

Used Nuclear Fuel Transportation Experience is Impeccable

According to a U.S. Department of Energy (DOE) report prepared by the Oak Ridge National Laboratory and Argonne National Laboratory, more than 25,000 shipments of used nuclear fuel (UNF) have been made worldwide to date, shipping more than 87,000 metric tons of fuel. Review of the data sources shows that all these shipments were undertaken without any injury or loss of life.

In the U.S., except for a limited amount of transport, the majority of UNF still remains at the reactor sites. Nevertheless, more than 1,300 used fuel shipments have been completed safely over the past 35 years in the U.S., according to the NRC, with most shipments performed by rail. Thanks to the robust transportation cask designs and stringent safety measures adopted by the industry, every one of these used fuel shipments has been completed safely with no release of radioactivity or environmental damage.

Additionally, the Department of Defense (DOD) has transported significant amounts of UNF from naval and research reactors. The U.S. Navy reports that over the past 60 years, it has completed nearly 850 shipments of used fuel from naval propulsion reactors, covering 1.6 million transportation miles. In addition, more than 250 transportation containers of UNF from foreign research reactors have been transported to and within the U.S. between 1990 and 2012. These also have been safely completed with no release of radioactivity or environmental damage.

Transportation of Used Nuclear Fuel is Highly Regulated

Part of the reason for this impeccable record is the fact that transportation of radioactive material, including UNF, is strictly regulated by each country's nuclear regulatory agencies, i.e., by the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Transportation (DOT) in the U.S. The NRC oversees the design, manufacture, use of and maintenance of casks for these radioactive shipments. The DOT coordinates with the NRC to set rules for the packaging of nuclear material, regulates carriers and sets standards for routes. The DOT also works with the NRC and affected states to regulate the transport operations while they occur.

Designs, Regulations and Safety Measures

Transportation casks for shipping UNF are robustly designed to protect the public from releases of radioactive material in the unlikely event of an accident. The NRC regulates the design and construction of these casks by requiring that the candidate cask must be demonstrated to survive four successive accident conditions involving free drop, puncture, fire and submersion in water events before it is considered fit for transportation. Three transport casks designed by Holtec International and licensed by the NRC, HI-STAR 190, HI-STAR 100 and HI-STAR 100MB (HI-STAR is an acronym for **Holtec International Storage Transportation and Repository**) could be used to move UNF from the reactor sites to the HI-STORE Consolidated Interim Storage Facility (CISF). The figure of the HI-STAR 190 on the next page illustrates the robustness of the genre of HI-STAR casks used throughout the nuclear industry. Casks, such as HI-STAR 190, HI-STAR 100 and HI-STAR 100MB, are designed and fabricated with multiple layers of steel, lead and other materials to safely confine the fuel, and shield workers and the public from radiation associated with the fuel. The cask is tightly sealed. Inside the cask, the used nuclear fuel, in solid form, is contained in another sealed canister, hence multiple layers of protection stand between the cask's contents and the environment. Fully loaded casks weigh 125 tons or more for rail shipments. Typically, for every ton of used fuel, a cask has about 4 tons of robust shielding material.

The NRC regulatory limit for dose rates around the cask is 10 mrem/hr at 2 meters from the vehicle. As a comparison, the dose from a single dental x-ray is about 4 mrem. That means that a person standing 2 meters away from a vehicle with a transport cask for 24 minutes (0.4 hours) would receive just about the same dose as from a single dental x-ray. However, that is not a realistic condition to consider for any member of the public. A member of the public would be further away from a transport cask, and typically for a shorter period of time, hence the dose would be much lower. Rather than evaluating the dose to an individual member of the public, it is therefore more meaningful to evaluate the total collective dose to all members of the public near the transport path of a transportation cask. The NRC has performed and published such evaluations for several transport routes across the U.S., and for both rail and truck transports. For rail transport, the collective dose is between 8 and 120 mrem, depending on the route. Note that this is the collective dose for the entire public along the route (in some cases more than 1 million people), including residents along the route, occupants of vehicles sharing the transport route, crews and escorts, and anyone near a stop, not for a single person. The maximum value for a single person would be substantially below the value of 4 mrem for the dental x-ray stated above. Another good comparison can be made with the background radiation that everyone receives. The dose from the transport is only a very small fraction, less than 1/1000, of the typical background radiation that people would receive at the same time. The only conclusion that can be made from that is that the dose from transportation of used nuclear fuel is truly negligible.

Transportation to New Mexico

In the U.S., more than 80,000 metric tons of UNF is stored at 73 nuclear reactor sites and 4 DOE facilities in 35 states. This amount increases by about 2,000 metric tons each year. More than 2,700 used fuel storage containers are currently in service at these reactor sites. Most of these are designed to be transportable and their designers have either obtained, or intend to seek, licenses from the NRC for transport.

According to current law, the DOE is responsible for shipping the used fuel from these sites to a repository specifically designed for permanent disposal. However, used nuclear fuel may also be shipped by or under the auspices of an entity other than DOE, such as Holtec. In addition to the regulations on safety and the design of the casks, the NRC regulates how UNF is protected in transit against sabotage or theft. The rules for physical protection of UNF include coordination with law enforcement agencies before the shipment, advance notice to states, Indian tribes and the NRC, using a communications center and other means to monitor shipments while enroute, using armed escorts, and using devices that allow drivers and escorts to protect the conveyance.

In summary, for the shipment of UNF to the HI-STORE facility, Holtec International, the nuclear industry, DOE and NRC are building on the established track record of safe shipment through the design and use of robust systems, adherence to strictly enforced regulations and implementation of strict security requirements.

