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A Division of Southwest Research Institute™
6220 Culebra Road • San Antonio, Texas, U.S.A. 78228-5166
(210) 522-5160 • Fax (210) 522-5155

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U.S. Nuclear Regulatory Commission
ATTN: Mrs. Deborah A. DeMarco
Two White Flint North
11545 Rockville Pike
Mail Stop T8 A23
Washington, DC 20555

Subject: Programmatic review of the abstract titled "Life Prediction of Container Materials for High-Level Nuclear Waste Repository" for the First Asian and Oceanic Congress for Radiation Protection Conference

Dear Mrs. DeMarco:

Attached is the subject abstract for the invited talk which will be presented at the First Asian and Oceanic Congress for Radiation Protection to be held on October 20–24, 2002 in Seoul, Korea. The paper summarizes the work conducted at the CNWRA on waste package container materials.

Please advice me of the results of your programmatic review. Your cooperation in this matter is appreciated. Please contact Narasi Sridhar at (210) 522-5538 if you have any questions regarding this abstract.

Sincerely yours,

Budhi Sagar
Technical Director

BS:NS:jg

cc:

J. Linehan	J. Piccone	T. McCartin	T. Essig	G. Cragnolino	R. Pabalan
D. DeMarco	K. Stablein	T. Ahn	A. Henry	D. Dunn	O. Pensado
B. Meehan	B. Leslie	W. Reamer	W. Patrick	S. Brossia	P. Maldonado
E. Whitt	S. Wastler	J. Andersen	CNWRA Dirs.	Y.-M. Pan	T. Nagy (contracts)
J. Greeves	D. Brooks	J. Thomas	CNWRA EMs	L. Yang	

Life Prediction of Container Materials for High-Level Nuclear Waste Repository

G.A. Cragnolino, D.S. Dunn, C.S. Brossia, Y.M. Pan, L.T. Yang, R.T. Pabalan, O. Pensado, V. Jain, and N. Sridhar,
Center for Nuclear Waste Regulatory Analyses, Southwest Research Institute
San Antonio, TX, USA

T.M. Ahn
Nuclear Regulatory Commission, Rockville, MD, USA

ABSTRACT

The life of radioactive waste containers is an important factor in the long-term performance of geologic repositories. The container life is in turn affected by the quantity of water, composition of the water contacting it, container surface temperature, mechanical forces from rockfall, residual stresses from fabrication, and the container material. This paper focuses on the methodology developed to predict the corrosion performance of high-level waste container materials in the U.S. repository program.

For repository conditions in a hydrologically saturated horizon that are expected to be reducing, container materials, such as copper that can provide thermodynamic immunity have been considered. However, the overall redox condition of the hydrologically unsaturated environment at the proposed U.S. repository at Yucca Mountain, Nevada is anticipated to be oxidizing. The U.S. Department of Energy has chosen alloys that may provide long life through their slow kinetics of corrosion. Low corrosion rates of these alloys result from the presence of a protective oxide film, called passive film. However, under some conditions, the passive film can be breached locally and the ensuing extremely high corrosion rates or stress corrosion cracking can lead to premature release of radionuclides.

The paper presents the use of repassivation and corrosion potentials in determining the conditions for the onset of localized corrosion. It has been shown using short (days to months) and medium-term (months to a few years) experiments that if the corrosion potential is higher than the repassivation potential for crevice corrosion, localized corrosion initiates. Otherwise, the metal corrodes in a slow, uniform manner through a passive film. It is also shown that stress corrosion cracking does not occur below the repassivation potential. The repassivation and corrosion potentials are shown to be functions of solution composition, temperature, and microstructure. The passive dissolution rate is measured as a function of environmental conditions. Mechanistic modeling of passive dissolution is discussed to increase the confidence in measured parameters in abstracted models used for life prediction. Multiple lines of evidence are important in increasing the confidence of predicted container life. The use of natural, archeological, and industrial analogs in increasing the confidence of conceptual models for corrosion is discussed.

The composition of the environment contacting the container is determined by initial water composition, evaporation, rewetting, and radiolysis. The time or relative humidity at which condensation of water occurs depends on the dissolved salt concentration. The paper reports

recent work related to the measurement of deliquescence point as a function of salt concentration and salt composition.