

Background Information Regarding Transportation of Spent Nuclear Fuel

The U.S. Department of Transportation and the Nuclear Regulatory Commission monitors and regulates the transportation of spent nuclear fuel.

The license application to the Nuclear Regulatory Commission (NRC) does not and is not required to address the safety of SNF transportation to and from the WCS site. The safety of SNF transportation will have to be addressed by the entity responsible for transport. WCS currently envisions that will be the U.S. Department of Energy.

The WCS application is required to address the potential impacts of SNF transportation in its environmental report for both normal and accident conditions.

- It uses routes to analyze shipment doses for normal conditions that bind the travel distances for WCS shipments and are representative of the population (i.e. mix of urban, suburban and rural) that would be along the possible routes.
- The postulated accident probabilities and releases used in assessing accident impacts are taken from NRC studies.
- The application uses the RADTRAN modeling code which is an industry standard and has been used by both the NRC to complete its risk studies and by intervenors in the Yucca Mountain processing and others.

The NRC has conducted a number of studies to evaluate the risk of shipping SNF to support the adequacy of DOT and NRC regulations. These include:

- Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes – NUREG-0170 (Dec 1977)
- Shipping Container Response to Severe Highway and Railway Accident Conditions – NUREG/CR-4829 (Feb 1987)
- Reexamination of Spent Fuel Shipment Risk Estimates – NUREG/CR-6672 (March 2000)
- Spent Fuel Transportation Risk Assessment – NUREG-2125 (Jan 2014)

All of the studies show that the risk and consequences of shipping SNF is extremely small.

The National Academy of Science (NAS) published an independent assessment of the risks of shipping SNF in 2006 entitled *Going the Distance*. In making this assessment, the NAS held public meetings in Washington, DC; Las Vegas, NV; Denver, CO; Chicago, IL; and Albuquerque, NM. The assessment concluded that *“the committee could identify no fundamental technical barriers to the safe transport of spent nuclear material and high-level waste in the United States. Transport by highway (for small-quantity shipments) and by rail (for large quantity shipments) is, from a technical viewpoint, a low-radiological risk activity with manageable safety, health and environmental consequences when conducted with strict adherence to existing regulations.”*

Since 2006 the NRC has conducted a series of additional studies to specifically address the effects of long duration fires on truck and transportation casks. These include:

- Analysis of Severe Roadway Accidents Involving Long Duration Fires -NUREG/CR-7035 (Feb 2011)
- Analysis of Severe Railway Accidents Involving Long Duration Fires -NUREG/CR-7034 (Feb 2011)

- Analysis of Structural Materials Exposed to a Severe Fire Environment -NUREG/CR-6987 (Feb 2009)
- Spent Fuel Transportation Response to the Baltimore Tunnel Fire Scenario – NUREG/CR 6886, Rev.2 (Feb 2009)
- Spent Fuel Transportation Response to the Caldecott Tunnel Fire Scenario – NUREG/CR 6894, (Jan 2007)
- Spent Fuel Transportation Response to the MacArthur Maze Fire Scenario, Final Report – NUREG/CR 7206, (July 2016)
- Spent Fuel Transportation Response to the Newhall Pass Tunnel Scenario, Final Report – NUREG/CR 7207, (July 2016)

All of these studies were open for public comment and show that the risk and consequences of long duration fires on SNF shipments is extremely small.

Facts About Safety Under Current Regulations

A radioactive cask's performance during a transportation accident, including its ability to contain radioactive contents and to provide adequate shielding and criticality safety, has always been a subject of concern to shippers, regulators, and the general public. *A Historical Review of the Safe Transport of Spent Nuclear Fuel*, a DOE report issued August 31, 2016, examines an actual accident involving a truck with a loaded SNF cask that occurred during a shipment in the US in 1971. It was a severe accident in which a truck overturned and then the cask being transported on the truck separated from the trailer. We believe, it was the most severe accident ever to occur during a shipment of SNF. However, the cask was only superficially damaged; it succeeded in keeping all of the radioactive material contained within the canister, and furthermore, the SNF element inside the cask was undamaged. Photographs of the accident scene, the cask damage, the recovery of the cask from the accident site, and the SNF element are included in the DOE report, along with a photograph of the cask upon its return to service after inspection and refurbishment.

The potential release of SNF from a shipment to WCS is very small because:

- The SNF is in the form of a solid fuel pellet.
- The pellets are not explosive or combustible under transport accident conditions.
- The fuel pellets are sealed inside a zircaloy tube.
- The SNF zircaloy tubes are bundled into an assembly and sealed into a one inch thick canister.
- The canister is placed in an NRC certified transportation cask.
- The casks have multilayered walls consisting of a composite of steel and lead or depleted uranium layers and can be 5 to 10 inches thick. The cask lids are bolted to the cask shell with 24 – 48 bolts.

The safety of spent fuel shipments is regulated primarily by the US Department of Transportation (DOT) under Title 49 of the Code of Federal Regulations. DOT regulates:

- Shipment of all classes of hazardous materials, including radioactive material
- Vehicle safety
- Hazards communication (shipping papers, marking and labeling of transportation shipping containers, placarding of vehicles)

- Shipper training
- Emergency response

The NRC imposes additional regulations for commercial spent fuel shipments under Title 10 of the Code of Federal Regulations. NRC regulates:

- The design, fabrication, use and maintenance of spent fuel shipping casks.
- Physical protection of commercial spent fuel in transit against malicious acts.

DOT and NRC coordinate their activities through an interagency Memorandum of Understanding.

In every reinvestigation of SNF transportation risk assessment undertaken by the NRC, the radiological risks of SNF transportation have been estimated to be low in comparison to the risks inherent in truck and rail transportation in general . Furthermore, the collective dose received by the general public from SNF and HLW shipments through their community is 10,000 smaller than the naturally occurring background dose received by the same population in the same period of time per the 2016 DOE report.