LETTERS TO THE EDITOR

PREDICTION OF FISSION GAS RETAINED IN MIXED-OXIDE FUELS

Dutt et al.[1] developed a model to predict fission gas release from mixed-oxide fuels. They assigned 100% fission gas release to all restructured fuel regions. Fission gas release from the nonstructured fuel is described by an equation of the form

$$F = 1 - \frac{1 - \exp(-C_1 B)}{C_1 B C_2 \exp(C_3 X)} , \qquad F \geq 0 ,$$

where

F = fractional release

B = local burnup

X = local linear heat rate

C_1, C_2, C_3 = constants.

This type of equation also seems to be suitable for describing the concentration of the retained fission gas. However, contrary to the simplifying assumptions of Dutt et al., we found the fission gas retention to be a function of temperature, even in the nonrestructured fuel.[2] Based on these experimental results, we have chosen the following equation to describe the burnup and temperature-dependent concentration of the retained fission gas in oxide fuels:

$$C = 2.63 \cdot 10^{-2} \frac{1 - \exp(-6.84 \cdot 10^{-5} B)}{\exp(0.45 + 1.3 \cdot 10^{-22} Q^{1.5} T^{5.8})} ,$$

$$C \leq 3 \cdot 10^{-7} B ,$$

where

C = fission gas atoms per uranium and plutonium atoms

B = burnup, MWd/MTM

Q = specific power, W/g

T = temperature, K.

Figure 1 shows the calculated concentrations of the retained fission gas as a function of burnup for various

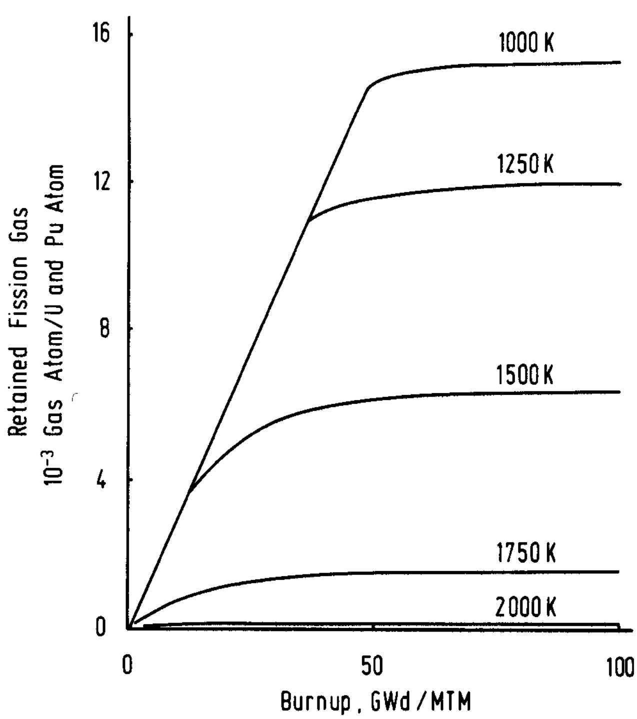

Fig. 1. Fission gas retention as a function of burnup calculated for a specific power of 200 W/g and different temperatures.

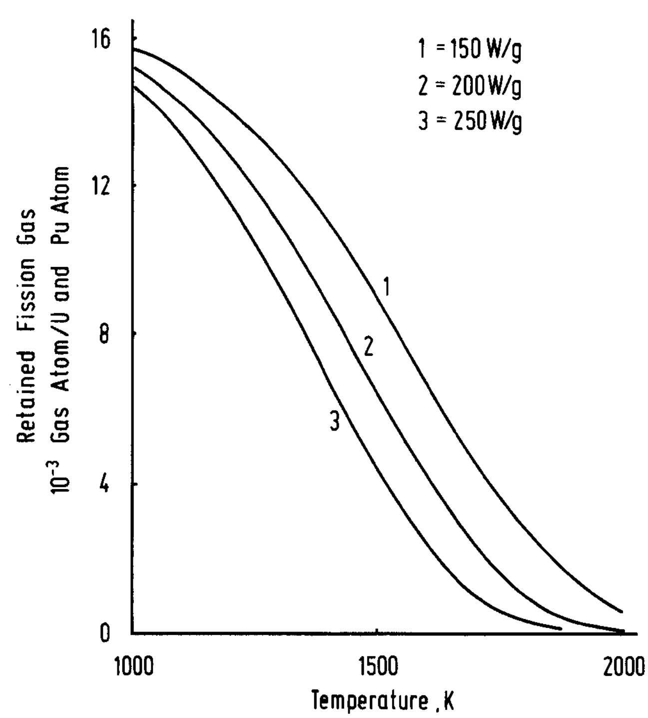

Fig. 2. Fission gas retention as a function of temperature for a burnup of 100 GWd/MTM and different specific powers.

temperatures at a specific power of 200 W/g. The decrease of the fission gas retention with increasing temperature for different specific powers at high burnup is shown in Fig. 2. These saturation levels are in agreement with experimental results in the temperature range between 1000 and 2000 K, if there is a high-temperature gradient in the fuel that causes fast bubble migration at higher temperatures, resulting in high fission gas release. If there is only insignificant bubble migration, e.g., in the thermal center of the fuel, the concentration of the retained fission gas is somewhat higher at temperatures above 1800 K.

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REFERENCES

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2. H. ZIMMERMANN, "Fission Gas Behavior in Oxide Fuel Elements of Fast Breeder Reactors," *Nucl. Technol.*, **28**, 127 (1976).