SUMMARY OF ACTIVITIES CONDUCTED UNDER TASK 1 (JOB CODE J5662)—DEVELOPMENT OF SCOPING OF OPTIONS AND ANALYZING RISK MODEL AND USER GUIDE: FISCAL YEAR 2011

Activities under Task 1 of the Integrated Spent Nuclear Fuel Regulatory Activities program were intended to revise the Scoping of Options and Analyzing Risk (SOAR) beta model and release Version 1.0 (Markley, et al., 2011), implement verification tests, update SOAR documents, and exercise SOAR by performing risk insights analyses. Later in the fiscal year, activities on systems-level analyses were carried out under Task 1 and seminars were developed to familiarize staff with international perspectives on scenario analysis and performance assessment. A summary of the activities is provided.

The SOAR model is intended as a flexible tool for the analysis of geological repository concepts. It was designed for simple execution via point and click and filling-field interfaces using the GoldSim® (GoldSim, 2011) software. A database of input parameters based on information in the literature (e.g., waste form dissolution rates, chemical phase solubilities, partition or sorption coefficients, diffusivities, corrosion rates) accompanies SOAR; however, changes are allowed to the input parameters and input distribution functions. SOAR was designed in a modular manner to allow replacement of model components when needed. The U.S. Nuclear Regulatory Commission (NRC) staff implemented a unique approach using Microsoft® SharePoint® (Microsoft Corporation, 2007a) for configuration control to document input parameters. Microsoft Excel® (Microsoft Corporation, 2003) files controlled in SharePoint are used to build a Microsoft Access® (Microsoft Corporation, 2007b) database from which SOAR can read input parameters and distribution functions. A "beta" or draft version of SOAR was completed in fiscal year 2010. Work in fiscal year 2011 focused on removing the beta designation of the model, by updating selected models, implementing verification tests, and revising SOAR documents. Early in the year NRC and Center for Nuclear Waste Regulatory Analyses (CNWRA®) staffs updated the waste form and disruptive events model components of SOAR to (i) account for an enhanced inventory abstraction and heterogeneity in the waste forms and (ii) add flexibility to account for processes and events that could cause waste package failure. When model updating was completed, the staff carried out tests of SOAR functionality and applied further corrections to address issues identified during testing. A verification report documenting 53 formal tests was included in an early version of the user guide, in the form of an appendix. Draft summary reports for each test and associated GoldSim model files are available on the shared drive. Because the appendix resulted too extensive to include in the user guide, the NRC and CNWRA staffs jointly decided to issue the appendix as a separate document. After completion of the formal testing and revision of the model to address identified issues, SOAR Version 1.0 was internally released. A total of six presentations and associated proceedings papers for the 2011 International High-Level Radioactive Waste Management Conference arose from SOAR work. The papers covered SOAR model abstractions and analyses used for SOAR development.

The NRC and CNWRA staffs developed a methodology for rapidly generating key insights into the disposal of radioactive waste in various geologic systems. This methodology was developed to ensure that NRC and CNWRA staffs are better prepared to evaluate potential future national policies for management of spent nuclear fuel and high-level radioactive waste. The methodology comprises four phases: (i) defining a scenario for analysis, (ii) identifying preliminary insights and test plans, (iii) conducting technical analyses to confirm or refute the preliminary insights, and (iv) documenting the results of the technical analyses. Using a combination of SOAR modeling, independent calculations, and literature reviews, staffs

conducted six initial technical analyses evaluating waste disposal scenarios, waste forms, inventories, and performance of engineered and natural barrier alternatives. The risk insights methodology and results of the initial technical analyses were detailed in a SharePoint file produced in close collaboration with NRC staff. SOAR model benchmarking was initiated later in the year, aimed at qualitatively comparing results generated from SOAR to other performance assessments available in the literature. This benchmark work is ongoing.

The SOAR Version 1.0 User Guide was completed during this fiscal year, also as a joint product of NRC and CNWRA staffs. Together with this document, the Frequently Asked Questions document was revised to remove beta references and update the descriptions consistent with revised models. As previously stated, the draft user guide included a verification report that will be issued as a separate document. The draft user guide also included an appendix with a library of results showing variations from changing one parameter at a time. Ongoing discussions will determine whether to move this results library appendix to the stand-alone verification document. All SOAR activities benefitted from extensive, in-depth collaboration between the NRC and CNWRA staffs, resulting in a product that is expected to meet NRC needs as the agency faces potential changes in the regulatory environment for the back end of the fuel cycle.

CNWRA established a subcontract with Galson Sciences Ltd. (United Kingdom) to provide a 2-day seminar on performance assessment and scenario analysis in high-level waste disposal programs outside the United States. The seminar, held at the CNWRA Rockville office, was useful in familiarizing the NRC and CNWRA staffs with the differences in performance assessment approaches and methods in other countries. Incorporation of international perspectives was deemed important as staffs prepare to respond to the evolving policy on radioactive waste disposal.

Late in the year, the CNWRA staff began developing approaches to analyzing risks associated with the back end of the fuel cycle from a broader, systems-level perspective. These analyses are intended to integrate and evaluate, from a risk perspective, scenarios of interim storage, long-term storage, reprocessing, transportation, and ultimate disposal. These efforts were initially not well integrated with parallel efforts by the NRC staff. By the end of the year, the staffs had improved communication and developed a unified approach to this work. Work is ongoing to define simplified approaches to define integrated worker and public risks, as well as other integral metrics to support decisions on multiple factors on the back end of the fuel cycle.

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