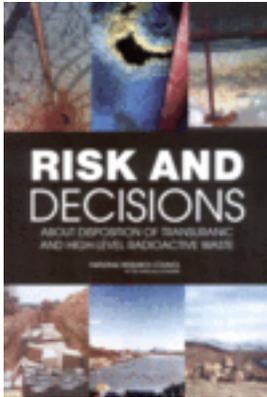


Free Executive Summary



Risk and Decisions About Disposition of Transuranic and High-Level Radioactive Waste

National Research Council

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Executive Summary

Risk and Decisions About Disposition of Transuranic and High-Level Radioactive Waste
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The U.S. Department of Energy's (DOE's) Office of Environmental Management asked the National Academies to recommend how DOE might implement risk-based approaches for disposition of transuranic (TRU) and high-level radioactive waste (HLW). This entails recommending technically sound approaches for using risk assessment in selecting disposition paths, including alternatives to deep geologic disposal, for TRU and HLW. DOE asked that the study explicitly address the following:

- key elements of a risk-based approach;
- criteria for risk assessment;
- potential alternatives to geologic disposal for disposition of low-hazard waste;
- compatibility with current regulatory regimes;
- knowledge and technology gaps for implementation; and
- broader implications, if any, for disposition of other DOE wastes.

Finally, the committee was asked to examine the application of recommended approaches to some DOE waste streams to assess the practical usefulness of these approaches.

In fulfilling its charge, the committee had to consider first whether a risk-based approach is appropriate and desirable in disposing of TRU and HLW. The nation has a system for classification of radioactive waste and

existing or proposed disposition options for each waste class, although there are unique wastes within some waste classes that do not yet have a disposition option. Cleanup and waste disposal programs across the country remain controversial and involve substantial uncertainty, and the DOE program is no exception—with additional complications related to the unique HLW and TRU wastes for which the path forward is unclear.

The critical questions for these wastes are the following:

1. Should the nation consider pursuing alternatives to deep geologic disposal for some waste currently classified as TRU or HLW? If the answer is yes, then other questions must follow:
2. What are legitimate and appropriate bases and processes for determining that alternative disposition should be used for a specific waste stream?
3. How should such processes be implemented?

The committee has framed the report around these questions and addressed the elements of the statement of task throughout the report. Chapter 1 discusses the statement of task and how the committee fulfilled that task. It also provides an overview of the current situation, including general descriptions of the wastes, definitions of the waste classes, and the history of the planned disposition for each class of waste. Chapter 2 discusses the need for flexibility in disposal options under the current regulatory regime and describes the candidate waste streams suggested by the committee. Chapter 3 argues that the nation should continue to treat deep geologic disposal as the presumptive disposition method but should adopt a formal, well-structured process for deciding on disposal paths for special cases of HLW and TRU waste streams. Chapter 4 describes key elements and attributes of a risk-informed approach to decision making, including procedures and criteria for risk assessment. Chapter 5 identifies and examines technical and institutional impediments to implementation of a risk-informed approach. Chapter 6 summarizes the findings and recommendations from the study. Appendix A gives a historical account of prior studies on risk and risk assessment. Appendix B summarizes previous risk studies carried out for or by DOE for its environmental management program.

MAJOR FINDINGS AND RECOMMENDATIONS

Finding 1: Deep geologic disposal is the default disposition option for HLW and TRU waste.

There is a long history of studies supporting deep geologic disposal of long-lived radioactive wastes. Deep geologic disposal remains the nation's approach for disposal of TRU and HLW.

Finding 2: Some waste currently classified as TRU or HLW may not warrant disposal in a deep geologic repository, either because (1) it is infeasible to recover and dispose of every last bit of waste that might conceivably be classified as TRU or HLW, or (2) the effort, exposures, and expense associated with retrieval, immobilization, and disposition in a repository may be out of proportion with the risk reduction achieved, if any.

