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U.S. Nuclear Regulatory Commission
ATTN: Mrs. Deborah A. DeMarco
Office of Nuclear Material Safety and Safeguards
Program Management, Policy Development, and Staff
Office of the Director
Mail Stop 8D-37
Washington, DC 20555

Subject: Programmatic Review of an Abstract

Dear Ms. DeMarco:

The enclosed abstract is being submitted for programmatic review. The title of the abstract is "Long Term Passive Behavior of Alloy 22" by O. Pensado, D. Dunn, S. Brossia, and G. Cragnolino. This abstract will be submitted for presentation at the Spring Materials Research Society meeting to be held February 25–March 1, 2001. Please advise me of the results of your programmatic review, so that we can submit the abstract in a timely manner.

Sincerely,

Budhi Sagar, Ph.D.
Technical Director

BS/cw

cc: J. Linehan, B. Meehan, J. Greeves, W. Reamer, T. Essig, J. Schleuter, W. Wastler, K. Stablein, J. Firth, D. Brooks, T. Ahn, C. Greene, W. Patrick, N. Sridhar, P. Maldonado, T. Nagy, (SwRI Contracts), O. Pensado, D. Dunn, S. Brossia, G. Cragnolino

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LONG TERM PASSIVE BEHAVIOR OF ALLOY 22

Osvaldo Pensado, Darrell Dunn, Sean Brossia, and Gustavo Cragnolino
Center for Nuclear Waste Regulatory Analyses, San Antonio TX, USA

The hypotheses of uniform and stoichiometric dissolution used to predict the lifetime of proposed high-level waste disposal containers made of Ni-Cr-Mo alloys, in the absence of environmental and electrochemical conditions leading to localized corrosion and stress corrosion cracking, are evaluated based on the point defect model for passive dissolution. The model indicates that the predominant charge conduction mechanism through the oxide film formed on Ni-Cr-Mo alloys (mainly composed of chromium oxide for alloys with Cr content greater than 12 weight percent) is interstitial transport of metal cations. Injection of interstitials into the film is accompanied by the creation of vacancies in the alloy. Possible consequences of this vacancy creation on the container lifetime are discussed. Of particular importance is the possibility for these vacancies to accumulate at the metal/film interface leading to film detachment and possible film spalling. A heuristic model for film spalling is proposed to estimate container lifetimes. According to the dissolution model and because of the low vacancy diffusivities in the metal substrate away from the passive film at near room temperatures, long-term dissolution is necessarily stoichiometric. Analyses of solution chemical composition using capillary electrophoresis are reported to evaluate the degree of congruency in the passive dissolution of alloy 22 (Ni-22Cr-13Mo-3W-5Fe). This study demonstrates that extrapolation of short-term behavior (of the order of days, months, years) to long-term performance (thousands of years) must be supported by mechanistic understanding of the dissolution phenomena.

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