# Intermodal Transportation of Spent Nuclear Fuel from Office of Civilian Radioactive Waste Management Sites—9328

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## ABSTRACT

U.S. Department of Energy (DOE) plans to ship most commercial spent nuclear fuel (SNF) by rail in sealed transportation, aging and disposal (TAD) canisters. Based on current and projected dry SNF storage programs, DOE believes the majority of commercial nuclear sites would have the capacity to load and prepare large-capacity, canister-based dry storage canisters such as the proposed TAD systems. Thus, only a small fraction of SNF, such as odd lots and SNF not meeting TAD criteria, is projected for truck (highway) shipment. However, at some commercial facilities rail tracks do not extend to the site, or on-site rail does not extend to the site's proposed loading spot, and intermodal transfers will be required. Advance coordination between DOE and commercial site operators, commercial carriers, specialized carriers and riggers, and state, tribal and local routing officials will be necessary to establish intermodal transfer areas and obtain necessary permits to move heavy loads over highways. Although intermodal transfers can involve a number of steps and several different entities acting in close coordination, such moves are commonly performed by industry and the system requirements are well-understood.

## INTRODUCTION

This paper was developed by the Office of Logistics Management (OLM) in the Department of Energy's (DOE) Office of Civilian Radioactive Waste Management (OCRWM) to provide general information about intermodal transport (IMT) and to discuss some of the issues OLM will need to consider as it prepares to ship spent nuclear fuel (SNF) to the proposed repository at Yucca Mountain, Nevada.

OCRWM does not expect actual shipments to begin before 2020, but has started the transportation planning process well in advance. Because SNF shipments from utilities would not take place for years, much location-specific information either cannot be known at this time or may change between now and commencement of shipping operations. Therefore, this paper is for informational and illustrative purposes only.

## INTERMODAL TRANSPORTATION DEFINED

*Intermodal transportation* is the process of lifting and transferring loads from one transportation mode, such as railcars or oceangoing vessels, to one or more alternative transportation modes, such as regular or modified trucks, barges, rail cars, or other conveyances, to ship the load to its destination.

Most manufactured goods in commerce are shipped via intermodal transport.[1] In the global transportation of consumer goods and industrial commodities of all types, many products are packaged by the manufacturer in standardized transportation containers (i.e. sea-land containers) and shipped on very large container ships. This enables shippers to consolidate their transfer and subsequent movements thereby reducing transfer times, handling costs, damages and losses. For example, U.S. West Coast ports and their associated railroad transfer yards achieve efficient lifting, transfer and movement of containers from ships such that IMT using cross-country rail is often faster and lower cost than water-only movements of goods to the East Coast or to Europe.

IMT is also commonly used where certain types of on-site transportation capabilities may be limited or unavailable, particularly when the item to be moved is over-dimension or overweight. Specialized lifting and transfer equipment such as high-capacity cranes or jacking systems, transporters such as trailers or barges, and heavy-duty prime-movers such as tractors or tug boats, may be required.[2] Utilities often employ specialized equipment to move large, heavy equipment such as reactor vessels, transformers and steam turbines. Intermodal transportation is also used for transferring SNF casks to, from, and around reactor sites as required for fuel management purposes.

## INTERMODAL TRANSPORTATION OF SNF: BACKGROUND

In April 2004, DOE decided to select the "mostly rail" scenario, analyzed in the *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* [DOE/EIS-0250F, February 2002) (FEIS), as the transportation mode both on a national basis and in the State of Nevada to the proposed Yucca Mountain repository.[3] Under the "mostly rail" scenario, DOE will rely on a combination of rail, truck and possibly barge to transport SNF and high-level radioactive waste to the repository, with most of the material being transported by rail.

Beginning in the mid-1980s, many utilities began to license and construct on-site dry cask storage facilities, or Independent Spent Fuel Storage Installations (ISFSIs). At these sites, utilities transfer SNF from its initial storage in water-filled pools to heavily shielded dry storage overpacks. In 2005, the DOE announced plans for a dry canister-based system suitable for transportation, aging and disposal (TAD) at the Yucca Mountain repository. The TAD canister-based system will comprise the bulk of the transportation cask fleet. The TAD canisters will be loaded with commercial SNF and sealed at utility reactor sites. TAD canisters will be placed into a transportation cask, or overpack, at utility reactor sites prior to transport to the repository. TAD canisters loaded with SNF and contained in overpacks are too large and heavy to be shipped by legal weight or overweight truck, so their widespread use requires shipment by rail.

Where direct rail service to a site is not available, IMT will be needed to transfer SNF casks to a rail line. The Department cannot use the Nuclear Waste Fund to pay for improvements or upgrades to public or private infrastructure. Therefore, utility sites lacking rail access or with inadequate rail infrastructure would be served by using intermodal transportation, including a combination of heavy-haul (highway) and barge to transfer casks to a rail line. The location where intermodal lifting, transfer and movement operations would occur would be based on agreements reached between the utility, DOE, local railroads, local officials, and contracted specialized carriers and riggers.