Recovery of every last gram of TRU and HLW will be technically impractical and unnecessary. Recovery of some of the waste that is hardest to retrieve may result in little reduction in risk compared to disposing of it in situ while substantially increasing other risks, impacts, and costs. Further, processing and treatment methods can separate highly radioactive material from some wastes, which greatly reduces their hazards. But because of the definition of HLW found in the law, this latter waste, even if it contains very low concentrations of hazardous radionuclides, could also be classified as HLW and, therefore, require deep geologic disposal. Some of these wastes, then, may not warrant deep geologic disposal.

Finding 3: The committee makes no recommendation whether specific wastes should be approved for alternative disposal, but it has identified three waste types that contain waste streams that merit consideration: (1) HLW remaining in tanks (heels); (2) low-activity products from treatment of HLW; and (3) buried TRU waste (not buried in a manner that facilitates retrieval).¹

¹ This term refers to TRU wastes generated prior to 1970 that were buried by shallow land burial before a directive was issued to segregate and retrievably store TRU wastes. DOE does not currently have plans to retrieve waste buried prior to 1970.

The nation must confront disposition decisions for each of the waste types listed. Each of these waste types spans a range of characteristics, from relatively low radioactivity and hazard to relatively high and volumes ranging from a few thousand liters to possibly billions of liters. The costs and risks of packaging and disposing of these wastes are very large. There is, then, the potential for a disproportion between the risk-reduction achieved and the costs and risks incurred for some wastes.

Finding 4: The nation needs a way to determine which of the wastes mentioned in Finding 3, if any, will be disposed in some manner other than deep geologic disposal.

Litigation over authority and agreements about waste disposition has left DOE's waste disposition program with substantial uncertainty concerning the path forward. Given the various disputes and the reality that not all of the waste will or can be recovered and disposed of in a deep geologic repository, an acceptable exemption process is needed.

Finding 5: Without a formal, well-structured, decision-making process, less desirable, ad hoc approaches will emerge.

Given the costs and difficulties of sending all waste that could be classified as HLW or TRU waste to a deep geologic repository, some approach will arise for deciding what waste gets geologic disposal and what does not. A formal, well-structured exemption process is needed regardless of the outcome of the various lawsuits and appeals concerning these wastes. The alternative to a reasoned, planned process is an ad hoc one, which could lead to inconsistent or poorly thought-out decisions that are not in the public interest.

Finding 6: Human health risk is a good basis or starting point for considering whether a waste stream should be granted an exemption, but it is not a sufficient basis for deciding these questions. At a minimum, costs, work-related risks, risks to ecosystems, technical feasibility, cultural and societal impacts, land use implications, pre-existing agreements, and other, site-specific factors are also relevant in what is called a risk-informed approach.

Risk-informed approaches are necessary to include all valuable information in an exemption process. Human health risk is an essential

consideration for exemptions because (1) risk reflects one of the basic values being protected—human health—and therefore is a sensible starting point; and (2) risk analysis is a powerful, structured, well-developed way of considering human health effects, and its strengths and weaknesses are well established. This report focuses on human health risk because it is of concern for all of the waste streams and because it has traditionally been studied in risk analysis. However, the committee does not mean to imply that other risks such as ecological or cultural are unimportant. A proper risk analysis should identify and consider all of the relevant risks at a given site. The process of performing a risk assessment is useful, too, because it draws attention to the critical assumptions and focuses thought on the most significant contributors to risks. The question of how such decisions should be reached, including the roles of these factors and ethical considerations, is critically important, but is entirely a policy question that is beyond the task statement of this technical committee.

Finding 7: The credibility of DOE's planning and decision making is reduced by the apparent conflict of interest created by DOE's authority both to propose and to approve disposition plans for radioactive waste.

The burden of proof for departing from the default disposition option must be on the petitioner seeking alternative disposition. Allocating the burden of proof to DOE is meaningful only if DOE is not also the decision maker. That is, the burden of proof would be weak indeed if it was simply a matter of DOE convincing itself that it is right. DOE's status as a self-regulating agency is problematic because of the perceived and real conflict of interest: DOE is both petitioner and decision maker. Outsiders might reasonably question whether DOE is able to separate these functions so that the agency is neutral in the latter role. Having DOE's application for exemption subject to the judgment of an independent arbiter would make the process more credible to skeptics, of which, in this area, there are many.

