Proceedings of the 15th International Symposium on the Packaging and Transportation of Radioactive Materials
PATRAM 2007
October 21-26, 2007, Miami, Florida, USA

DOE INITIATIVE TO IDENTIFY ROUTES FOR SHIPPING SPENT NUCLEAR FUEL AND HIGH-LEVEL RADIOACTIVE WASTE TO YUCCA MOUNTAIN

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ABSTRACT

The Department of Energy's (DOE) Office of Civilian Radioactive Waste Management (OCRWM) is working to identify preliminary national suites of highway and rail routes for shipping spent nuclear fuel (SNF) and high-level radioactive waste (HLW) from commercial and DOE sites to the Yucca Mountain repository. This initiative is meant to help develop and begin implementing a comprehensive national spent fuel transportation plan. The OCRWM national transportation plan will address state, local and Tribal concerns as well as the interests of railroads and other affected stakeholders.

OCRWM is responsible for developing and implementing a safe and secure transportation system to the repository. OCRWM's Office of Logistics Management (OLM) encourages and supports participation of program stakeholders in a process to identify suites of national rail and highway routes. The principal objective in the routing process is to identify preliminary suites of national highway and rail routes that reflect responsible consideration of the interests of a broad cross-section of stakeholders. This will facilitate transportation planning activities to help meet program goals, including providing an advanced planning framework for State and Tribal authorities; supporting a pilot program for providing funding under Section 180(c) of the Nuclear Waste Policy Act to eligible States and Tribes through whose jurisdictions DOE plans to transport SNF and HLW; allowing sufficient time for railroads to conduct security and operational reviews in advance of shipments to Yucca Mountain; and ensuring routes for shipments are identified sufficiently in advance to support utility planning and readiness for transportation operations.

Concepts for routing and routing criteria have been considered by several state regional groups supported by cooperative agreements with OLM. OCRWM is also working with

transportation service providers to ensure the criteria are consistent with operating practices. Specifically, OCRWM will coordinate with rail and truck carriers, the Federal Railroad Administration, Federal Motor Carrier Safety Administration, the Association of American Railroads, and others involved in the transportation industry. These coordination efforts will ensure the experience, knowledge, and expertise of the transportation industry, regulatory agencies, affected sites and communities, and current shippers are considered in the process to identify the preliminary national suites of routes.

INTRODUCTION AND BACKGROUND

The Nuclear Waste Policy Act (NWPA) of 1982, as amended, established OCRWM within DOE to construct and operate a geologic repository for the disposal of spent nuclear fuel and high-level radioactive waste. Following the 2002 approval of Yucca Mountain, Nevada, as the site for the nation's first repository for SNF and HLW, OCRWM began to accelerate development of the transportation system. The Office of Logistics Management (OLM) was established to design and implement a transportation system to support waste acceptance and disposal. OCRWM is working collaboratively with interested parties to conduct studies, gather information, develop specific policies, and take decisions that will lead to a safe, secure and effective operational transportation system.

OCRWM's *Strategic Plan for the Safe Transportation of Spent Nuclear Fuel and High-Level Radioactive Waste to Yucca Mountain: A Guide to Stakeholder Interactions*[i] commits to collaboratively working with States through State Regional Groups (SRGs), and with Tribal governments, to identify transportation routes. Identifying a suite of potential routes will ultimately allow State, Tribal and local planning and resource allocation to be focused along a more defined set of routes.

OCRWM is planning to begin shipments to the Yucca Mountain repository no earlier than May 2017. The national rail and highway networks are complex and dynamic systems, and both expect considerable development in the near term. Therefore routes identified now may not be the actual ones utilized at the time of shipment from particular sites. OCRWM believes it is prudent to begin the route identification process now for several reasons. These reasons ensure that there is operational flexibility and logistical optimization while maintaining a set of routes for planning purposes. These reasons include:

- The experience of other radioactive materials shipping campaigns indicates that routing can be an intensely controversial issue. Routing is a "keystone" issue in transportation planning, because routing decisions determine which corridors, jurisdictions and people are, and are not, affected by the transportation activity. Route identification can be expected to generate intense public and governmental interest and, therefore, it is critically important to allow sufficient time to make routing decisions based on objective, transparent criteria that enhance safety, security and merit public confidence.
- Section 180(c) of the Nuclear Waste Policy Act requires DOE to provide funds and technical assistance to train emergency responders and public safety officials in preparation for repository shipments through their jurisdictions. The grant program

will focus on the specific needs posed by shipments of SNF and HLW. Preliminary identification of routes will support a pilot program for providing funding to eligible States and Tribes through whose jurisdictions DOE plans to transport SNF and HLW.

