NUCL 40200 Engineering of Nuclear Power Systems

Assignment 9

(1) Consider the containment system as shown in Figure 7.14 after loss of coolant accident (LOCA). Assume that the containment is filled with saturated liquid, saturated vapor, and air and nitrogen gas released from rupture of one of the accumulators, all at thermal equilibrium. The containment spray system has begun its recirculating mode, during which the sump water is pumped by the residual heat removal (RHR) pump through RHR heat exchanger and sprayed into the containment.

Assume that after 1 h of operation the RHR pump fails and the containment is heated by core decay heat. The decay heat from the core is assumed constant at 1.3% of the rated power of 2282 MWth.

Find the time when the containment pressure reaches its design limit, 0.75MPa. Additional necessary information is given below.

Containment after 1 h:

Water mixture mass (m_w) =1.35 x 10^6 kg, Water mixture quality (x_{st}) = 0.023,
Air mass (m_a) = 5.05 x 10^4 kg, Nitrogen mass (m_{N2}) = 1.25 x 10^3 kg,
Initial temperature (T) = 385.8 K

Thermal properties of gases:

$$R_{air} = 0.286 \text{ kJ/kg K}$$
$$c_{va} = 0.719 \text{ kJ/kg K}$$
$$R_{N_2} = 0.296 \text{ kJ/kg K}$$
$$c_{vN} = 0.742 \text{ kJ/kg K}$$

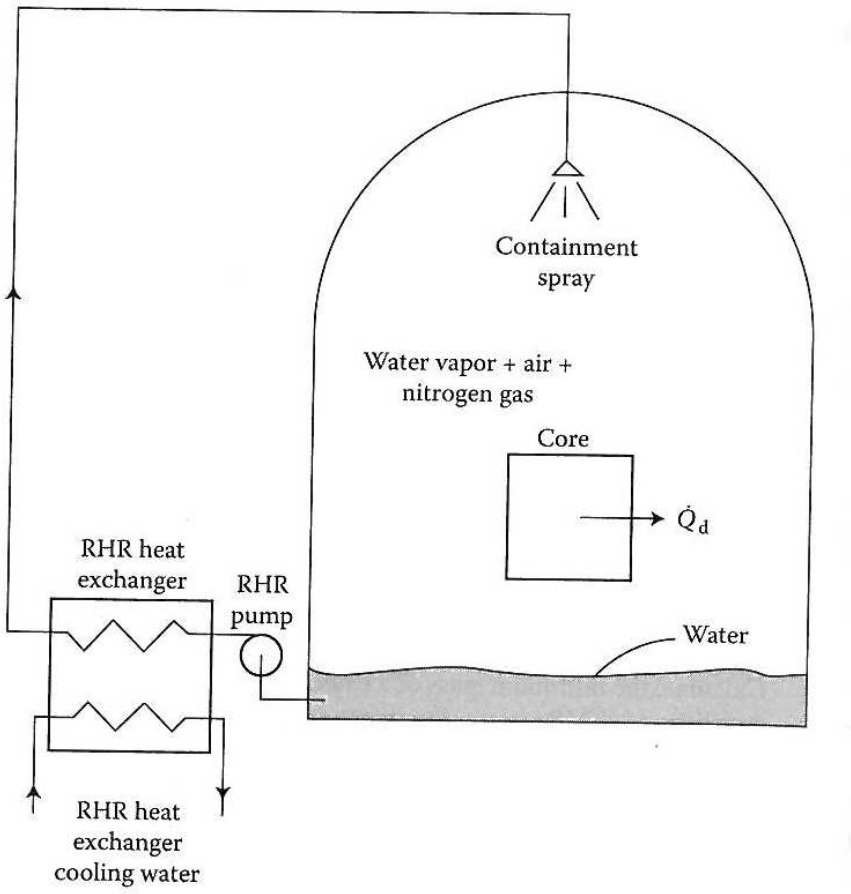

FIGURE 7.14 Containment.