Cold War's nuclear wastes pose challenges to science, engineering, society

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Seven papers published in the current issue of *Technology and Innovation*, Proceedings of the National Academy of Inventors report on efforts by the U.S. Department of Energy (DOE) to ensure continued safe and secure storage and disposition of 50 years worth of spent nuclear fuel, surplus nuclear materials, and high-level wastes at DOE facilities.

"Technology, innovation, development and deployment are key elements in the DOE cleanup effort," said Yvette T. Collazo, Paula G. Kirk and A. Alan Moghissi of the DOE's Office of Environmental Management and authors of a lead-in editorial outlining the issues addressed by papers – issues that range from how to prioritize projects to the nuts and bolts of advanced mediation efforts. "The DOE has implemented a new approach and business model to incorporate innovative strategies that build on scientific advancements to reduce the legacy footprint."

During 50-plus years of nuclear weapons production and government-sponsored nuclear energy research and production that generated contaminated soil and groundwater covering two million acres in 35 states, the U.S. government did not have environmental structures, technologies or infrastructure to deal with the legacy.

"Many of the excess facilities awaiting deactivation and decommissioning are one-of-a-kind or unique to the DOE, with unprecedented scope and complexity," said the authors. "In many cases, the necessary technologies are not yet developed or, if developed, they

require significant re-engineering to fit DOE needs."

However, as outlined and evaluated by papers published in the current issue of *Technology & Innovation*, recent DOE efforts have both offered and analyzed remediation technology projects; technical reviews for evaluating system-level modeling and simulation; remedies for subsurface contamination; engineering systems for predicting the fate and transport of wastes; and communication models for the technical communities. The new models also include designs for collaboration between regulators, stakeholders, field offices, contractors, scientists, and technology developers.

For example, a critical review of technology and safe practices in spent nuclear fuel transport and storage found that mid-term storage (up to several decades) is feasible, yet long-term storage (up to 100 years) needs strengthened technology and management practices (Gary R. Peterson, DOE, Office of Environmental Management).

Another paper analyzes the success of polyphosphate remediation for uranium sequestering in areas where uranium groundwater contamination exceeds EPA limits (Dawn W. Wellman, Pacific Northwest National Lab, et al.). An External Technical Review team analyzed software and simulation modeling tools to support the planning for life-cycle liquid waste disposition and found that new tools are needed (John R. Shultz, DOE, Office of Waste Processing, et al.).

A fourth paper describes the development of a state-of-the-art tool and approach for predicting subsurface flow and contaminant transport behavior in complex geological systems (Mark K. Williams, DOE, Office of Environmental Management, et al.). And the DOE's Office of Environmental Management, responsible for the cleanup of the nation's nuclear weapons programs' wastes, created the Advanced Remediation Technologies (ART) projects that access private sector expertise for

developing radioactive waste disposition technologies (Gary R. Peterson, DOE, Office of Environmental Management).

The Cementitious Barriers Partnership collaborated with the Department of Energy to devise simulation tools to estimate and improve the performance of cement barriers in nuclear applications (Daryl R. Haefer, DOE, Office of Environmental Management and Sharon L. Marra, Savannah River National Laboratory). Finally, Process Knowledge (PK) is a key resource for the DOE Office of Environmental Management's efforts to deactivate and decommission facilities for disposition. This article explains how the elements of the PK body of knowledge were developed (Paula G. Kirk, DOE, Office of Environmental Management, et al.).

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