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

β-SOAR: A Flexible Tool for Analyzing Disposal of Nuclear Waste

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Abstract

In an effort to create a more efficient regulatory structure for the back-end of the nuclear fuel cycle, the U.S. Nuclear Regulatory Commission developed a Plan for Integrating Spent Nuclear Fuel Regulatory Activities. One specific task outlined in the plan is the development of a simplified performance assessment model to provide risk and performance insights on a range of nuclear waste geological disposal options. The model, beta-Scoping of Options and Analyzing Risk (β-SOAR), is being developed in a modular fashion to allow for future enhancement and refinement.

The β-SOAR incorporates simplified representations of components common to performance assessments of geologic disposal systems: the waste form, the waste package, the near field, the far field and the biosphere. The waste forms considered in the model are spent nuclear fuel, high-level waste glass from reprocessed spent nuclear fuel, and spent mixed-oxide fuel. The waste package materials accounted for are copper, stainless steel, carbon steel and titanium. The near field component is a model for radionuclide transport through the waste package internals, any surrounding backfill, and the disturbed zone within the geologic host formation. The far field component incorporates representations of geologic media such as sediments and crystalline rock to represent ranges in transport behavior such as transport through a rock porous matrix or transport through sparsely fractured rock. The far field model incorporates three segments, each of which is independently selectable to represent either sediments or crystalline rock under oxidizing or reducing conditions. System performance is measured as dose to a receptor via drinking water or radionuclide release rates.

The β-SOAR incorporates three distinct levels of flexibility, identified by the relative level of modeling expertise required. A basic level (one) was designed to allow a novice user to run the model under a control panel or “dashboard”, Undel level one, the user can only modify a selected field of inputs. In the intermediate level (two), the user can explore the effect of alternative values of existing input parameters on the system performance. By creating additional datasets, users can study alternative systems including different waste forms, engineered materials, and geologic media. An expert level (three) allows for the modification or addition of model components to the β-SOAR model structure.

To highlight the flexibility of the β-SOAR, two simulations are presented. It is assumed that the conditions in the near and far field environments are reducing in the first simulation, and oxidizing in the second simulation.. The results are discussed and interpreted based on the

understanding of the effect of the redox state of the groundwater on material degradation and radionuclide transport.

The NRC staff views expressed herein are preliminary and do not constitute any final judgment or determination of the matters addressed or of the acceptability of any licensing action that may be under consideration at the NRC. The abstract is an independent product of the CNWRA and does not necessarily reflect the view or regulatory position of the US NRC.

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