Therefore, the burden of proof implies, and the committee here makes it explicit, that a separate federal entity is needed as the regulatory decision maker for exemption purposes. DOE is, of course, regulated by a number of different federal and state entities. Persuasive arguments could be made for either the U.S. Environmental Protection Agency (U.S. EPA) or the U.S. Nuclear Regulatory Commission (U.S. NRC) as

regulator, because both have significant expertise in the regulation of radioactive materials. The committee does not have a basis for making a recommendation for either agency but offers some observations on the merits of each for this role.

The U.S. EPA would appear to be the most obvious regulator for TRU waste, because it is already the decision maker identified by law and has worked extensively with such waste at the WIPP facility. U.S. EPA also has been the principal regulator for cleanup at the sites at which HLW and TRU waste is found and U.S. EPA has extensive experience with stakeholder interaction under several statutes; probably more experience than U.S. NRC has. The U.S. NRC, on the other hand, is the agency mentioned in the current definition of HLW. U.S. NRC will rule on DOE's license application for a HLW repository and is the regulator for the cleanup of waste, including HLW, at DOE's West Valley site, which is perhaps the experience that is technically most similar to the management and cleanup of HLW at Hanford, Savannah River, and INEEL. Also, U.S. NRC is legally an independent agency and has some distance from the administration in power. At the same time, however, U.S. NRC is perceived by some to be a captured regulator, serving the interests of the nuclear industry. Further, coming as it does from the same parent agency (the Atomic Energy Commission), U.S. NRC is perceived by some as being too close to DOE and therefore having an institutional bias for DOE.

Finally, the committee notes that it is desirable, but not essential, for the sake of efficiency and consistent application, that the same agency be the exemption decision maker for both HLW and TRU waste.

Recommendation 1: The nation should pursue a formal, well-structured, risk-informed approach to decide which specific waste streams within the waste types enumerated in Finding 3, if any, should be disposed in some manner other than deep geologic disposal.

The adoption of a formal, well-structured, risk-based approach cannot be the work of one institution alone. DOE must take the initiative, but it is constrained by legislation, the regulation of multiple federal agencies, state regulation, and formal and informal agreements with states, American Indian nations, and other stakeholders. Each of these has a role in the adoption and implementation of such an approach. The committee has recommended that DOE's exemption applications be re-

viewed and approved or rejected by an independent regulator (or decision maker). Where it is possible and appropriate to identify a particular actor who should be responsible for a particular part of the process described herein, the committee has done so. However, in several settings, the choice of a regulator and their authority is essentially a political one, and beyond the committee's mandate.

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Recommendation 2: DOE should *not* attempt to adopt these changes unilaterally. Likewise, the exemption process that the committee recommends must be implemented in the context of DOE's existing or renegotiated compliance agreements.

Put another way, if DOE wants to renegotiate its compliance agreements, it must make a case for renegotiation that is informed by risk, sets out clear criteria for an exemption, comprehensively addresses health risks (including worker, transportation, and long-term risk), and follows a transparent process that allows and enables meaningful public input.

Recommendation 3: DOE and its regulators for HLW and TRU waste should adopt a six-step process for risk-informed decision making: (1) initiate the process, laying out viable options and potential decisions; (2) scope the information and analysis; (3) collect data and refine models; (4) prepare refined risk assessment; (5) develop additional analyses and data collection, as needed, to support decisions; and (6) finalize the decision.

Finding 8: An effective and credible risk-informed-decision-making process has several characteristics. It is (1) participatory; (2) logical; (3) consistent with current scientific knowledge and practice; (4) transparent and traceable; (5) structured with reasonable independence of the decision authority from the petitioner; (6) subjected to thorough, independent peer review; (7) technically credible, with believable results; and (8) framed to address the needs of the decision process.

