FACT SHEET

Experience, Testing Confirm Transportation Of Used Nuclear Fuel Is Safe, Reliable

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Key Facts

■ The nuclear energy industry has completed more than 3,000 shipments of used nuclear fuel over the past 40 years with no injuries, fatalities or environmental damage as a result of the radioactive nature of the cargo, according to the U.S. Nuclear Regulatory Commission.

■ Shippers transport used nuclear fuel as a solid, ceramic material that is unable to leak or explode.

■ Constructed of many layers of steel and lead, containers used to carry the fuel are extremely robust. The NRC requires thorough tests and analyses prior to certifying used fuel containers.

■ Facilities such as Sandia National Laboratories have tested containers under extreme circumstances to ensure they would protect the public in the unlikely event of an accident during transport. Tests have proven that containers can withstand high-speed crashes, extremely hot and long-lasting fires, and submersion in water.

Moving Fuel Safely For 40 Years

The nuclear energy industry has demonstrated over four decades that it can safely transport used nuclear fuel. In that time it has completed thousands of shipments with no injuries, fatalities or environmental damage resulting from the radioactivity of the cargo.

Used nuclear fuel is a solid, ceramic material. There is no liquid that can drain out of the shipping container. Used nuclear fuel cannot explode.

The containers that transport the used nuclear fuel are extremely robust, with multiple layers of steel, lead and other materials to confine radiation from the used fuel. These specially designed containers weigh between 25 and 40 tons for truck transport and between 75 and 125 tons for rail shipments, including the weight of the used fuel. Typically, for every ton of used fuel, there are about 4 tons of protective shielding.

In the United States, shippers occasionally transport radioactive materials via barge, using the same rugged transportation containers used for rail or truck shipments. Internationally, transporting used fuel on specially designed ships is routine.

Scientists and engineers know that accidents can happen, so they designed the containers to be the safest on the road, on the rails and on the water, and to protect the public against even the most unlikely accidents. The containers can withstand high-speed crashes, long-lasting fires and submersion in water, all without breaking open.

Established Record of Safe Transportation

Over the past 40 years, the U.S. nuclear energy industry has safely transported more than 3,000 shipments of used nuclear fuel over 1.7 million miles. Since 1971, nine accidents involving commercial used nuclear fuel containers have occurred—four on highways and five during rail transport. Four of these accidents involved empty containers, and none resulted in a breach of the container or any release of its radioactive cargo.

In 1971, for example, a tractor-trailer carrying a 25-ton shipping container holding used nuclear fuel swerved on a Tennessee road to avoid a head-on collision and overturned. The trailer, with the container still attached, separated from the tractor and skidded into a rain-filled ditch. The container suffered minor external damage but—as designed—prevented the release of radioactive material. This accident was the most

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severe of the nine involving used fuel containers.

The NRC Requires Tests Of Used Fuel Containers

The NRC must approve containers that transport used nuclear fuel. Before the agency certifies container designs, they must meet rigorous engineering and safety criteria. In addition, the container designs must be shown, by test or analysis, to survive a sequence of four hypothetical accident conditions simulating the cumulative effects of impact, puncture, fire and submersion.

The test sequence involves:

- a 30-foot free fall onto an unyielding surface, which would be equivalent to the cask being struck by a train traveling 60 mph
- a puncture test allowing the container to fall 40 inches onto a steel rod 8 inches long and 6 inches in diameter
- a 30-minute exposure to fire at 1,475 degrees Fahrenheit that engulfs the entire container
- submerging the same container under 3 feet of water.

Separate, undamaged containers are also subjected to immersion in 50 feet of water.

Furthermore, casks must survive greater than 600 feet of water pressure for one hour without collapse, buckling or inleakage of water.

In addition to the tests required for NRC certification, engineers and scientists at Sandia National Laboratories in New Mexico conducted a wide range of tests on used nuclear fuel transportation containers in the 1970s and 1980s. These tests included:

- running a flatbed tractor-trailer carrying a container into a concrete wall at 84 mph
- placing a container on a rail car and driving it into a concrete wall at 81 mph
- placing a container on a tractor-trailer and broadsiding it by a train traveling at 80 mph.

In all cases, post-crash assessments showed that the containers, although slightly dented and charred, would not have released their contents.

The NRC also conducted a study in 1987 to evaluate further the ability of used fuel transport containers to withstand real accidents. Using data from severe accidents of all kinds, the NRC concluded that transport containers designed to NRC requirements would withstand actual accidents.

Other Sandia tests evaluated a terrorist attack, subjecting a container to a device 30 times more powerful than a typical anti-tank weapon. The test resulted in a quarter-inch-diameter hole through the primary containment wall.

The NRC estimates that such a hole would have resulted in the release of less than 10 grams—about one-third of an ounce—of used fuel.

In combination with actual testing, transportation container manufacturers use computer programs and scale models to evaluate the containers' protective capabilities and verify—with a substantial margin of safety—that the containers meet NRC and international requirements. For example, drop testing of full-scale and partial-scale transportation containers in Germany and Japan have validated previous simulations.

NRC regulations also require the establishment of a security plan to ship used nuclear fuel safely to the used fuel repository at Yucca Mountain, Nev., and implementation of this plan before shipments begin. The shipper will track and monitor these shipments carefully over the entire route. The agency must review and approve in advance the plan and procedures to protect against radiological sabotage or theft.

This fact sheet also is available at www.nei.org. *A nine-minute video, "An American Success Story: The Safe Shipment of Used Nuclear Fuel," is also available under Resources & Stats.*