WHAT MEASURES ENSURE SAFE TRANSPORTATION OF HIGH-LEVEL NUCLEAR WASTE?

The safe transportation of spent nuclear fuel from utilities and high-level nuclear waste from defense activities is essential to the protection of the public and the environment. Many measures ensure that workers, the public, and the environment will not be exposed to hazards from spent fuel or defense high-level nuclear waste during shipments.

4.1 Safety Record

How long have radioactive material shipments been made in the United States?

What is the safety record?

Radioactive material has been safely shipped in this country for over 40 years. Each year there are about 2 million shipments of radioactive materials of all kinds. Only a small fraction (less than 1/10%) of these shipments are spent fuel or defense high-level waste. Over the years, there have been some accidents involving shipments of radioactive materials. Any injuries in these accidents were like those of other transportation accidents, and none of the injuries were related to the radioactive nature of the cargo. This excellent 40-year record is due to shippers strictly following regulations as well as to the well-designed packages or casks used to carry the materials.

4.2 Minimizing Transportation Risk

What are some steps taken to ensure safety?

Spent fuel shipping *casks* are designed, built, and maintained to ensure that they will *contain* and shield their contents, even under severe accident conditions. Before shipment, casks are specially sealed and then labeled to clearly identify the hazard of the contents. The radiation level of each shipment is checked to be sure it is within regulatory limits. The cask is also checked for contamination on the outside both before it departs and after it reaches its destination. These shipping casks are the main protection against any potential radiation exposure for transportation workers and the public.

Contain —To keep within limits...*Full-scale tests proved that the casks would contain their contents even under severe accident conditions.*

What protects workers and the public from radiation exposure?

Special routing procedures are used for spent fuel shipments, and shipping papers with detailed information about cask

contents as well as emergency contacts and telephone numbers accompany each shipment. Drivers of spent fuel shipments must update their required training every 2 years. Special training is provided to State and local teams about emergency response for all hazardous materials shipments. Finally, the Department of Energy (DOE) and other Federal agencies maintain emergency response teams to assist State and local teams if needed.

4.3 Agencies with Responsibility

Who has responsibility for safe transportation of all hazardous materials in the United States?

The U.S. Department of Transportation (DOT) has the main responsibility for the safe transportation of **all** hazardous materials, including radioactive material. It regulates every aspect of transportation—packaging, handling, all paper work and labeling, loading and unloading, and routing. The U.S. Nuclear Regulatory Commission (NRC) also has some responsibility for the transportation of spent fuel. It sets strict standards for the design and performance of the casks that carry spent fuel. Both the DOT and the NRC base their regulations on radiation safety standards issued by the International Atomic Energy Agency and adopted by the United Nations.

What is the NRC responsible for?

Under the Nuclear Waste Policy Act of 1982, the U.S. Department of Energy (DOE) will be responsible for shipments of spent fuel and other high-level nuclear waste to a repository or storage facility. DOE will use casks certified by the NRC and will follow DOT regulations for these shipments.

What are U.S. standards based on?

What are estimates of maximum exposures?

Who will be responsible for shipments to a repository or storage facility?

Maximum Exposure Estimates

The maximum exposures per shipment for people living less than 30.3 meters (100 feet) of the route of a vehicle carrying spent fuel would be about 0.0005 millirem.* If 100 spent fuel shipments went by the same house every year, the increase in radiation exposure to people living in the house would be much less than one percent of the exposure they already get from background radiation. It's also about half the radiation exposure people receive annually from watching television.

**Source:* *U.S. Department of Energy,* Transporting Radioactive Materials...Answers to Your Questions *(DOE/EM10097), 1993.*

