

## **“Going The Distance?” A National Academies Report on Spent Fuel and High-Level Waste Transportation**

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### **ABSTRACT**

The National Academies released the report entitled *Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States* in February 2006. This paper provides a summary of the findings and recommendations from that report.

### **INTRODUCTION**

In 2003, the National Academies initiated a study on transportation of spent nuclear fuel and high-level radioactive waste in the United States with financial support from several organizations: Department of Energy, Department of Transportation, Electric Power Research Institute, National Academy of Sciences, National Cooperative Highway Research Program, and the Nuclear Regulatory Commission. The study was carried out by a committee of sixteen eminent experts (Box 1) appointed by the president of the National Academy of Sciences.

The committee was originally charged with examining risks and identifying key technical and societal concerns for the transport of spent fuel and high-level waste in the United States. The study was later expanded to include a congressionally mandated examination of the procedures used by the Department of Energy to select land routes for the transport of research reactor spent fuel in the United States.

The committee's report, entitled *Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States* [1], was released in February 2006. The summary from that report is reprinted below with the permission of the National Academies Press. The report can be read online and purchased at <http://books.nap.edu/catalog/11538.html>. As this paper was being completed, arrangements were in progress to make the report available for free downloading from this website.

### **REPORT SUMMARY<sup>a,b</sup>**

This study was initiated by the National Academies to meet what it perceived to be a national need for an independent, objective, and authoritative analysis of spent nuclear fuel and high-level radioactive waste transportation in the United States in light of

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<sup>b</sup> This summary provides a brief overview of the findings and recommendations. A more detailed summary appears in the report chapter entitled “Summary of Findings and Recommendations.” The appendix, chapter, and sections that are referred to in this summary can be found in the report.

- The federal government's program to construct and operate a repository at Yucca Mountain, Nevada, to permanently dispose of the nation's spent fuel and high-level waste; and
- The commercial nuclear industry's program to construct and operate a facility in Utah for the temporary (interim) storage of spent fuel from some of its power reactors.

As this study was being completed, the federal government initiated another program to assess the feasibility of developing an integrated facility to receive, store, and recycle commercial spent fuel. If

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executed, these programs could involve the shipment of large quantities<sup>c</sup> of spent fuel and high-level waste over the nation's railways and roadways for periods of several decades.

The Committee on Transportation of Radioactive Waste (hereafter referred to as the committee; see Appendix A) was appointed by the National Academies to carry out this study. The original objectives of this study were to examine the risks and identify key current and future technical and societal concerns for the transport of spent nuclear fuel and high-level radioactive waste in the United States. After this study was under way, its scope was expanded to include a congressionally requested and U.S. Department of Transportation (DOT) sponsored examination of the procedures used by the U.S. Department of Energy (DOE) for selecting routes for transporting research reactor spent fuel between its facilities in the United States. This report provides background information on spent fuel and high-level waste

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<sup>c</sup> This report identifies two general types of transportation programs, *small-quantity shipping programs* and *large-quantity shipping programs*. While there is no precise quantity demarcation between these two program types, the former involve shipment on the order of tens of metric tons of spent fuel or high-level waste, while the latter involve shipment on the order of hundreds to thousands of metric tons.

transportation (Chapter 1) and the committee's findings and recommendations with respect to the original study charge (Chapters 2, 3, and 5) and the expanded study charge (Chapter 4).

This report does not examine the security<sup>d</sup> risks for spent fuel and high-level waste transportation because of an inability to access classified and otherwise restricted information. It also does not examine the viability of temporary storage or permanent disposal sites for spent fuel and high-level waste, or the risk trade-offs involved in transporting spent fuel and high-level waste to centralized interim storage or permanent disposal sites versus leaving them in place at current storage sites. The committee operated within the constraints of federal policy decisions that have set the nation on a clear path to transport spent fuel and high-level waste for permanent disposal. The intent of this study is to improve understanding of the issues associated with the transportation of spent fuel and high-level waste regardless of their ultimate destination. A brief summary of the committee's findings and recommendations is presented below. Readers are strongly encouraged to examine the full text of the findings and recommendations in the referenced sections of this report for additional details.

- The committee could identify no fundamental technical barriers to the safe<sup>e</sup> transport of spent fuel and high-level radioactive waste in the United States. However, there are a number of social and institutional challenges to the successful<sup>f</sup> initial implementation of large-quantity shipping programs that will require expeditious resolution (see Section 3.2 and Section 5.1). The challenges of sustained implementation should not be underestimated.
- Malevolent acts against spent fuel and high-level waste shipments are a major technical and societal concern, but the committee was unable to perform an in-depth examination of transportation security because of information constraints. The committee recommends that an independent examination of the security of spent fuel and high-level waste transportation be carried out prior to the commencement of large-quantity shipments to a federal repository or to interim storage (see Section 5.1).
- Transportation packages<sup>g</sup> play a crucial role in transportation safety by providing a robust barrier to the release of radiation and radioactive material. Current international standards and U.S. regulations are adequate to ensure package containment effectiveness over a wide range of transport conditions. However, recently published work suggests that there may be a very small number of extreme accident conditions involving very long duration fires that could compromise package containment effectiveness. The committee recommends that the U.S. Nuclear Regulatory Commission (USNRC) undertake additional analyses of very long duration fire scenarios that bound expected real-world accident conditions as outlined in Section 2.5. Based on the results of these investigations, the USNRC should implement operational controls and restrictions on spent fuel and high-level waste shipments as necessary to reduce the chances that such conditions might be encountered in service.

