Abstract for submission to the subject category on the Engineered Systems at the 13th International High-Level Radioactive Waste Management Conference (IHLRWMC): Albuquerque, New Mexico, USA, April 10–14, 2011

Model Abstraction of Stainless Steel Waste Package Degradation

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Abstract

The U.S. Nuclear Regulatory Commission (NRC) and its contractor Center for Nuclear Waste Regulatory Analyses staff have been developing a beta (preliminary) version of the performance assessment model *Scoping of Options and Analyzing Risk*. This model is intended to provide risk and performance insights for a variety of potential high-level radioactive waste geological disposal concepts. The model includes a representation of the engineered barrier system, which includes submodels for the waste form, waste package, and engineered backfill material. The Waste Package model component specifically accounts for chemical degradation (i.e., corrosion) of waste package materials, such as copper, stainless steel, carbon steel, and titanium materials, in limited environmental conditions. This paper describes how the general and localized corrosion processes of stainless steel were abstracted and conceptualized to estimate waste package failure times and the extent of damage to the waste package surface for disposal systems located in either oxidizing or reducing host rock.

General corrosion is assumed to be a relatively slow and uniform process resulting in waste package thinning. The stainless steel waste package failure time due to general corrosion is calculated as the time at which the corrosion front penetrates the material thickness dependent on the general corrosion rate. Localized corrosion, on the other hand, is modeled as a relatively fast degradation process compared to general corrosion, leading to waste package failure at different times depending on whether the geologic disposal system is located in reducing or oxidizing host rock.

A simplified description for the extent of damage to the waste package surface (breached area) was adopted in the model. Radionuclide releases away from the waste packages are a function of the dimension of this breached area. Localized corrosion is assumed to affect a smaller fraction of the waste package surface area than general corrosion. Damage due to general corrosion is assumed not to significantly restrict releases away from the waste package.

The simplified model abstractions and associated parameter inputs are built upon the knowledge and experience gained from domestic and international performance assessments for a variety of geologic disposal options. The performance assessment model is flexible and can be modified to incorporate other waste package materials. The insights gained from this scoping analysis may help the staff identify needs for future research and development activities on specific waste package materials.

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