

With breakthroughs in specialized equipment allowing the use of rail for projects that traditionally would have been transported only by truck, a new era of radioactive waste rail shipping may have begun.

Innovative Approaches to Rail Transport of Radioactive Waste

By Gene Gleason

One of the most exciting developments in the radioactive materials management field during the past few years has been the tendency of radioactive waste managers to use bulk packaging and rail conveyance to contain and move both large and small quantities of radioactive waste from their nuclear facilities to waste disposal and processing facilities. Reflecting that trend, a panel was held at the recent Waste Management

2004 meeting to explore the economic, safety, and programmatic aspects of using bulk packaging and rail transportation for radioactive waste management. It was the first time that a WM conference had hosted such a discussion.

The panel, held on March 3, 2004, highlighted and discussed new breakthroughs in packaging and the use of specially designed rail equipment, two developments that have prompted the industry to take a fresh look at rail as a secure, cost-effective, and safe means of transportation

for radioactive waste materials. Seven recent case studies were presented: shipments from Piketon, Ohio, to the Nevada Test Site (NTS), plus reports from the Savannah River and Brookhaven National Laboratory sites, the story behind the rail shipment of a damaged reactor vessel head from Ohio to Envirocare of Utah, the movement of radioactive materials by rail from the San Onofre-1 decommissioning project, the use of innovative technology for tracking rail equipment, and an overview of lessons learned from various U.S. Department of Energy rail projects.

Although direct rail and intermodal truck and rail transport has gained wider acceptance and respect from the radioactive material community over the past five years or so, truck transportation continues to be the primary transportation mode. In the past, railroads were used sparingly for certain



Turbine rotor blades from San Onofre-1 being transported in a high-sided gondola railcar.

large, heavy project cargo shipments only. But now, with breakthroughs in specialized equipment that allow the use of rail for projects that traditionally would have been transported only by truck, many believe that a new era of radioactive waste rail shipping has begun.

The timing could not be better. As the industry knows well, there is heightened demand for the movement of large quantities of radioactive waste, spurred by the DOE's Environmental Management program, the Army Corps of Engineers Formerly Utilized Sites Remedial Action (FUSRAP) program, the decommissioning of large nuclear power plants, and other factors. The following four project case studies, summarized from presentations made at the WM conference, show that rail can be used for many types of shipments and that it can improve the safety and economics of a range of transportation projects.

PORTSMOUTH GASEOUS DIFFUSION PLANT

This project's shipment of waste by intermodal rail and truck transport to the NTS from the Portsmouth plant is an important historical milestone for the industry. The Bechtel Jacobs Co., contracted by the DOE, was charged with the job of managing the remediation program at the Piketon, Ohio, facility. Bechtel Jacobs, in turn, hired MHF Logistical Solutions to act as subcontractor to handle the transportation of waste from the site to the NTS.

The first step was the delivery of containers to the site for inspection and preparation. A parking lot-sized area was roped off to stage the containers. The containers were large, innovative intermodal containers, each capable of carrying 625 cubic feet of radioactive waste. In contrast, the traditional method of packaging had been the use of B-25 containers, which are capable of carrying approximately 96 ft³ each.

After the task of mobilizing the containers had been completed, these containers then had to be filled, closed and secured, manifested, and placed on so-called ABC ("articulating bulk commodity") railcars. The weight limit for each container, approximately 40 000 pounds, was determined by the last leg of the journey, from the MHF Logistical Solutions transload facility in Cisco, Utah, to the NTS. Since the NTS facility does not have rail access, the containers were transported by truck from the transload facility.

The Piketon case shows that new developments in bulk packaging, such as the certified bulk material intermodal container, the direct use of private specialized rail equipment, ABC railcars, and intermodal transfer facilities, allow the safe, secure movement of large quantities of material to ultimate disposal. The resulting savings allow accelerated cleanup of the site at significant savings to the taxpayers.

SAVANNAH RIVER SITE

During its decades of operation, the Savannah River Site (SRS) has built up a vast quantity of depleted uranium oxide (DUO) in various forms. Some of the DUO has been stockpiled in 55-gallon steel drums housed in various



Bulk materials inside MHF Logistical Solutions' totally enclosed transload facility in Worcester, Mass., being transloaded from a truck to a gondola railcar, positioned below, for shipment by rail.

buildings on the SRS complex. In early 2003, the DOE decided to ship more than 3000 drums of DUO from the South Carolina site to a disposal site in the western United States.

It was, to say the least, an ambitious undertaking. Because of the length of time the DUO had been stored, as well as the dilapidated state of some of the buildings in which the drums were housed, some of the containers had begun to show signs of deterioration and could not be certified as U.S. Department of Transportation (DOT)-compliant packages for truck shipment.

A new approach was required. After extensive analysis by Westinghouse Savannah River Co. (WSRC), the facility's operator, the decision was made that the best solution was bulk packaging for transportation by gondola railcars. After further review, WSRC opted for using a combination of the soft-sided, Super Load Wrapper™ railcar lining and closure system, in conjunction with privately owned 105-ton capacity, low-sided gondola cars that had been modified with a load securement system to ensure proper transport by the logistics provider, MHF Logistical Solutions.

