July 19, 2001

MEMORANDUM TO: M. Wayne Hodges, Deputy Director
Technical Review Directorate
Spent Fuel Project Office, NMSS

FROM: Nilesh C. Chokshi, Chief **/RA by Edwin Hackett Acting For/**
Materials Engineering Branch
Division of Engineering Technology, RES

SUBJECT: COMPLETION OF ZINC-ZIRCALOY INTERACTION STUDY

In response to user need request NMSS-2000-006, "Request for Expedited Activities Related to Probabilistic Assessment of Dry Storage of Spent Nuclear Fuel," the Office of Research and NMSS designated the evaluation of zinc vapor on zircaloy cladding as a priority task. As such, a research program was initiated at Argonne National Laboratory under NRC JCN Y6373. The objective of this research was to determine if zinc-zirconium intermetallics could form on oxide coated Zircaloy-4 fuel rods exposed to CarboZinc11 under conditions representative of those inside the VSC-24 casks in actual use.

This work has been completed. The results of the research is given in the attached report. This report is to be published as NUREG/CR-6732, “Zinc-Zircaloy Interaction in Dry Storage Casks.”

In summary, prototypical cladding and coating materials were used and the cladding was preoxidized to form a surface layer comparable to those on irradiated fuel rods at medium burn up. The test temperature was 300°C (which envelops the peak cladding temperature of 282°C at a realistic cask heat load of 12 kW) and the maximum hold time at temperature was 90 days. No zinc-zircaloy interaction was found in any of the tests. These results differ from those of earlier tests conducted by NIST, under less prototypical and generally more aggressive conditions. The major influence on the test results apparently was the oxide layer on the cladding specimens in the present tests. This oxide appears to be effective in blocking the migration of zinc vapor to the Zircaloy-4 metal substrate. Because an oxide layer is always formed on fuel rod cladding from in-reactor service, the cladding would be protected as long as the oxide layer remains intact and adherent to the Zircaloy metal.

The present work only considered a heat load and cask temperature for VSC-24 casks currently in service. If future casks may be loaded with fuel providing a higher heat load, then the cask temperature will be increased. Thus, future work might be to reproduce the present tests at the maximum allowable heat load and temperature for the VSC-24 cask. Also, some tests may be conducted on Zircaloy-4 cladding without the protective oxide, to simulate fuel that could have exposed bare metal due to spallation or severe cracking of the oxide.

If you have any questions, feel free to call me (415-0190) or Douglas Kalinousky (415-6788).

Attachment: Final Draft NUREG/CR-6732

cc: Mike Mayfield, RES
Charles Interrante, NMSS

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