873.

Problem 55.25 (RHK)

The neutron generation time t_{gen} *in a particular reactor is* 1.0 ms. *The reactor is operating at a power level of* 500 MW; *we have to find the number of neutrons* (*neutrons that will subsequently induce a fission*) *are present in the reactor at any moment*.

Solution:

When a nuclear reactor operates at constant power output the multiplication factor $k = 1$. The neutron generation time of a particular reactor $t_{\text{gen}} = 1.0\text{ ms}$. This reactor is operating at a power level of 500 MW. Therefore, in 1s the number of generations of fissions that would have taken place in this reactor will be 1000.

As the reactor is operating at 500 MW power level, the energy released in each fission generation will be

$$E = \frac{500\times10^6}{1000}\ \text{J} = 5\times10^5\ \text{J}$$

$$= \frac{5\times10^5}{1.6\times10^{-13}}\ \text{MeV}$$

$$= 3.13\times10^{18}\ \text{MeV}.$$

We assume that average energy released per fission is 200 MeV. Therefore, the number of neutrons present in the reactor at any instant will be

$$N = \frac{3.13\times10^{18}\ \text{MeV}}{200\ \text{MeV}} = 1.57\times10^{16}.$$