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# Long-Term Institutional Management of U.S. Department of Energy Legacy Waste Sites

Committee on the Remediation of Buried and Tank Wastes

Board on Radioactive Waste Management  
Commission on Geosciences, Environment, and Resources

National Research Council

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**Cover Image:** The U.S. Department of Energy is engaged in an effort of national importance to address the legacy of environmental contamination resulting from its Cold War defense mission. Many U.S. defense complex sites are highly contaminated with radionuclides and hazardous chemicals and cannot be cleaned up with current technologies (top image). These sites must be managed to isolate and contain the waste (fence image in center), in some cases in perpetuity (hourglass image). These contaminated sites will require long-term institutional management to protect the land and the people who live "outside the fence" (bottom image). The bottom image also embodies the hope that in at least some instances the principles of long-term institutional management, diligently applied, make the need for the fence eventually to go away, as sites that are contaminated today are cleaned up in the future with new technologies.

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This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Research Council (NRC) Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making the published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their participation in the review of this report:

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## Preface

The Committee on Remediation of Buried and Tank Wastes was asked by the U.S. Department of Energy (DOE) to:

... assess approaches for developing criteria for transition from active to passive remediation and subsequent long-term disposition, including institutional control with monitoring and surveillance, of DOE waste sites and facilities such as Hanford, Washington; Savannah River, South Carolina; Idaho National Engineering Laboratory; and Oak Ridge National Laboratory, Tennessee. Such criteria will include technical feasibility, future land use, performance assessment of remediation activities, and risks to health, safety, and the environment associated with long-term site disposition. Relevant federal and state regulatory requirements and agreements will be included. Appropriate approaches will be applicable to facilities such as high-level radioactive waste tanks (including related facilities and contaminated environments), buried radioactive waste (such as the Hanford low-level waste disposal sites), and on environments contaminated by nuclear testing (such as the Nevada Test Site weapons test event location).

Implicit in this charge is DOE's recognition that radiological and chemical risks are likely to persist at many DOE waste sites for very long time periods, and that protecting humans and the environment from these risks is a dauntingly complex task. For society, now and in the future, this task challenges not only our scientific and technological capabilities, but also our ability to establish and maintain the institutional arrangements that are fundamental to ensuring this protection.

The committee approached its charge by developing a conceptual framework for long-term institutional management of DOE's waste sites. In its study, it concentrated on the sites identified in the DOE request but took other DOE waste sites into account as well. The conceptual framework developed by the committee focuses on three complementary elements of waste site disposition - waste reduction, waste isolation, and stewardship—using the metaphor of a "three-legged stool." The characteristics of and interrelationships among these three elements were examined in the committee's study, as were current capabilities, limitations, and other contextual

factors that must be taken into account. Following this assessment, general design criteria for long-term institutional management were identified.

The committee took this general, conceptual approach because the diversity of DOE's waste sites and their residual contaminants, together with large uncertainties about the present and future capabilities of science, technology, and stewardship measures as well as budgetary uncertainties, preclude quantifying the current and future risks posed by various sites or providing a single "recipe for success." Instead, as described in this report, long-term institutional management, broadly and systematically conceived, is essential to responsible site disposition.

In summary, at most of DOE's waste sites complete elimination of unacceptable risks to humans and the environment will not be achieved, now or in the foreseeable future. At many of DOE's sites, radiological and chemical contaminants posing potentially substantial risks are likely to remain on site and may migrate off site. Engineered measures for waste isolation, together with institutional controls and other stewardship measures, will largely be relied upon to prevent unacceptable exposure to these contaminants. The quality of management of residually contaminated waste sites, both in the present and over the longer term, will determine whether these measures are adequately protective. At most sites, no single element—waste reduction, waste isolation, or stewardship—can be relied upon. Long-term institutional management will require an integrated, systems approach that is tailored to the conditions of the site and is revisited over time, as the conditions of the site and its surrounding area change and as new technologies become available.

In closing, we should note the genesis and evolution of this committee. The Committee on Remediation of Buried and Tank Wastes was formed in 1992. Its work has resulted in numerous reports addressing problems of site remediation in the DOE complex (the Idaho National Engineering and Environmental Laboratory aquifer pumping and infiltration test, use of systems analysis and systems engineering at the Hanford Site in Washington, isolation barriers, the Niagara Falls Storage Site, technical management at DOE, and tank waste remediation at Hanford), culminating in the present examination of the long-term disposition of DOE waste sites. This report is in many ways a direct descendant of those earlier studies, and the present committee members owe a debt of gratitude to those earlier members who, though not part of the group that prepared this report, were instrumental in helping to shape the thinking that we brought to bear.

We are indebted to Tom Burke, Bob Catlin, Tom Cotton, Rod Ewing, Glenn Paulson, and, especially, to Paul Witherspoon, whose wit and wisdom have continued to echo through the committee's deliberations. We owe a special debt of thanks to Bob Budnitz, the committee's first chair, whose ceaseless admonitions to "think outside the box" we hope we have honored. The committee also extends its warmest thanks to John Lehr, our DOE liaison, who proved to be a man of infinite forbearance, and to DOE's consultant to the committee, Julie D'Ambrosia, whose insightfulness and ability to sweep aside confusion continue to amaze. All of these people have been of tremendous assistance, but none of them bear responsibility for this report. Finally, we want to acknowledge the essential role that the NRC staff plays in bringing reports like this one to completion. Although they are "just doing their jobs," as Senior Staff Officer Bob Andrews constantly reminded us, Bob and Senior Project Assistant Laura Llanos are especially to be commended for their help and encouragement. We are especially indebted to Bob, who, over the years of the committee's life, became a true friend to all of us.

Thomas M. Leschine, *Chair*

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Committee on Remediation of Buried and Tank Wastes

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