In addition, at a number of sites that have rail service, lifting, transfer and movement on-site may be necessary to bypass SNF buildings too small to handle casks delivered on 85-foot rail cars, or to accommodate preparing of SNF canisters/TADs for transportation. These on-site movements are the responsibility of the utility, as they manage similar on-site moves as part of their ongoing operations.

**OPERATIONAL CONSIDERATIONS FOR INTERMODAL TRANSPORT OF SNF**

Figure 1, Overview of Inter-Modal Activities and Operations, depicts IMT transfer activities and operations. Intermodal lifting and transfer operations would be conducted at a transfer location where empty casks would be delivered to origin sites; this process would essentially be reversed to return loaded casks to their railcars.

The intermodal transfer location could be located outside utility property. Determining its location would depend on site-specific factors and consultations with the utility, railroad, local officials, and specialized lifting and transport contractors. Such consultation would begin at least one year in advance of initial shipments from a site, with a final decision on specific intermodal transfer locations being made as soon as the route is selected. To avoid repeating site preparation and equipment setup, intermodal lifting and transfer equipment (e.g. crane) would usually remain at the transfer location until all the casks slated for near-term delivery are loaded and shipped. Intermodal moving equipment, including heavy-haul trailers, barges, and tractors would cycle back and forth between the transfer location and the SNF storage facility at the utility site, moving casks one at a time. Time saved by utilizing multiple transporters could offset their increased cost, but this would need to be determined on a case-by-case basis.

**Figure 1 Overview of Intermodal Activities and Operations**

| Lift | Transfer | Move |
|---|---|---|
|  |  |  |
| **Operations**<br>Move crane and transport vehicle (railcar) to transfer location – spot adjacent to each other.<br>Set up crane, attach skid lifting fixture to hook.<br>Mate lifting fixture to cask skid and disengage skid-to-railcar securements. | **Operations**<br>Disengage skid-to-railcar securement(s).<br>Lift skid to clear railcar deck.<br>Transfer skid and then secure to heavy-hauler or barge deck. | **Operations**<br>Inspect transporter deck and prime mover(s) and correct any defects.<br>Pre-notify authorities and follow approved route to and from Origin site. |
| **Responsibilities**<br>Establish transfer location – DOE, railroad, local officials, specialized rigger and carriers.<br>Build up access roads, transfer pads and security features - DOE contractor. | **Responsibilities**<br>Provide Skid lifting fixture(s) – DOE<br>Monitor lifting and transfer operations – Specialized Carrier and Riggers (SCR)<br>Secure skid to heavy-haul trailer or barge deck – SCR | **Responsibilities**<br>Inspect trailer and/or barge deck and prime mover – SCR/federal and state agencies.<br>Operate mover over approved routes and follow regulations – SCR. |
| **Interfaces**<br>Delivering railroad.<br>Origin site representatives.<br>State and local routing and permitting authorities.<br>Specialized carriers and riggers. | **Interfaces**<br>Specialized carrier and rigger(s).<br>DOE (to ensure proper load securement) | **Interfaces**<br>State and local overweight/over-dimension routing and permitting authorities.<br>Specialized carriers.<br>Origin site operators and Railroads. |

*Lift:* At the selected location, portable lifting equipment would be delivered and set up. Portable lifting equipment sufficient to lift and transfer 200 tons could itself weigh 200-300 tons, be up to 100 feet long and may come in multiple segments to be assembled and set up at the transfer location. Choice of a transfer location must take into account the delivery and return of lift equipment as well as heavy-haul moving vehicles. Transfer location setup could include construction of temporary access roads and crane platforms. Load platforms or reinforcement pads to prevent destabilizing subsidence during load transfers could consist of leveled gravel and cribbing, or thick wood or steel plates designed to support the combination of crane and skid loads of 350 – 400 tons (700,000 – 800,000 lbs).

*Transfer:* Once the crane is set up and the cask skid lifting fixture is engaged to the crane hook and the cask skid,[4] the skid-to-railcar deck securements would be disengaged. The crane would hoist the skid high enough to clear any load obstructions (such as shear boxes used to prevent load shifting during transportation that are welded to the railcar deck). Then the crane would pivot to move the skid into position over the heavy-haul transport trailer or barge deck. After lowering and securing the load, the skid lifting fixture would be disengaged and the crane returned to its neutral location.

*Move:* With the skid on the heavy-haul trailer or barge load deck and secured, the trailer or barge would be moved using a heavy-duty prime mover (a tractor for highway or a tugboat for barge). Prior to any movement from the intermodal transfer area, the trailer, tractor, barge and/or tugboat would be inspected and any defects corrected. Departure notifications would be made and escorts (as necessary) positioned.

## INTERMODAL TRANSPORTATION COORDINATION ISSUES

From a logistics planning standpoint, there will be complexities regarding lifting, transferring and moving weight-concentrated loads of commercial SNF.