4.4 Cask Testing

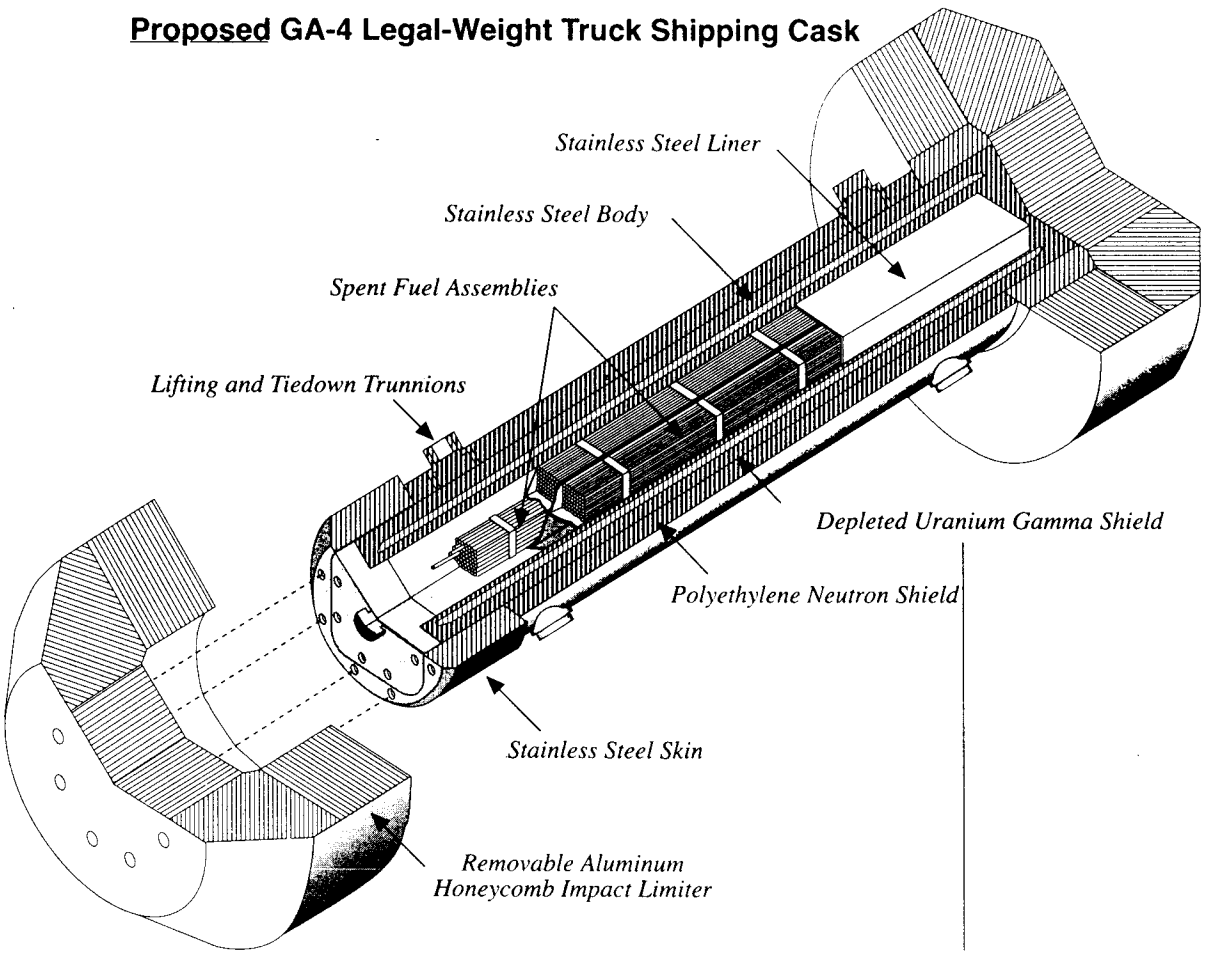
Shipping casks provide both containment and *shielding* during transport. The amended Nuclear Waste Policy Act requires that spent nuclear fuel and high-level waste from defense activities be transported to a repository or storage facility in casks certified by the Nuclear Regulatory Commission. To be certified, a cask design must withstand a sequence of four tests that measure its performance in severe accident conditions.

Shielding — Material used to protect people or living things from ionizing radiation...*Lead can act as shielding for gamma waves.*

