

Assuring Safe Transportation of Nuclear and Hazardous Materials

Sandia National Laboratories develops and applies technology to assure the safe transportation of radioactive and hazardous materials.

Transportation: A Source of Risk

Because of potential risk to the public, the safe transportation of radioactive and hazardous materials is a matter of significant concern. When evaluating the risks of hazardous and radioactive material transportation, two primary elements must be considered: integrity of the transport package and the route used. Sandia National Laboratories has expertise and sophisticated testing and analysis resources to analyze the risk component of package design. In order to provide accurate, reliable data informing regulations, environmental management, and the nuclear energy industry, this element serves as an inextricable component of the safe and secure transport of radioactive and hazardous materials.



Transportation of transuranic waste to the Waste Isolation Pilot Plant



Full-scale impact test of a Type B radioactive shipping cask (above) and a simulation of a train striking a spent fuel cask (upper right)

transit), Sandia leverages expertise and tools in a number of areas constructing a comprehensive, full-spectrum approach to transportation risk analysis.

These areas include:

- Package design (development of design models)
- Thermal testing and analysis
- Structural testing and analysis
- Extreme environment analysis
- Fabrication shops and laboratories
- Quality assurance
- Regulation development and refinement

Drawing on nearly 60 years of support provided to the Nuclear Regulatory Commission (NRC) and other prominent regulatory agencies through regulation development and refinement, Sandia applies its extensive knowledge of both regulation-based and extra-regulatory environments to model, test, and analyze nuclear transportation packages. Since most standard regulations are based on general, foreseeable operating conditions and likely complications, the extra-regulatory element is of increasing importance

A Way to Ensure Safe Transport

Sandia plays a significant role in developing and applying technology to assure and demonstrate the safe transportation of radioactive and hazardous materials. While industry performs the majority of package design, Sandia conducts testing and analysis required to determine the response of packages to various situations. These demonstrations provide assurance that transportation of radioactive and hazardous materials is performed safely, and to the degree possible, economically.

Convergence of Disciplines

In order to accurately characterize a package's behavior and response to a specific set of transportation-related conditions (i.e. prolonged exposure to hot or cold weather, vehicle collision, system malfunction during

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when working with nuclear materials. It accounts for unlikely, but often grave, extreme conditions. Natural disasters, terrorist attacks, and other situations requiring “above and beyond” safety and security assurance are essential factors that must be considered in the implementation of a particular package design. Sandia determines the response of packages in regulation and extreme environments which plays a key role in assuring the integrity and reliability of hazardous and radioactive material packages.

RADTRAN

Sandia developed RADTRAN as a unique environmental impact assessment code for analysis of transportation involving radioactive or hazardous materials. Although this code was initially developed for the NRC, it has been in use around the globe for 35 years. As an internationally-validated code, RADTRAN is accepted by the International Atomic Energy Agency.

RADTRAN is a unique program using two models to analyze risk associated with the transportation of radioactive materials. First, it uses a routine model, which displays the



NAC LWT used fuel cask - a container modeled by RADTRAN

vehicle as a sphere depicting the external radiation dose as a virtual source at the center of the sphere. The second model is an accident scenario developed by Sandia using parts of other risk assessment codes. This model can be used to look at risk and uncertainty associated with events such as standard air pollution, economic modeling, and loss of lead shielding in the absence of a loss of radioactive material.

Extreme Environment Testing

Sandia serves as a unique environment for the study of hazardous and radioactive material transportation because it combines a number of sophisticated, hard-to-find tools and distinct testing facilities into a single organization. These tools and testing facilities allow researchers to examine the risks to a package in both regulation-based and extreme environments. With the ability to perform classified testing and analysis, Sandia is the only institution in the world that has tested a radioactive package containing radioactive materials.

Unlike other institutions, Sandia performs failure tests in extreme environments through physical testing. Using facilities such as the Rocket Sled Track (a controlled environment for high-velocity impact, aerodynamic acceleration, and related testing of both small and large items) and the Mechanical Shock Facility (where acceleration, strain, force, and other data is captured through mechanical shock simulations representing environments produced by transportation, flight, impact, explosions, and other dynamic events), packages are subjected to extreme environments allowing researchers to execute performance and risk analysis.



Puncture test of the Trupact-III transuranic waste transportation container

Supporting Industry and Regulatory Agencies

With a long history of support to the NRC and other regulatory institutions, Sandia works closely with national standards and regulatory agencies to make the nuclear energy enterprise safer. Sandia’s hazardous and radioactive transportation packaging analyses help industrial designers understand and comply with national standards, while providing essential scientific support to create and refine those standards as industry and environmental needs evolve with time. Using this keen developed knowledge base of existing regulations and extra-regulatory needs, Sandia’s transportation work plays an important role in making the nuclear energy enterprise a safer, increasingly assured industry.

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