Vadose Zone Impact Assessment for the 241-S-SX Tank Farms, Conceptual Models and Approach

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Richland, Washington

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**Page 2 of 2**
Preliminary Results of Modeling Vadose Zone Flow at the 241-S-SX Tank Farms, Hanford Site

ABSTRACT
The U.S. Department of Energy (DOE) has initiated a Resource Conservation and Recovery Act (RCRA) Corrective Action project to address the impacts of past and potential future tank waste releases to the vadose zone at the 241-S-SX single-shell tank farms at the Hanford Site in southeastern Washington. The corrective actions include evaluation of impacts to groundwater resources (i.e., the concentration of contaminants in groundwater) and long-term risk to human health (associated with groundwater use). Numerical models have been developed that consider the extent of contamination presently within the vadose zone, contaminant movement through the vadose zone to groundwater, and contaminant movement in the groundwater to points of compliance. Results are included on analysis of laboratory measurements for physical and hydraulic properties for soil samples in the vicinity of the 241-S and 241-SX tank farms, and testing of small-scale measurements for soil properties characteristics. The two-dimensional model considers the accelerated movement of water around and beneath single-shell tanks that is attributed to bare, gravel surfaces and those enhancing net infiltration of meteoric water (from water precipitation and snowmelt). Water infiltration, possibility exceeding 100 mmyr⁻¹, is further enhanced in the tank farm because of the umbrella effect (i.e., the effect of percolating water being diverted by an impermeable, sloping surface), created by large, 24-m-diameter, buried tank domes. The enhanced recharge can potentially mobilize tank leak water and result in an earlier arrival of contaminants in the water table. Preliminary modeling results are presented.

COMPUTER CODES USED
The computer code used is STOMP (Subsurface Transport Over Multiple Phases), developed by Pacific Northwest National Laboratory. The simulator is specifically designed to provide scientists and engineers from varied disciplines with multidimensional analysis capabilities for modeling subsurface flow and transport phenomena.

Macroscopic Anisotropy Relationships: Polman (1990)

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Composite van Genuchten-Mualem Parameters for various strata at the S-SX Tank Farms

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Calculated macroscopic anisotropy for different strata

- Enhanced Water Movement Around the Tank Domes
- No Barriers: Distribution of Fluxes at the Water Table
- Surface Barriers: Distribution of Fluxes at the Water Table
- Saturation Distribution Due to Water Line Leak (25,000 Gallons over 5 days)

SUMMARY
- A suite of two-dimensional simulations were used to investigate the impact of surface barriers and groundwater issues.
- The simulations consider the accelerated movement of water around the tank domes and the saturation-dependent anisotropy for the heterogeneous media.
- The surface barriers, as expected, reduce magnitude of fluxes to the water table.
- The water line leak (25,000 gallons over 5 days) was sufficient to saturate the soil near the tanks, but the saturated plumes diffused readily at 0 ppm through the vadose zone, having negligible impact below the Plio-Pleistocene layer.

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