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2003 Initial Assessments of Closure for the C Tank Farm: Numerical Simulations

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July 2003

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Summary

In support of CH2M HILL Hanford Group, Inc.'s (CHG) preparation of a Field Investigative Report (FIR) for the closure of the Hanford Site Single-Shell Tank (SST) Waste Management Area (WMA) tank farms, a set of numerical simulations of flow and solute transport was executed to investigate different potential contaminant source scenarios that may pose long-term risks to groundwater from the closure of the C Tank Farm. This report documents the simulation of 14 cases (plus two verification and five sensitivity cases) involving two-dimensional cross sections through the C Tank Farm (Tanks C-103–C-112). Using a unit release scenario at Tank C-112, four different types of leaks were simulated. These simulations assessed the effect of past leaks and leaks during retrieval as well as residual wastes and ancillary equipment after closure. Two transported solutes were considered: uranium-238 (U-238) and technetium-99 (Tc-99). To evaluate the effect of sorption on contaminant transport, six different sorption coefficients were simulated for U-238. Overall, simulations results for the C Tank Farm showed that only a small fraction (<1.2%) of the U-238 with sorption coefficients greater than 0.6 mL/g migrated from the vadose zone in all of the cases. For the conservative solute, Tc-99, results showed that the simulations investigating leaks during retrieval demonstrated the highest peak concentrations and the earliest arrival times due to the high infiltration rate before water was added and surface barriers installed. Simulations investigating past leaks showed peaks and arrival times similar to the retrieval cases. Several different release rates were used to investigate contaminant transport from residual tank wastes. All showed similar peak concentrations and arrival times, except for the lowest initial release rate, which was 1,000 times slower than the highest release rate. Past leaks were also investigated with different release rate models, including advection-dominated, diffusion-dominated, and saltcake release models. Of the three models, peak concentrations were lowest and arrival times later for the saltcake model due to the low solubility (and hence lower release rate) of the residual tank waste solids. For the tank ancillary equipment leak case, the diffusion-dominated release rate model yielded peak concentrations and late arrival times that were similar to the majority of the past leak cases for residual tank wastes. For all source types, the peak concentrations and arrival times were sensitive to the estimated saturated hydraulic conductivity of the unconfined aquifer. When the saturated hydraulic conductivity was increased by a factor of 10, peak concentrations at the first compliance point, the fence line boundary, were decreased by approximately the same magnitude. Peak arrival times also occurred earlier with the higher estimate of hydraulic conductivity.

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