A risk-informed process that fails to meet any of these eight essential characteristics would likely be ineffective. In order to be effective, a risk-informed approach must be trusted. The eight characteristics listed above are intended not only to ensure a *result* that can be trusted, but *equally importantly* to create a process that can be trusted. For example, a

technically credible risk-based approach that lacks participation or transparency would likely not be trusted and, therefore, would likely be ineffective in supporting a waste exemption process.

In summary, Findings 7 and 8 describe the key elements of a risk-informed approach as being a well-structured, participatory, and transparent process with an independent decision maker that uses current scientific knowledge and practice to address human health risk but also takes into account other impacts to reach a decision.

Finding 9: The biggest challenges to developing a meaningful risk-informed decision process, such as recommended herein, are minimizing disruption to existing laws, regulations, and agreements; creating buy-in to the approach; and enabling meaningful participation by participants who have few resources.

Disrupting existing laws, regulations, and agreements (e.g., changing the rules to allow potentially unsafe practices to proceed without due process) will tend to cause resistance and unintended consequences of an exemption process. Any meaningful decision process that involves stakeholders such as the risk-informed process recommended here will require finding ways to implement an exemption process in the least disruptive manner possible with regard to existing laws, regulations, and agreements. This process is difficult but important to maintain predictability, to create fewer unintended consequences, and to avoid destabilizing the policy equilibrium that has been reached as people have acted in reliance on the existing framework. The committee does not know how many exemptions DOE might seek or a regulator might approve. Assuming that the number will be relatively few, the committee has recommended exemptions because they can minimize disruption while preserving the desirable features of a risk-informed approach (see Section 3.2).

Recommendation 4: Congress, DOE, U.S. EPA, and U.S. NRC should take actions as necessary to enable DOE to implement effectively the risk-informed approach recommended here. Specifically, they should provide for a formal, well-structured exemption process, institute technical review of the risk analysis independent of the agency producing the analysis, give decision-making authority to an agency outside DOE, and ensure that sufficient resources are relia-

bly available for regulators, American Indian nations, and stakeholders to participate meaningfully in the process from the outset.

The committee did not develop detailed actions for each entity/agency for the steps necessary to implement this recommendation. There are many possible distributions of responsibilities; what one agency might contribute toward implementation of the recommendations depends heavily on what others would contribute. The implementation of the recommendation should be achieved jointly by the entities involved, without attempting to define in advance of inter-agency discussions what each should contribute.

Finding 10: The DOE risk assessments and decision processes examined by the committee do not exhibit all of the characteristics of an effective and credible risk-informed decision-making process, listed in Finding 8. Other bodies have made similar recommendations on how DOE should incorporate risk into environmental decision making, and DOE has made progress, but institutional factors appear to have interfered and perhaps undermined attempts to implement these approaches. This implies that changes are needed at DOE to address internal and external impediments to the risk-informed approach.

In its site visits the committee requested that DOE present its best examples of risk assessment informing waste disposition or cleanup decisions. Through DOE's presentations to the committee and the committee's review of documents, the committee examined many risk assessments and decision processes. DOE and its contractors have performed technically complex risk assessments, and in many cases have performed risk assessments as part of regulatory processes that lead to cleanup decisions with stakeholder input. Yet the cases examined by the committee do not meet the needs identified and described in this report for the following reasons. The complex analyses were not decision oriented and were not carried out in a transparent manner needed for meaningful participation by those outside DOE. The actions supporting regulatory decisions in many cases also were lacking—the steps in the processes appeared to have been performed simply to meet procedural requirements and most did not appear to have taken the kind of cooperative approach that the committee sees as essential to reach credible decisions and to foster buy-in by other relevant parties.

