with the elements in multiphase systems at equilibrium" is erroneous: The UO_2 fuel was *not* in thermodynamic equilibrium during the accident at TMI-2!

Indeed, in that diffusional processes are considered to be key factors affecting fission product behavior (gaseous as well as volatile), the FASTGRASS diffusive flow model has been improved along the lines suggested by Matthews and Wood.[10] A paper describing this model as well as other improvements (e.g., modeling intergranular bubble behavior with lenticular bubbles instead of spherical) and an extensive comparison of FASTGRASS predictions with experimental results will be available in the near future.

Fission product release from Three Mile Island Unit 2 (TMI-2) is estimated to be ~70% for the noble gases and ~50% for both iodine and cesium.[11] Figure 4 of Ref. 11 shows that FASTGRASS predicts that this magnitude of release is possible from low-burnup solid fuel under "TMI-2-type" heating conditions.

J. Rest

Argonne National Laboratory
Materials Science and Technology Division
9700 South Cass Avenue
Argonne, Illinois 60439

March 25, 1983

REFERENCES

1. W. CHUBB, "Comments on 'Evaluation of Volatile and Gaseous Fission Product Behavior in Water Reactor Fuel Under Normal and Severe Core Accident Conditions,' " *Nucl. Technol.*, **63**, 185 (1983).

2. H. MATZKE, "Gas Release Mechanisms in UO_2—A Critical Review," *Radiat. Eff.*, **53**, 219 (1980).

3. G. T. LAWRENCE, "A Review of the Diffusion Coefficient of Fission-Product Rare Gases in Uranium Dioxide," *J. Nucl. Mater.*, **71**, 195 (1978).

4. J. A. TURNBULL and C. A. FRISKNEY, "The Release of Fission Products from Nuclear Fuel During Irradiation by Both Lattice and Grain-Boundary Diffusion," *J. Nucl. Mater.*, **58**, 331 (1975).

5. L. C. MICHELS and R. B. POEPPEL, "In-Pile Migration of Fission Product Inclusions in Mixed-Oxide Fuels," *J. Appl. Phys.*, **44**, 1003 (1973).

6. N. OI and J. TAKAGI, "Diffusion of Non-Gaseous Fission Products in UO_2 Single Crystals," *Z. Naturforsch.*, **19A**, 1331 (1964).

7. F. A. NICHOLS, "Transport Phenomena in Nuclear Fuels Under Severe Temperature Gradients," *J. Nucl. Mater.*, **84**, 1 (1979).

8. F. A. NICHOLS, "On the Diffusional Mobilities of Particles, Pores and Loops," *Acta Metall.*, **20**, 207 (1972).

9. D. R. OLANDER, "Fundamental Aspects of Nuclear Reactor Fuel Elements," TID-26711-P1, U.S. Department of Energy (1976).

10. J. R. MATTHEWS and M. H. WOOD, "An Efficient Method for Calculating Diffusive Flow to a Spherical Boundary," *Nucl. Eng. Des.*, **56**, 439 (1980).

11. J. REST and C. E. JOHNSON, "A Prediction of TMI-2 Core Temperatures from the Fission Product Release History," NSAC-12, Nuclear Safety Analysis Center of the Electric Power Research Institute (1980).

COMMENTS ON "A COMPARISON OF GADOLINIA AND BORON FOR BURNABLE POISON APPLICATIONS IN PRESSURIZED WATER REACTORS"

The paper by Goldstein and Strasser[1] concerning the use of gadolinium in pressurized water reactors (PWRs) inexplicably omits three seminal references. The first[2] made the important observation that, for the 3 to 4 wt% Gd_2O_3 range, a one-for-one replacement of burnable ^{10}B elements by Gd_2O_3/UO_2 elements need not have major effects on power distributions and cycle lengths for first cycles.

The second[3] analytically presented the effects of axial zoning of Gd_2O_3 in PWRs for the first time in the open literature and suggested generic techniques for power shaping by means of such axial zoning.

The third reference[4] discussed the reduction of moderator coefficient in PWR first cycles by development of a unique hybrid (Gd_2O_3 and ^{10}B) design, the purpose being the solution of the anticipated-transient-without-scram problem.

Burton Rothleder

Science Applications, Inc.
1710 Goodridge Drive
P.O. Box 1303
McLean, Virginia 22102

April 28, 1983

REFERENCES

1. L. GOLDSTEIN and A. A. STRASSER, "A Comparison of Gadolinia and Boron for Burnable Poison Applications in Pressurized Water Reactors," *Nucl. Technol.*, **60**, 352 (1983).

2. H. ROTH-SEEFRID and J. G. FITÉ, "First Core Design of a 1300-MW(e) PWR with Gadolinium," *Trans. Am. Nucl. Soc.*, **31**, 233 (1979).

3. B. M. ROTHLEDER and W. J. EICH, "Global Effects of Axially Zoned Gadolinium in PWR Cores," *Trans. Am. Nucl. Soc.*, **35**, 97 (1980).

4. B. M. ROTHLEDER, "Reduction of Moderator Temperature Coefficient by Gadolinium Substitution for PWR Application," *Trans. Am. Nucl. Soc.*, **39**, 616 (1981).