 kg glass cylinders would be needed (assume the glass contains 10% FPs) to contain all the solidified waste? (c) How many 1000 MWe PWR reactor years does this waste correspond to?

$Bq := sec^{-1}$

$Vol := 100 \cdot m^3$ $\quad S_{Sr} := 1.09 \cdot 10^9 \cdot Bq \cdot mL^{-1}$ $\quad s_{Sr} := \frac{2180 \cdot 10^{12}}{1000} \cdot Bq \cdot kg^{-1}$

$R_{tot} := Vol \cdot S_{Sr}$ $\quad m_{tot} := \frac{R_{tot}}{s_{Sr}}$ $\quad m_{tot} = 5 \cdot 10^4 \cdot kg$

(a) $H_{FP} := 1.9 \cdot watt \cdot kg^{-1}$ $\quad Q_{tot} := H_{FP} \cdot m_{tot}$ $\quad Q_{tot} = 95 \cdot kW$

(b) $m_{FP} := \frac{34}{1000} \cdot m_{tot}$ $\quad m_{FP} = 1.7 \cdot 10^3 \cdot kg$ $\quad m_{cyl} := 500 \cdot kg$

$x_{cyl} := 10 \cdot \%$ $\quad n_{cyl} := \frac{m_{FP}}{x_{cyl} \cdot m_{cyl}}$ $\quad n_{cyl} = 34$

(c) Assume a burnup of 33 MWd/kg. $\eta := 34 \cdot \%$ typical LWR thermal efficiency

$BUP := 33 \cdot 10^6 \cdot watt \cdot day \cdot kg^{-1}$

$P_e := 1000 \cdot 10^6 \cdot watt$ $\quad P_{th} := \frac{P_e}{\eta}$ $\quad P_{th} = 2.941 \cdot 10^9 \cdot watt$

$SP_{fuel} := \frac{P_{th}}{BUP}$ $\quad SP_{fuel} = 3.255 \cdot 10^4 \cdot \frac{kg}{yr}$

$R_{years} := \frac{m_{tot}}{SP_{fuel}}$ $\quad R_{years} = 1.5 \cdot yr$