That the risk assessments examined by the committee do not exhibit all of the characteristics of an effective and credible risk-informed decision-making process does not imply that DOE has been derelict. These are technically difficult cleanup problems being addressed in a complex political and social environment. DOE has stabilized into safe, although temporary, conditions dangerous wastes and facilities across the complex, and in most cases has an enviable safety record in its cleanup program. Working toward effective and credible risk-informed decisions on these issues is very difficult. Further, many of the risk assessments examined by the committee were addressing smaller although significant problems, and so may not have warranted the effort recommended in this report. Also, the risk assessments were not necessarily aimed to fill the role described in this report. But on the latter point, the committee notes that numerous studies summarized in Appendixes A and B make recommendations consistent with those made in this report on how to incorporate risk into environmental decision making. DOE has made progress, but these approaches still have not permeated DOE's decision-making apparatus. It appears that institutional factors both inside and outside DOE have impeded attempts to implement risk-informed approaches. These factors include a tradition of internal rather than open decision making, incentive structures that favor distorting or ignoring risk, and a public wariness or mistrust of DOE's use of risk assessment to justify proposed actions.

The committee's role is to help DOE to bring the best practices to bear on the challenges DOE is addressing on the nation's behalf. DOE's difficulty in adopting risk-based or risk-informed approaches recommended previously by other committees and observers implies that DOE needs to make changes and perhaps changes are needed more broadly in the nation's approach toward managing risks at DOE sites.

Recommendation 5: To address the challenges of implementation and acceptance, DOE should form an authoritative, credible, and reasonably independent group to revamp the way DOE goes about implementing risk-informed approaches applied to waste disposition decisions.

These are enormously complex problems with numerous parties involved and a great deal of institutional inertia (as evidenced by unsuccessful previous attempts to change). The committee sees a need to break out of old approaches, so DOE needs an action-oriented group that

provides advice and identifies alternatives, but also assists with implementation and draws in major stakeholders to get buy-in. The group must be credible, and to be credible the group must be authoritative on the issues it addresses and independent so as to be unbiased and free of conflicts of interest. Before implementing this recommendation, it would be useful to consider the extensive experience of a variety of federal agencies with outside advisory committees, including the committees' roles and effectiveness.

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RISK AND DECISIONS

ABOUT DISPOSITION OF TRANSURANIC
AND HIGH-LEVEL RADIOACTIVE WASTE

Committee on Risk-Based Approaches for Disposition of
Transuranic and High-Level Radioactive Waste

Board on Radioactive Waste Management

Division on Earth and Life Studies

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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 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 content of the review comments and draft manuscript remains 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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Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations, nor did they see the final draft of the report before its release. The review of this report was overseen by Louis Lanzerotti, Bell Laboratories, Lucent Technologies, and New Jersey Institute of Technology, Murray Hill and George Hornberger, University of Virginia, Charlottesville. Appointed by the National Research Council, they were responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the National Research Council.

Preface

Risk and Decisions About Disposition of Transuranic and High-Level Radioactive Waste
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Risk has become a pervasive concept in modern society. The public confronts it in almost every aspect of life, from recreational sports to investments to surgical procedures, and people are urged to consider risks described in qualitative or quantitative terms. In our society we are not satisfied to wait in ignorance to see how a future event comes out. In financial decisions, potential shareholders must be fully informed of the risks before investing; in medicine, patients must be informed of the health risks of a drug or medical procedure; and in protecting the environment and human health, regulators do not wait for actual harm to occur before taking protective action. In some places, owners of buildings that may be vulnerable to earthquakes must post notices of that risk at their entrances. And for thirty years, the federal government has had a requirement that the risks associated with major federal actions be assessed as part of the decision-making process. This committee's study is about the role of risk and risk assessment in decisions about federal actions that will cost tens of billions of dollars, require decades of work by possibly thousands of workers, and affect the environment for millennia.

Much work precedes this committee's efforts on the role of risk in decision making and on the disposition of long-lived radioactive waste. The committee has not, therefore, tried to reinvent what has been done so ably by its predecessors. Instead, the committee has endeavored to apply insights from prior studies to the specific situation of disposition of relatively low hazard high-level radioactive waste and transuranic waste. Readers should note that the study does not cover spent nuclear fuel, commercial high-level radioactive

waste, or DOE wastes with undetermined waste classification or disposition path (“orphaned wastes”).

