13th International High-level Radioactive Waste Management Conference (IHLRWMC):
Albuquerque, New Mexico, USA, April 10–14, 2011

Modeling Disruptive Events Using the β-SOAR Model: Levels of β-SOAR Model Flexibility in Applications and Initial Insights

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Abstract

The US Nuclear Regulatory Commission (NRC) recently developed a simplified generic analytic model for providing insights into the development of a more efficient and effective regulatory program in response to changes in the U.S. policy for disposal of high-level radioactive waste. The model is named β-SOAR (beta Scoping of Options and Analyzing Risk). The β-SOAR model considers two performance metrics, human dose risk and integrated environmental releases. In the initial development phase, β-SOAR is limited to simulations of generic repository systems without disruptive events such as seismicity. However, flexibility is built into the model such that users may modify either model parameters or model elements to mimic scenarios of disruptive events. The objective of this paper is three fold - identify limitations to this flexibility in simulating disruptive events, determine future model development requirements for these events, and derive preliminary insights on (1) impacts of source release modes on performance and (2) necessary and optimal disruptive events process abstractions.

Seismic events may result in limited or extensive damages to waste packages, depending on the magnitudes of the events, environmental conditions and the integrity of the waste packages as impacted by corrosion processes. In these events, the engineered buffer is assumed to decay with time, possibly correlating with the accumulative impacts of seismic events. The frequency and magnitude of seismic events are modeled by a Poisson process, with the resulting peak ground velocity correlated to the number and size of stress corrosion cracking.

Experiments with the β-SOAR model indicated that large but rare seismic events that result in geologic disposal system-wide waste package damages can be modeled in a straightforward manner. For seismic events of lesser magnitudes, model component modifications are required to implement the Poisson process and to correlate seismic event magnitudes and times with waste package and backfill material degradations. Further results about release mode impacts and future model development requirements will be discussed in the paper.

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