

## SPECIALIZED EQUIPMENT NEEDS FOR THE TRANSPORTATION OF RADIOACTIVE MATERIAL

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### Summary

To ensure the safe and reliable transportation of radioactive materials and components, from both the front and back-end of the nuclear fuel cycle, a transport management company needs three key elements: specialized knowledge, specialized training and specialized equipment. These three elements result, in part, from national and international regulations which require specialized handling of all radioactive shipments.

While the reasons behind the first two elements are readily apparent, the role of specialized equipment is often not considered until too late in the shipment process even though it plays an integral part of any radioactive material transport.

This paper will describe the specialized equipment needed to transport three of the major commodities comprising the bulk of international nuclear transports: natural uranium (UF<sub>6</sub>), low enriched uranium (UF<sub>6</sub>) and fresh nuclear fuel.

### Specialized Equipment for Natural Uranium (UF<sub>6</sub>)

Natural uranium hexafluoride is usually transported in 48 inch steel cylinders. For international transportation, an integral shipping unit (Fig. 1) is created in which a 48 inch cylinder is secured to a specifically designed steel cradle which is then secured to a 20 foot ocean container (usually a flat rack).

All 48 inch cylinders are designed with fittings allowing connection of the cradle arm directly to the cylinder. Not all cradles are designed the same; some cradles require extensions (i.e. shackles) for the cradle arm to reach the securement point on the cylinder. Additionally, some 48" cylinders are designed, or have been modified with an additional securement point, to accommodate cradles with short arms.

For the cylinder/cradle combination to be secured to the 20' container (or flat rack), the container must be specifically modified using one of two methods:

-- Areas of the wooden floor of the container, over the central beams, are replaced by steel plate

which is welded directly to the frame. The steel plates are then drilled to accept 1 inch bolts which are typically used to secure the cradle to the container;

- The container is redesigned by welding two steel I-beams, spaced approximately 48" apart, to the frame of the container. The I-beams, which run the length of the flat rack, are drilled to allow easy securement of the cradle to the flat rack. This method of modification secures the cylinder/cradle combination to the container without the need to gain access to the underside of the container.

Cradles and modified flat rack containers are essential for the safe and secure transport of natural uranium hexafluoride. However, these items are not typically found in the inventory of producers and consumers. An effective transport management company can provide this type of equipment.

### Specialized Equipment for Low Enriched Uranium (UF<sub>6</sub>)

Low enriched uranium hexafluoride (enriched less than 5%), except in small quantities, is transported in 30 inch cylinders (Fig. 2). The cylinders are encapsulated in protective shipping packages (or overpacks) (Fig. 3). The overpacks are then secured to either a larger shipping container (i.e. modified 20' flat rack container) for ocean shipments, or an over-the-road flat bed trailer for internal domestic transport (Fig. 4).

### **Overpacks**

In accordance with international regulations for transporting fissile material, filled 30 inch cylinders must be transported in approved overpacks. Currently, there are three types of approved overpacks: DOT21PF-1, NCI-21-PF1 and UX-30. Several designs for new types of overpacks are in various stages of the approval process.

The three overpacks are similar in design with cylindrical bodies and rectangular cradle-like structures which are used for direct securement to a ocean container (flat rack), or flat bed truck, by eight bolt/nut pairs. The rectangular cradle-like structures consist of four securement points (or "feet") at the corners; each foot has two bolt holes.

### **Flat Racks for Ocean Shipments**

For the safe transport of 30 inch cylinders/overpacks by ocean, modified 20' flat racks containers are used (Fig. 5). These flat racks are designed to accommodate four cylinder/overpack combinations. A modified flat rack can take two forms:

- 1) Areas of the wooden floor of the flat rack, near the side frame of the flat rack, are replaced by steel plate which is welded directly to the frame. Two holes are drilled in the steel plates to accommodate 3/4" bolts; these are used to secure the overpacks to the flat rack. This design accommodates other types of freight.

- 2) The flat rack is redesigned by welding two steel I-beams, spaced approximately 48" apart, to the frame of the container. The I-beams, which run the length of the flat rack, are drilled for the securement of four (4) filled 30" cylinders/overpacks to the flat rack. This method of modification secures the cylinder(s)/overpack(s) to the container without the need to gain access to the underside of the container. This design does not accommodate other types of freight.

### Flat-Bed Trailers for Road Shipments

There are two different modifications/designs of flat bed trailers which can be used for the transport of 30 inch cylinders/overpacks within the United States. The modifications/designs are made to 48' flat bed trailers; both designs allow trailer use for other types of cargo (when they are not being used for the transport of low enriched uranium (UF6)). Five filled 30 inch cylinders/overpacks can be transported on one 48' flat bed trailer (the amount of cylinders which can be loaded on one trailer is limited by U.S. bridge laws). The two different designs are as follows:

- Holes are drilled into the floor of a flat bed trailer. The holes are evenly spaced along the length of the trailer to evenly distribute the weight of the packages.

If the flat bed trailer has wooden floors then additional steel plates are needed to secure the cylinder/overpacks to the trailer. The steel plates, drilled with two 3/4" holes (matching the feet of the overpack), are placed on the underside of the trailer between the wooden floor and the nut(s), to provide additional support for the wood.

If a flat bed trailer has a metal floor, there is no need for steel plates to be installed; the overpacks are secured directly to the floor of the trailer.

This design is specifically used for transport of cylinders/overpacks within the United States. The cylinders/overpacks would not be secured inside ocean equipment such as a 20' flatrack.

