

# Transportation and Packaging

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## Fact Sheet 320-092

Division of Environmental Health  
Office of Radiation Protection



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Each year in the United States there are about 500 billion shipments of all kinds. Approximately 100 million (less than 1%) of these shipments involve hazardous materials that are either flammable, explosive, toxic, or radioactive. Approximately two million of these hazardous shipments contain radioactive materials (this does not include used, or spent fuel from nuclear power reactors).

- ◆ Annually, about twenty million packages of all sizes containing radioactive materials are routinely transported worldwide on public roads, railways and ships.
- ◆ There has never been any accident in which a container with highly radioactive material has been breached, or has leaked.

About 95 percent of all radioactive material shipments are used for medical applications, agriculture, education, research, manufacturing and industry. The remaining shipments are low-level radioactive wastes; materials that emit low levels of radiation, slightly above normal background levels. The waste often consists of solid materials, such as clothing, tools, or contaminated soil. It is packed in drums and is transported from its origin to waste treatment sites, or to an intermediate or final storage facility where it will be monitored and controlled. Low-level wastes are moved by road, rail, and internationally, by sea. However, most low-level waste is only transported within the country where it is produced.

High-level waste comes from commercial nuclear power reactors and consists of the used fuel (a solid material contained in rods) called spent fuel. High-level waste is packed in special containers called casks and transported on special trucks designed specifically for this use. High-level wastes are moved by road, rail, and internationally, by sea.

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## HOW ARE NUCLEAR MATERIAL SHIPMENTS REGULATED?

In the United States the Department of Energy (DOE) and the Nuclear Regulatory Commission (NRC) have joint responsibility for regulating shipments. The U.S. Postal Service has regulations that augment these.

Regulations and protocols for shipping nuclear materials are governed by two objectives: (1) the transportation protocol should minimize the chance for an accident to occur; and (2) the materials should be packaged so no radioactive material is released if an accident should occur.

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## HOW ARE THEY PACKAGED?

The principal assurance of safety in the transport of radioactive materials is the design of the packaging, which must allow for foreseeable accidents. Many different radioactive materials are transported and the degree of potential hazard from these materials varies considerably. Different packaging standards have been developed to recognize that increased potential hazard calls for increased protection.

- ◆ Protection is achieved by:
  - ◆ Containment of radioactive contents
  - ◆ Control of external radiation levels;
  - ◆ Prevention of criticality
  - ◆ Prevention of damage caused by heat
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## HOW ARE WE PROTECTED?

When the package contains radioactive materials, it is important to ensure that radiation exposure of both those involved in the transport of such materials and the general public along the transport route is limited. Packaging for radioactive materials includes, where appropriate, shielding to reduce potential radiation exposures. In the case of some materials, such as fresh uranium fuel assemblies, the radiation levels are negligible and no shielding is required. Other materials, such as high-level waste, are highly radioactive and purpose-designed containers with integral shielding are used. It is less hazardous to ship the solid nuclear fuel than to ship many other materials (such as gasoline) that are routinely transported all over the country. Specially designed and tested shipping containers prevent the release of radioactive materials, even in the most severe accident. Conditions which containers are tested to withstand include: fire, impact, wetting, pressure, heat and cold. Packages of radioactive material are checked prior to shipping.

As with other hazardous materials being transported, packages of radioactive materials are labeled in accordance with the requirements of national and international regulations. These labels not only indicate that the material is radioactive, by including a radiation symbol, but also give an indication of the radiation field in the vicinity of the package. Personnel directly involved in the transport of radioactive materials are trained to take appropriate precautions and to respond in case of an emergency. Although not required by transportation regulations, the nuclear industry chooses to undertake some shipments of radioactive materials using dedicated, purpose-built transport vehicles or vessels.

<b>End Use</b>	<b>Number of Shipments</b>	<b>Percent of Shipments</b>	<b>Percent of Radioactivity</b>
Medical	1,730,000	62.2	34.3
Other	519,000	18.6	0.2
Industrial	213,000	7.6	63.1
Low Level Waste	181,000	6.5	1.5
Power	114,000	4.1	0.7
Research/ Teaching	17,100	0.6	0.1
Unspecified	7,550	0.3	0.1

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## Sources

World Nuclear Association,  
[Transport of Radioactive Materials - http://world-nuclear.org/info/inf20.html](http://world-nuclear.org/info/inf20.html)

Environmental Radioactivity, Eisenbud, Merrill & Gesell, Thomas, 1997

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