Accordingly, the 55-gal drums were banded to wooden pallets. A select group of specially trained WSRC waste operation personnel banded four drums onto structurally engineered 4- × 4-ft oak pallets. Each drum weighed an average of 1650 lb, with the total gross weight of each pallet being approximately 7000 lb.



Drums of depleted uranium oxide from the SRS being loaded in an MHF Logistical Solutions gondola railcar.

Fewer Conveyances

Waste loading operations began in April 2003. Each conveyance transported an average of 30 pallets (120 drums), which equaled about 210 000 lb, including the weight of the packaging and blocking/bracing materials. Based on industry standards and DOT over-the-road trucking regulations regarding allowable truck weight limits, the bulk/rail shipping options produced an approximate 4.7:1 truck-to-rail ratio.

The bottom line—WSRC realized substantial cost savings and improved transportation safety by reducing the number of conveyances involved and by the use of rail transport. Analysis indicates a saving of 36 percent, or almost \$300 000, for the 27 shipments by rail versus truck shipments that would have been required to transport the same quantity of drums (if the drums were in proper condition for shipment by truck). Additional savings were realized for the project by using the rail option, because there was no need to repackage the drums before transport.

The project was completed in late summer 2003, safely and ahead of projected schedule.

BROOKHAVEN: RELIABLE SCHEDULING A KEY ISSUE

A project to package and ship 10 000 cubic yards (270 000 ft³) of radioactive waste from Brookhaven National Laboratory, on Long Island, N.Y., over a 60-day period required a tight schedule with little room for delay, regardless of the reason. Contractors and subcontractors were hired based in large part on their demonstrated expertise and not necessarily on low-cost bids. In addition, the railroads and rail equipment suppliers were integral participants in the planning process, which ensured that deliveries were made on time.

Rail transportation offered many advantages for the project. The most obvious was the number of trucks that would have been required to complete a waste shipping campaign of this magnitude over the short time frame. Indeed, the truck equivalent would have been 550 truck shipments, compared to 100 railcar shipments. In addition, it would have been difficult to coordinate truck traffic at Brookhaven, given heightened security and checkpoints. Another factor in favor of rail transportation was avoiding the increased time required for radiological surveys and manifest preparation for truck transport.

To meet the schedule, 15 gondola railcars had to be loaded and shipped each week. Three railcars would be required to be loaded and removed each day, with new ones to be stationed each evening for the next day's work. The movement of railcars was handled by use of a mobile railcar mover that allowed the movement of several empty railcars and five loaded ones. The rail logistics and equipment subcontractor, MHF Logistical Solutions, provided this piece of equipment as a contingency to ensure daily railcar switches without involvement of the railroad.

To ensure compliance with DOT and disposal site acceptance requirements, the materials were loaded and packaged into a DOE-approved railcar liner system, the Super Load Wrapper. The liner was installed within the envelope of the gondola railcar prior to loading. A front-end bucket loader, equipped with a device called a "bucket scale," was used for loading onto the railcars. The bucket scale is designed to weigh each bucket as it is loaded onto the railcar so as to avoid overloading.

The rail weight limit on Long Island is 263 000 lb. With the railcar tare weight at 60 000–63 000 lb, each car could hold a maximum of 200 000 lb. As it developed, not one car in the entire Brookhaven project was overweight.



Drums of depleted uranium oxide from the SRS being covered with liner after being loaded into gondola railcars.



Teams securing tie-down straps for loaded drums of depleted uranium oxide from the SRS, prior to shipment in gondola railcars.



Worker installs Super Load Wrapper lining system in a gondola railcar prior to loading of low-level radioactive waste. Location: Brookhaven National Laboratory, Long Island, N.Y.

The transit time for the shipments from Long Island to the disposal site in Utah was 14 days. Three separate rail lines were involved, starting with the New York & Atlantic Railroad and then to the CSXT Railroad and on to the Union Pacific, which serves the Utah region.

Upon arrival and inspection at the disposal site in Utah, the railcars were positioned at a rollover facility for unloading. Each railcar was secured and then rotated 180 degrees, with the waste materials dumped onto a concrete loading pad. From there, the materials were transferred to high-capacity dump trucks using a front-end bucket loader and then to the designated disposal cell.

The Brookhaven experience serves as an example of the importance of working closely with vendors, railroads, and equipment suppliers throughout both the planning stages and implementation. Selecting subcontractors based on the ability to perform in lieu of low cost proved in the end to save taxpayers significant dollars by enabling the project to be completed within a tight time frame.