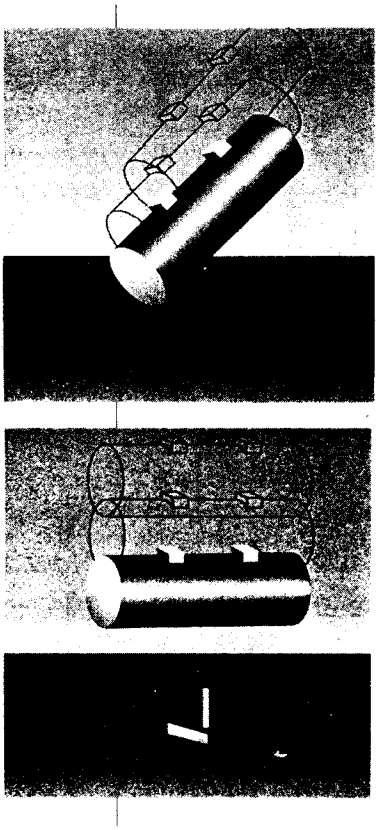
The ability of a cask design to withstand these tests can be shown by engineering analysis (such as computer tests) or by scale-model or full-scale testing. In most cases, a combination of tests is used. Every cask is not tested. That would be an expensive and time-consuming process. Instead, a scale model of a cask is thoroughly tested. If the model passes all required tests, that cask *design* is certified.

How are cask designs certified?

Proposed GA-4 Legal-Weight Truck Shipping Cask



How are casks tested?



Tests of spent fuel casks show that they can withstand severe accident conditions.

Free Drop — The cask is dropped from 9 meters (30 feet) onto a flat, unyielding, horizontal surface so that the cask strikes its weakest point.

Puncture — The cask is dropped from 1 meter (40 inches) onto a steel bar 20 centimeters (8 inches) high and 15 centimeters (6 inches) in diameter at a point where damage is most likely to occur.

Thermal — The entire cask is kept for 30 minutes in a jet fuel fire burning at a temperature of 800 °C (1,475 °F).

Water Immersion — The cask is totally immersed under 0.9 meters (3 feet) of water for at least 8 hours.

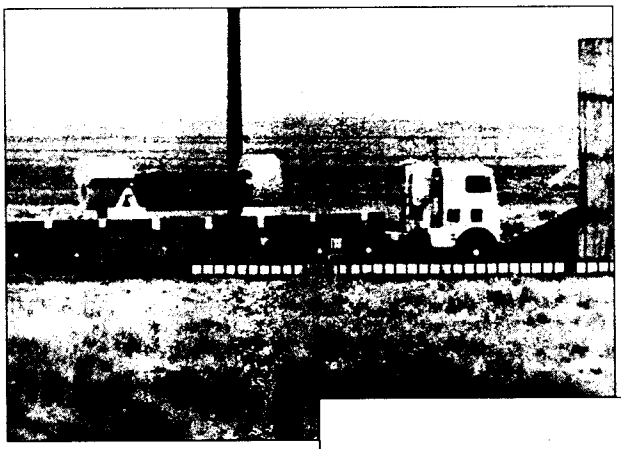
— In a separate test, another cask is tested below 15 meters (50 feet) of water for at least 8 hours.

4.5 Full-Scale Tests

Simulate — To have or take on the appearance or form of...*Material that simulates radioactive material is used in full-scale tests instead of actual radioactive material.*

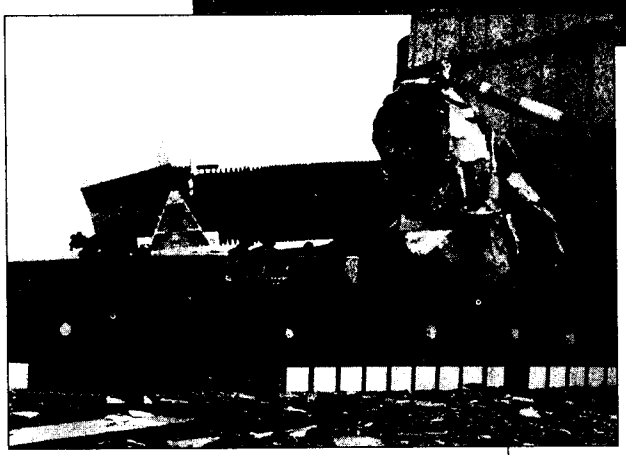
What full-scale tests were conducted?

A series of full-scale tests conducted in the United States during the mid-1970's showed that spent fuel casks could successfully protect their contents in the most severe accidents. The tests included crashing two tractor-trailers, each loaded with a cask, into a concrete wall. One crash, conducted at 98 kilometers per hour (kph) (61 miles per hour [mph]), had no effect on the cask. Another crash, at 135 kph (84 mph), slightly damaged the cask, but it did not release the *simulated* (imitation) "radioactive material" it was carrying.



