Research Insights for Modeling, Monitoring and Remediating Radionuclide Transport in Ground Water

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The Office of Nuclear Regulatory Research (RES) is sponsoring research that couples monitoring, modeling and remediation of radionuclide transport in ground water. Insights and information from this research program may be used by both the NRC staff and licensees for their ground-water investigations. The RES objective is to develop the technical bases for evaluating exposures and uptakes to receptors related to the ground-water pathway. If the exposures are estimated to be significant, the research also focuses on evaluating the efficacy of remediation technologies. An important accomplishment is the development and issuance of guidelines for an integrated ground-water monitoring strategy as documented in NUREG/CR-6948. The strategy focuses on the development and testing of conceptual site models. These models are coupled to site-specific analytical models and ground-water monitoring strategies using performance indicators. These performance indicators are selected to be both simulated model outcomes and corresponding monitored conditions. Development of the site-specific model balances the need for realistic representation of site-specific features, events and processes with model abstraction techniques to identify significant processes and conditions affecting radionuclide transport. In particular, the need is to understand and model the interface between engineered systems, which may be subject to abnormal releases, and potential anthropogenic pathways to transport radionuclides to the natural ground-water flow system. The ground-water monitoring strategy should be designed to confirm the site conceptual model which includes the engineered, anthropogenic and natural system interfaces, and to detect contaminant releases. The analytical model integrates site and contaminant source characterization and monitoring data at various scales into a logical framework. These models need to use site-specific parameters such as hydraulic conductivity, ground-water gradients and retardation factors to estimate contaminant fluxes for forecasting doses due to exposure and uptake to receptors. They are also used to predict the efficacy of remediation technologies. Refining these models using ground-water monitoring data will enhance confidence in these forecasts and reduce uncertainties. Most importantly, the site-specific ground-water model communicates understanding of the system to the public, and facilitates technical interactions by the regulator, licensee and stakeholders.