DAVIS-BESSE'S CHOICES

The April 2002 challenge facing FirstEnergy Nuclear Operating Co.—

how to transport a damaged 125-ton reactor vessel head (RVH) from its Davis-Besse nuclear power station in Oak Harbor, Ohio, to the Envirocare of Utah disposal facility. The traditional approach to transporting such a large component would have been to segment the component, package the segmented pieces into multiple shielded containers, and transport these with a heavy-haul flatbed



Workers attaching lifting straps to lifting frame to raise MHF Logistical Solutions flexible Lift Liner, which can carry up to 24 000 lb of radioactive materials. Location: Brookhaven National Laboratory, Long Island, N.Y.

truck over public highways for the entire journey. But that option raised a number of serious concerns, not the least of which was the need for multiple heavy-haul conveyances completing single, highly visible shipments—and with that, exposure to the public and possible protesters.

A second, and ultimately preferred, option was to ship the damaged RVH intact by rail, directly from Davis-Besse to Utah.

As part of its research into the rail option, FirstEnergy commissioned a preliminary clearance evaluation based

sonnel and equipment costs to support the multiple crane lifts (to position the RVH for segmentation and packaging); fabrication, monitoring, and demolition of a segmentation building; and heavy-haul permits for highway transportation. Davis-Besse would also have to establish a remote radiation control area (RCA) because the segmentation area would be established in the non-RCA turbine bay.

The second option required full segmentation of the RVH by cutting the flange area from the dome section to produce four quarter-moon sections and one smaller

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on potential maximum dimensions and weights of the damaged RVH that would be loaded onto a heavy-duty railcar. All available rail equipment choices were examined for available load areas and capacities. The various options explored included positioning the damaged RVH in different configurations on railcars to determine the best transport clearance option.

The analysis indicated that the best approach was to stand the damaged RVH upright, install counterbalances and metal saddles on a depressed-center, heavy-duty railcar, and secure the damaged RVH to the railcar. Rail route clearances were secured based on that strategy and configuration.

The bottom line—the RVH would not be visible to the general population or interact with various uncontrolled motorists on the public highways—a big boost for the project's safety.

But that's only part of the story. The other step was to develop a packaging strategy that was economical, feasible, and safe.

While shipping the component in one piece was possible, Davis-Besse also researched two additional packaging options.

The first option required partial segmentation of the RVH by cutting it in half and creating two pieces that were 17 ft 6 inches long by 8 ft 9 in. wide by 10 ft high. Two separate packages would be required to contain the two halves and meet DOT strong-tight requirements.

The advantage of this package design was that the packages would not require rail clearances or any additional packaging once placed into the original container. The disadvantage of this packaging option was that Davis-Besse would be faced with longer packaging time frames; additional vendor costs for segmentation; plant per-

sonnel and equipment costs to support the multiple crane lifts (to position the RVH for segmentation and packaging); fabrication, monitoring, and demolition of a segmentation building; and heavy-haul permits for highway transportation. Davis-Besse would again have to establish a remote RCA because the segmentation area would be established in the non-RCA turbine bay.

Given all those complexities and added costs, the decision was made to utilize the RVH as the package itself.



Davis-Besse reactor head being loaded onto depressed, flat railcar.

Davis Besse directed its vendors to apply InstaCote™ adhesive in conjunction with a shield plate and top hat to meet all applicable DOT regulations to ship the RVH as Class A radioactive waste. This packaging option allowed Davis-Besse to eliminate the various costs, personnel, and exposure associated with segmentation; reduce the amount of time to package the RVH; ship the RVH by secure rail conveyance; and use only two critical lifts to package and position the RVH onto the railcar.

Once the packaging decision was made, Davis-Besse requested that its transportation logistics vendor, MHF Logistical Solutions, work directly with its packaging contractor to ensure the railcar shipping saddles and counterbalances were able to accept the RVH package with minimal amount of onsite work and to guarantee the RVH package would not exceed any of the dimensions identified in the previously completed clearance evaluations of the travel route.

With all the preshipping analysis completed and conveyance and packaging decisions made, plans were made to load the RVH onto a railcar. Testing was done to ensure the container would be properly set upright and loaded to make sure there would be no jeopardizing the integrity of the container or alterations to the tie down securement locations.

Also, with the completion of packaging, rigging/lifting, and securing blocking/bracing plans and the fabrication and installation of the shipping saddles and counterbalances to the heavy-duty railcar at a designated offsite location, the railcar would be ready to load once it arrived at the loading site.

As an additional step, an RVH Transportation and Emergency Response Plan was prepared by MHF Logistical Solutions and approved by Davis-Besse and their team detailing the specific route the RVH would travel including the main switch locations between railroads. Specific instructions were developed in case of an emergency, package breach or damage, or delay.

In the end, the shipment took 12 days to reach Clive, Utah, without any delays at the switchyards or during the interline process (railcar handoff to the next carrier) from one

rail line to another. And perhaps most important, the railcar and package did not interact with any personnel outside of the workers at the various rail lines completing inspections at the switchyards.

A GROWING TREND

New packaging techniques, innovative rail equipment, and the increased use of rail transportation have been important ingredients in

the success of many large and small radioactive waste shipping campaigns over the past few years. The examples discussed at the WM conference in Tucson portend a growing trend for the nuclear industry. ■

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