
PROBLEM 7-16N QUESTION

Containment Pressurization Following Zircaloy-Hydrogen Reaction

Consider a LOCA in a typical PWR in which the emergency cooling system is insufficient to prevent metal-water reaction of 75% of the Zircaloy clad and the hydrogen produced subsequently combusts. Using the results of Problem 3.6, this sequence of events yields the following material changes and energy releases relevant to the containment pressurization:

Primary coolant released	=	2.1×10^5 kg
Zr reacted	=	$0.75 \times 24,000$ kg
Energy released from Zr-H ₂ O reaction	=	1.195×10^{11} J
H ₂ produced and reacted	=	394.7 kg mol
Energy released from H ₂ combustion	=	9.47×10^{10} J
O ₂ consumed	=	<i>you must determine</i>
Net H ₂ O change	=	<i>you must determine</i>

Take the initial primary coolant and containment vessel geometry and conditions the same as Table 7-2. Also, assume that nitrogen has the same properties as air.

QUESTION

For the sequence described (e.g., LOCA, 75% Zircaloy clad reaction and subsequent complete combustion of the hydrogen produced):

- (a) Demonstrate that the final equilibrium temperature is 449 K, neglecting containment heat sinks using the initial conditions of Table 7-2, and
- (b) Find the final equilibrium pressure.

HINT: Is the final state likely saturated water or superheated steam in equilibrium with the air? Consider the energy releases compared to those of Example 7.2.