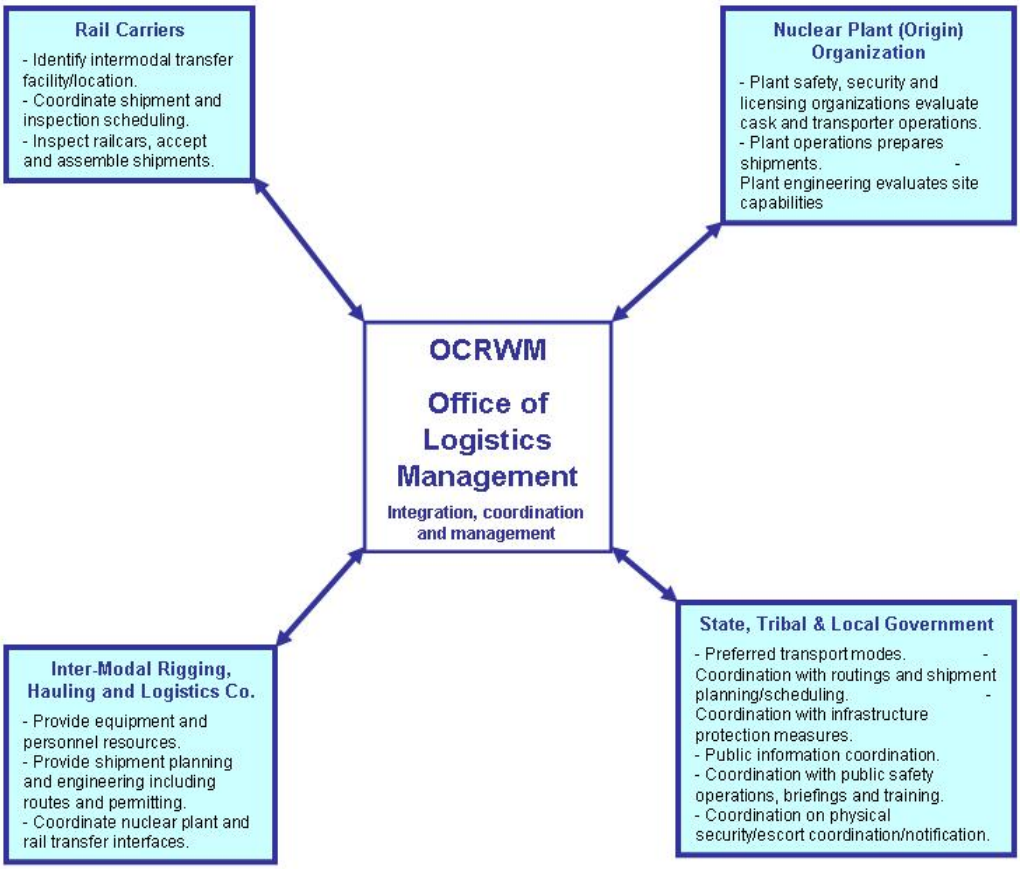
In addition, the Department will need to develop a general concept of operations and description of equipment for off-site heavy-haul truck and barge movements and intermodal transfers of its SNF casks. DOE will also need to develop its approach for involving the commercial transportation industry special carrier operations.

Figure 2, Implementing Intermodal Transportation Operations, (below) summarizes some of the remaining technical issues that will need to be addressed before final transportation plans can be approved and implemented. Because the repository will not begin operations before 2020, there is ample time to resolve these technical issues.

## CONCLUSIONS

DOE intends to make use of the substantial experience and capability among U.S. specialized carriers and riggers to the maximum extent possible to ensure that intermodal transport of SNF will be conducted safely, securely, efficiently, and at reasonable cost. The Specialized Carriers and Riggers Association[5] lists over 1,200 world-wide members in 43 countries who have the qualifications and capabilities to lift, transfer and move specialized over-dimension and overweight loads and consists (e.g. cask skids). Equipment, personnel and resource availability throughout the country is good, with resources being concentrated around major population and construction locations. There are issues that DOE/OCRWM will need to address including institutional coordination, equipment procurement, operating practices, and definition of roles and responsibilities, but these are fully manageable given the time for advance planning prior to shipments to the repository.

**Figure 2, Implementing Intermodal Transportation Operations**




## REFERENCES

[1] For a comprehensive discussion of freight IMT, see U.S. Department of Transportation, Federal Highway Administration, *Quick Response Freight Manual II*, September 2007, Section 13 (found at http://www.ops.fhwa.dot.gov/freight/publications/qrfm2/qrfm.pdf).

[3] *Record of Decision on Mode of Transportation and Nevada Rail Corridor for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nevada*, 69 Fed. Reg. 18557, Apr. 8, 2004.

[4] The term "skid" as used here refers to a pallet, a flat steel structure used to lift and move the cask resting upon it.

[5] Website at http://www.scranet.org/.