



UNITED STATES DEPARTMENT OF COMMERCE  
National Institute of Standards and Technology  
Gaithersburg, Maryland 20899

July 30, 1990

Dr. Charles Interrante  
Materials Engineering Section  
Division of High-Level Waste Management  
Office of Nuclear Materials Safety and Safeguards  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555

Dear Dr. Interrante:

Enclosed are pages B-41 and B-42 for Appendix B to replace A-41 and A-42, which are numbered incorrectly for that Appendix, and are included in the report, "Evaluation and Compilation of DOE Waste Package Test Data," NUREG/CR-4735, Volume 6. The complete report was transmitted to the NRC on July 23, 1990. If you have any questions, please call me.

Sincerely,

J. Harris  
Corrosion Group  
Metallurgy Division

cc: WM Docket Control Center

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## CONCLUSIONS OF AUTHOR

1. Uranium concentrations peaked at higher levels early in the Series 3 bare-fuel tests than in Series 2 tests and fell to much lower levels. Pu activities in the 85°C Series 3 bare-fuel tests also fell to lower levels than in the Series 2 tests.
2. The corrosion products from stainless steel vessels affected solution chemistry in the Series 3 tests; The drops in actinide and Tc concentrations may have been caused by coprecipitation with iron oxy-hydroxide and/or reduced solubility due to reduced oxygen potential.
3. Fuel dissolution behavior in the bare-fuel tests did not depend on temperature (85°C vs 25°C). Vessel type (sealed SS vs unsealed silica) and fuel type (HBR vs TP) appeared to affect concentrations and total measured release values.
4. The chemistry of J-13 well water was little changed at 25°C in both Series 2 and 3 tests, but at 85°C in the Series 3 tests, Ca, Mg, Si, and HCO<sub>3</sub> concentrations were reduced.
5. In both Series 2 and 3 tests, release of radionuclides was much greater from bare-fuel than from fuel with defected cladding.

## COMMENTS OF REVIEWER

From this study and related HLW reports it has been concluded that actinide release from spent fuel is a congruent process while fission products such as <sup>99</sup>Tc are released at a much faster rate, possibly because they are concentrated at the grain boundaries. The reviewer finds the conclusions based on comparisons with other experiments to be very confusing. The authors may state a fact but not really a conclusion. For example, conclusion 5. above cannot possibly be very surprising.

The reviewer recommends that release of radionuclides be compared with the EPA 10<sup>-5</sup> release rate (based on nuclide inventory after 1000 years of storage). In this report the solution concentration of U and Pu are somewhat below the 10<sup>-5</sup> limit while release of <sup>99</sup>Tc and <sup>14</sup>C are somewhat above the limit. Thus far tests of this type have been done on 2 reactor fuels. Measurements should be made on additional fuels to determine the variability in spent fuels.

It is clear that the purpose of filtering is to detect the presence of small particulate or colloidal U, but the authors never state a conclusion concerning their importance.

Presence of colloidal material could be of crucial importance because the small particles might also lead to transport of other fission products leading to much higher transport than expected on the basis of solubility data.

It appears that  $10^{-5}$  of the specimen inventory is not rate (per year). The NRC criterion is the  $10^{-5}$ /year, controlled release rate. Therefore, a sample calculation should be given including the time factor.

The solubility limit, which may not be available at the present time, is not given in this paper. Perhaps the solubilities of pure elements in deionized water would be useful if they were drawn in all figures.

Although the curves show the uranium concentration at 25°C levels off with a higher concentration than that at 85°C, the total uranium release in the Series 3 bare fuel tests was ~5 times greater at 85°C than at 25°C as listed in Table III, since the results of Table III took into account solid precipitates. The following two problems need clarification before having a complete scenario of events: (1) Can those precipitates on the test vessel be formed in rock environments? (2) Is, the  $10^{-5}$ , rate (per year) or not?

Figure 1 does not appear to show any gaps, nor to describe maintaining the air gaps in the content, for defected or for bare fuels. Also, the oxygen has a solubility limit in the solution at the level of from ppm to ppb. Therefore, this discussion is valid except one case when the dissolution rate of gaseous oxygen is very fast compared to the rate of iron oxidation with an infinite amount of gaseous oxygen to be supplied. Certainly, a qualitative estimate in the paper would be useful.

The authors list all possible roles of iron ions in decreasing the dissolved uranium concentration. Therefore, the effects of chromium and nickel should be addressed too.

#### RELATED HLW REPORTS

1. C. N. Wilson and V. M. Oversby, in Waste Management 85, Ed. R. G. Post, Vol. 1, pp. 497-504 (also UCRL-91464, March 1985).
2. V. M. Oversby and C. N. Wilson, in Scientific Basis for Nuclear Waste Management IX, Ed. L. O. Werme (Materials Research Society, Pittsburgh, PA 1986) pp. 337-346.
3. C. N. Wilson, "Results from Cycles 1 and 2 of NNWSI Spent Fuel Dissolution Tests," HEDL-TME-85-22, Hanford Engineering Development Laboratory, Richland, WA.

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