What were the results of the full-scale tests?

A railcar carrying a cask was crashed into a massive concrete barrier at 130 kph (81 mph) and was then engulfed in a jet fuel fire for 125 minutes. A crack about the thickness of a dollar bill occurred, but the cask retained its shielding ability. The material substituted for actual radioactive material remained inside the cask. In another test, a cask dropped from a helicopter crashed into the desert at 378 kph (235 mph). Some paint scratches were the only damage.



In a 1984 test conducted in the United Kingdom, a locomotive was crashed at 161 kph (100 mph) into a railcar carrying a nuclear waste shipping cask. The locomotive was wrecked in the head-on collision, but the shipping cask suffered only minor scratches, despite being thrown 61 meters (200 feet).*

Why are the tests important?

In each of these tests, damage to the casks was external. If they had contained spent fuel, none of the casks would have released its contents. The tests are important because they verify (demonstrate the accuracy of) predictions of computer models. They also show that the regulations for casks provide safety.

4.6 New Cask Designs

DOE is developing new casks for shipping spent fuel.

What are some advantages of new cask designs?

With a multi-purpose canister concept, spent fuel assemblies would be placed inside a metal canister and sealed. The canister would then be placed inside a separate steel container called a cask for shipment or storage. At a repository, the canister would be placed inside a metal container for permanent disposal.

The canister concept would reduce the need for handling and could be used to store spent nuclear fuel at powerplants. Multi-purpose canisters would also provide an additional barrier between spent fuel and the environment. A more complete discussion of multi-purpose canisters is included in the reading lesson *The Role of the Multi-Purpose Canister in the Waste Management System.*

Another approach would use high-capacity cask designs, placing more spent fuel in each cask while meeting weight limits. Fewer spent fuel shipments would be required, reducing the potential for accidents.

**Source: U.S. Department of Energy,* Transporting Spent Nuclear Fuel: An Overview *(DOE/RW—0065), 1986.*

4.7 Shipping Routes

In 1982, the U.S. Department of Transportation established rules for determining highway routes for shipments of high-level radioactive materials. After thorough studies, "preferred routes" for these shipments were identified. A preferred route consists of highways of the interstate system, including bypass routes around cities where possible, or an alternate route selected by a State or Indian Tribe. As part of the process of naming an alternate route, a State or Indian Tribe must first consult with neighboring States, Indian Tribes, and affected cities or towns. An alternate route must provide adequate protection to the public.

What routes are used for highway shipments?

Can a State or Indian Tribe select an alternate route?

Shippers and railroad companies that operate between the origin and destination select routes for rail shipments. They base routes on safety, the best tracks available, schedule efficiency, and cost.

How are railroad routes chosen?

4.8 Notification of States

The Governor (or other designated State official) receives written notice in advance of certain shipments of nuclear waste and spent fuel within or through that State. The advance notice is designed to help emergency preparedness. Written notice includes the planned shipping schedule, route, shipment description, and name and address of the carrier. Also, the U. S. Department of Energy (DOE) operates a satellite tracking system to monitor certain shipments from their origin to their destination. With this system, officials have quick access to information about the shipment at all times.

Are States notified about shipments in advance?

How can shipments be tracked?

4.9 State and Local Roles

State and local governments are responsible for the safety of people within their areas. Their responsibilities include such things as highway construction and maintenance, vehicle inspections, enforcement of traffic laws, and emergency response. State and local governments also provide input to

What are State and local governments responsible for?

proposed Federal transportation regulations. DOE consults with State, local, and Tribal representatives about the transportation system.

State and Local Laws

Many State and local governments have passed laws with special requirements for transporting radioactive material within their boundaries. The laws may stand if 1) they are consistent with Federal law, and 2) they do not make it difficult or impossible to carry on commerce or business. However, if a law interferes with general commerce or the conduct of business or if it is inconsistent with Federal laws or regulations, it may be preempted (voided or set aside) by the courts.

How will public safety officials receive training?

The amended Nuclear Waste Policy Act requires DOE to provide assistance and funds to States for the training of public safety officials of affected local governments and Indian Tribes. The training covers procedures for routine transportation under normal conditions as well as emergency response for accidents.