Experts appointed by the National Research Council to review this report asked several interesting questions that were beyond what the committee could examine in the current report. We share these here in hopes that the ideas will not be lost. Questions were asked about the nature, time requirements, and expenses associated with the RCRA delisting process. Questions were also raised about adhering to the exemption process schedule. It may be useful to explore the effects of protracted scheduling delays on cost and human health risk as a potential drawback to seeking exemptions.

The statement of task states that the study “will examine the application of risk-based approaches to selected DOE waste streams to assess their practical usefulness.” In the report, the committee examines three waste types and endorses a risk-informed approach for addressing their disposition. The committee, however, specifically declines to make a recommendation concerning the disposition of these wastes. The risk-informed approach requires a formal, well-defined, participatory process for evaluating risks and other impacts; it would be inconsistent to recommend such a process and in the same report purport to conduct a useful risk analysis for disposition of the waste streams without following the approach. For the same reasons, the committee does not dictate how different factors should be balanced or valued.

An important component of the study was a survey of prior studies. The literature on environmental health risks and decisions is vast and summarizing all of the previous reports would have been too large a task resulting in a too-large report. The summaries in Appendix A therefore cover only the points directly relevant to disposition of transuranic and high-level radioactive waste and the summaries in Appendix B address only studies directed at helping DOE incorporate risk into its environmental management program.

There have been several political and legal developments during the course of this study. The states of Washington and Oregon and the Confederated Tribes of the Umatilla Indian Reservation and the Confederated Tribes and Bands of the Yakama Nation all filed notices of intent to sue DOE over natural resource damages at the Hanford Site. The State of Washington overwhelmingly passed a ballot initiative requiring that no additional wastes could be added to the Hanford site until waste that is already on-site has been cleaned up and stored, treated, or disposed of in compliance with all state and federal environmental laws. The committee did not examine natural resource trusteeships or natural resource damage assessments, and the report does not address the Washington ballot initiative. As the committee's report was about to enter peer review, the U.S. House of Representatives and the U.S. Senate agreed on legislation that could change the legal context for high-level waste

significantly, at least in South Carolina and Idaho. President Bush signed the act into law on October 28, 2004. In a further twist, the U.S. Court of Appeals for the Ninth Circuit reversed a lower court decision on provisions of DOE's Order 435.1 that allow for DOE to manage some waste in its HLW tanks as transuranic or low-level waste. The report now presents a few of the details of these developments, but does not explore all of the issues that led to differing opinions on the issues by the different states and courts because they are not essential to the committee's message. It is not yet clear how either of these actions will affect plans and waste disposition, but they do not change the approach recommended by the committee. Indeed, if anything, they lay the stage for DOE to use the approach recommended here to develop its plans for disposition of TRU and HLW. If DOE is able to implement this approach in a collaborative manner with the stakeholders, American Indian nations, states, and federal regulators then the nation may avoid further litigation and legislation on these issues.

The committee held public meetings in Washington, D.C., Idaho Falls, Idaho, Augusta, Georgia, and Richland, Washington. We recognize that a great deal of effort went into making these meetings possible and supporting the committee's requests for information. The committee thanks the many people at DOE headquarters and the field offices, site specialists (lab scientists and contractors), U.S. EPA headquarters and regional representatives, U.S. NRC personnel, state regulators, representatives of American Indian tribal nations, local governments, public-interest groups, and interested citizens for the time and effort they put into our study. Many of these people are listed in Appendix C as presenters at the committee's meetings. We specifically note support provided by Keith Lockie, Bill Pearson, and Mary Goldie, who served as the points of contact at INEEL, SRS, and Hanford, respectively, and coordinated excellent tours and meetings. Finally, the committee thanks the staff of the Board on Radioactive Waste Management, Micah Lowenthal, Darla Thompson, Angela Taylor, Toni Greenleaf, Marili Ulloa, and Kevin Crowley, for their assistance to the committee in completing the study.

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Committee on Risk-Based
Approaches for Disposition
of Transuranic and High-
Level Radioactive Waste

Risk and Decisions About Disposition of Transuranic and High-Level Radioactive Waste
<http://books.nap.edu/catalog/11223.html>

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