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<sup>d</sup> *Security* refers to measures taken to protect spent fuel and high-level waste against sabotage, attacks, and theft while it is in transport.

<sup>e</sup> *Safety* refers to measures taken to protect spent fuel and high-level waste during transport operations from failure, damage, human error, and other inadvertent acts.

<sup>f</sup> The committee defines *success* in terms of the program's ability, under existing statutes, regulations, agreements, and budgets, to transport spent fuel and high-level waste in a safe, secure, timely, and publicly acceptable manner.

<sup>g</sup> Containers used for the transport of spent fuel or high-level waste, whether loaded or empty.

- The committee strongly endorses the use of full-scale testing to determine how packages will perform under both regulatory and credible extraregulatory<sup>h</sup> conditions. The committee recommends that full-scale package testing continue to be used as part of integrated analytical, computer simulation, scale-model, and testing programs to validate package performance. Full-scale testing of packages to deliberately cause their destruction should not be required as part of this integrated analysis or for compliance demonstrations (Section 2.5).
- This report provides quantitative health and safety risk comparisons for both normal transport conditions and accidents (Section 3.3). The radiological health and safety risks associated with the transportation of spent fuel and high-level waste are well understood and are generally low, with the possible exception of risks from releases in extreme accidents involving very long duration, fully engulfing fires. The likelihood of such extreme accidents appears to be very small, however, and their occurrence and consequences can be reduced further through relatively simple operational controls and restrictions. The committee recommends that transportation planners and managers undertake detailed surveys of transportation routes to identify and mitigate the potential hazards that could lead to or exacerbate extreme accidents involving very long duration, fully engulfing fires (see Section 3.4).
- The social risks<sup>i</sup> of spent fuel and high-level waste transportation pose important challenges to the successful initial implementation of programs for transporting spent fuel and high-level waste in the United States. Transportation implementers should take early and proactive steps to establish formal mechanisms for gathering high-quality and diverse advice about social risks and their management on an ongoing basis using the steps recommended in Section 3.4.

The committee also provides several recommendations for improving current and future programs to transport spent fuel and high-level waste to a federal repository or to interim storage. Although these recommendations are directed at DOE and DOT, they would also apply to programs for shipping commercial spent fuel to private storage.

- DOE's procedures for selecting routes within the United States for shipments of foreign research reactor spent fuel appear on the whole to be adequate and reasonable. DOT routing regulations are a satisfactory means of ensuring safe transportation, provided that the shipper actively and systematically consults with the states and tribes along potential routes and that states follow the route designation procedures prescribed by the department. The committee recommends that DOT take steps to ensure that states that designate routes for shipment of spent nuclear fuel rigorously comply with regulatory requirements that such designations be supported by sound risk assessments (see Section 4.4).
- The committee strongly endorses DOE's decisions to ship spent fuel and high-level waste to the federal repository by mostly rail using dedicated trains. The committee recommends that DOE fully implement these decisions by completing construction of the Nevada rail spur and making other necessary arrangements before commencing the large-quantity shipment of spent fuel and high-level waste to the federal repository. DOE should also examine the feasibility of further reducing its needs for cross-country truck shipments of spent fuel (see Sections 5.2.1 and 5.2.3).
- DOE should identify and make public its suite of preferred highway and rail routes for transporting spent fuel and high-level waste to a federal repository as soon as practicable to

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<sup>h</sup> That is, under conditions that exceed those embodied in current regulatory requirements.

<sup>i</sup> Social risks arise from both *social processes*, which influence peoples' interactions and shape their communities, and *perceptions*, which influence peoples' behaviors, whether or not such perceptions are an accurate picture of reality.

support state, tribal, and local planning, especially for emergency responder preparedness. DOE should follow the practices of its foreign research reactor spent fuel transport program (see Chapter 4) of involving states and tribes in these route selections (see Section 5.2.2).

- DOE should negotiate with commercial spent fuel owners to ship older fuel first to a federal repository or to federal interim storage. Should these negotiations prove to be ineffective, Congress should consider legislative remedies. Within the context of its current contracts with commercial spent fuel owners, DOE should initiate transport to the federal repository through a pilot program involving relatively short, logistically simple movements of older fuel from closed reactors to demonstrate its ability to carry out its responsibilities in a safe and operationally effective manner (see Section 5.2.4).
- DOE should begin immediately to execute its emergency responder preparedness responsibilities defined in Section 180(c) of the Nuclear Waste Policy Act using the innovative steps recommended in Section 5.2.5.
- DOE, the Department of Homeland Security, DOT, and USNRC should promptly complete the job of developing, applying, and disclosing consistent, reasonable, and understandable criteria for protecting sensitive information about spent fuel and high-level waste shipments. They should also commit to the open sharing of information that does not require such protection and should facilitate timely access to such information, for example, by posting it on readily accessible Web sites (see Section 5.2.6).
- The Secretary of Energy and the U.S. Congress should examine options for changing the organizational structure of DOE's program for transporting spent fuel and high-level waste to a federal repository to increase its chances for success. The following three alternative organizational structures, which are representative of progressively greater organizational change, should be examined: (1) a quasi-independent DOE office reporting directly to upper-level DOE management; (2) a quasi-government corporation; or (3) a fully private organization operated by the commercial nuclear industry (see Section 5.3).

## References

1. National Research Council, "Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States," National Academies Press (2006).