- The second design, similar in modifications to the first described above, has collapsible metal sides. Trailers with collapsible metal sides allow access to the underside of flatracks. As access to the underside of a flat rack is required to secure/remove an overpack, this modification allows a 30 inch cylinder/overpack, already secured to a 20' flat rack, to be transported. Without collapsible metal sides, a 30" cylinder/overpack, secured to a 20' flat rack, would need to be transported on a standard chassis.

This design allows for the flatbed trailer to be used for domestic transport or to handle international shipments when the 30 inch cylinders/PSPs which are secured to ocean equipment.

Modified equipment, whether 20' flat racks or flat-bed trailers, are necessary to ensure the safe and secure transport of low enriched uranium (UF6). However, other than 30 inch cylinders, these items are not typically found in the inventory of most producers and consumers. A few commercial ocean carriers have a limited supply of modified 20' flat racks; however, these are slowly being removed

from inventories. Current trends indicate that transport management companies are purchasing new, or modifying used 20' flat racks, to transport 30 inch cylinders/overpacks.

### Specialized Equipment for Fresh Nuclear Fuel

Fresh nuclear fuel is transported in specially designed packages. The design of the package is specific to the dimensions of the fuel which the package will transport. Fuel fabricators will design, and obtain approval to use, a package which meets the requirements of fuel manufactured at their sites. The dimensions and weight of the package determines the type of ocean container that will be used for the international transport.

Fresh fuel is usually secured inside 20' or 40' open top ocean containers for international shipments. Open top containers are used to allow for loading and unloading by overhead cranes. The use of an overhead crane causes far less impact than other means of handling or lifting.

Some fabrication facilities make minor modifications to the internal floor of the open top containers to assist with securement of the fuel packages inside the container. The modifications generally are the welding or affixing of metal rings to the side walls or floor of the open top container. This allows the use of nylon straps and metal binders, which are draped across several packages inside the container, to secure the cargo to ocean container. This limits the shifting of the packages from side to side within the container. Pieces of lumber are secured to the floor of the container (front and back) to limit the shifting of the packages in that direction.

Special chassis or flatbed trailers are used for the transport of fresh fuel between the consignor and the point of import/export in the United States. The chassis or flatbed trailer must have air ride suspension. This type of suspension adsorbs some of the impact the fuel might encounter while be transported by road. The use of this special equipment limits the potential damage to the fuel during transport.

### Conclusion

Specialized equipment such as shipping packages, steel cradles and ocean equipment are necessary to ensure the safe and reliable transportation of radioactive materials. Transport management companies, such as Edlow International, can supply all of the necessary equipment to assist with ensuring that the transport of radioactive materials is performed safely. The current trend is for transport management companies to purchase and maintain this specialized equipment, such as packages, cradles, ocean containers, so that they can be provided for use in transportation.



FIGURE 1

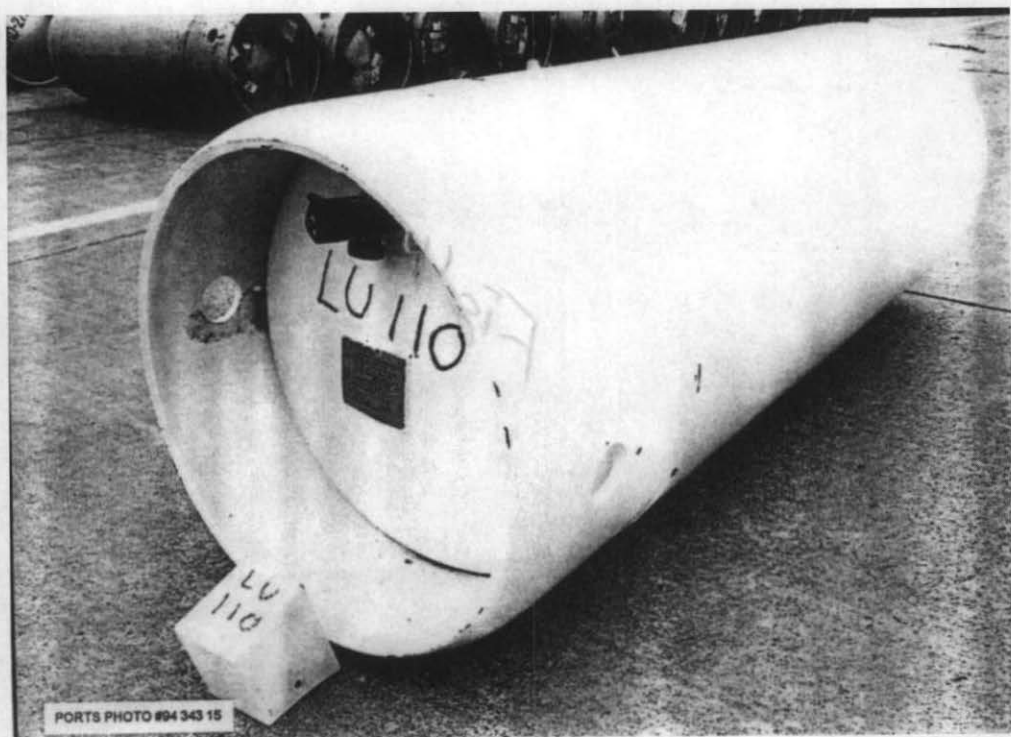


Photo From: USEC-651 Revision 7  
Uranium Hexafluoride: A Manual of Good Handling Practices

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FIGURE 2



FIGURE 3



FIGURE 4





FIGURE 5