- In 2006, the National Academy of Sciences issued a report entitled *Going the Distance: The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States.*[ii] That report strongly endorsed DOE's approach of involving State and Tribal governments in its decisions on routing, and specifically recommended that "DOE should identify and make public its suite of preferred highway and rail routes for transporting spent fuel and high level waste to a federal repository as soon as practicable to support State, Tribal and local planning, especially for emergency responder preparedness."
- Operational and logistical analyses and long-term planning require inputs, including a rudimentary knowledge of routing, to optimize system performance: maximizing shipment efficiency while decreasing costs, distances and time in transit. Distances and time in transit are directly related to accident and dose rates, as well as costs.
- Shipments to Yucca Mountain will primarily involve rail (over 90% of the total mass shipped and 140 of the expected 175 shipments per annum) and many railroads will be involved in handling cask shipments. OCRWM has not yet determined what contractual or other arrangements with rail carriers or others it will employ; however, a preliminary understanding of likely routes and shipment volumes from customer sites will provide a meaningful starting point for discussions and negotiations.
- The general principles of security based on non-predictability of routes, seasonal or weather conditions that may require alternative routes as well as operating and emergency situations requiring rerouting (i.e. maintenance of track, flooded roadway), require routing alternatives.
- The availability of specific routes, due to rail industry operational concerns will impact shipments. Examples of these operational concerns include: regulatory and legislative controls, infrastructure capacities and limitations (load bearing, clearances, tunnels, class of track), current and future burden (traffic), as well as other factors will also be considered.

NATIONAL ROUTE PLANNING NEED, OBJECTIVE AND PROCESS

Representation from a broad base of stakeholders, via the Transportation External Coordination Working Group (TEC) membership and others, allows for responsible consideration of the interests of a broad cross-section of stakeholders while helping to ensure that the experience, knowledge, and expertise of the transportation and nuclear industries, regulatory agencies, State, Tribal and local governments and others who have an essential interest are captured in the process of criteria development and ultimately identifying a suite of routes.

ROUTING TOPIC GROUP

In October 2006, the TEC Working Group formed the Routing Topic Group (RTG) to provide detailed focus on this issue. The key activities planned for the RTG include:

1. Developing a consensus definition of the "suite of routes" concept;
2. Developing fundamental principles for routing, based on regulatory requirements and operational experience;
3. Developing and comparing approaches for route identification ("routing criteria"); and
4. Identifying a planning-basis suite of routes sufficient to support logistical planning and implementation of NWPA Section 180(c) pilot program.

In the interest of cooperative planning, DOE has stated its willingness to consider any reasonable approach for carrying out the above activities. The topic group meets twice yearly, and also holds monthly conference calls. The group has a website containing a work plan, meeting and conference call notes, and a roster of participants. DOE intends that the topic group will provide cooperative, detailed input into route analysis, evaluation, and identification. The group's work will feed into, and profit from, other efforts undertaken by member stakeholders and other entities to provide cooperative development of a routing approach and process. Initial research and comment on potential routes and routing criteria have recently been considered from two regional groups of the Council of State Governments: the Midwestern Office and Eastern Regional Conference.

BENCHMARKING

Yucca Mountain shipments will build upon a well-established history of domestic SNF shipments. In carrying out its mission, OLM will build on the Department of Energy's experience of over 40 years in successfully planning and executing the transportation of hazardous shipments, including prior experience shipping SNF and radioactive waste, such as the Foreign Research Reactor Spent Fuel Program and the Waste Isolation Pilot Project. These benchmarking efforts will provide useful background information in the national routing effort. The routing process will include examination of previous shipping campaigns to take advantage of lessons learned. The OCRWM routing initiative will also be closely coordinated with DOE organizations currently conducting SNF shipments such as the Naval Nuclear Propulsion Program (NNPP).

Information must also be obtained from operators of the commercial reactor and DOE sites, where the shipments will originate. This includes data about local infrastructure and other needs to ensure that the interests of the operators of shipping sites and their communities are reflected during transportation planning. Concurrent with the coordination of other program stakeholders on criteria development and identification of routes, OCRWM will work with transportation service providers to ensure the criteria used in routing development are consistent with operational and safety practices. Specifically, OCRWM will work with rail and truck carriers, the Department of Transportation, the Association of American Railroads, and others involved in the transportation industry. The purpose of the coordination efforts will be to help ensure that the experience, knowledge, and expertise of

the transportation industry, other Federal agencies, affected sites and communities, and current shippers are all considered in the process to identify preliminary national suites of routes.

ROUTING CRITERIA

DOT, DOE and NRC regulations, industry standards and DOE policies will comprise the starting point for routing criteria discussions. Additional routing criteria being suggested include: the desire to minimize emergency response time; the ability to retrieve casks in the event of an accident; avoiding difficult to evacuate population centers; minimizing transit during inclement weather; avoiding hazardous situations; and imposing day-of-week and time-of-day restrictions.

SNF and HLW are only one category of hazardous materials, and hazardous materials are shipped safely and securely by all modes on many different routes every day. Nonetheless, the characteristics of individual routes may differ sufficiently to cause some routes to be preferred to others for particular types of hazardous materials shipments.

In the process of identifying the routes that it will use, OCRWM is identifying a potential set of routing principles that can be used to identify a national suite of routes for discussion among DOE and its stakeholders.

Highway Routing:

The U.S. Department of Transportation (DOT) has established highway routing requirements for Highway Route Controlled Quantity shipments of radioactive materials. The DOT routing guidelines require a carrier to ensure that a motor vehicle containing the specific quantities of radioactive materials use "preferred routes," defined by the DOT as the interstate highway system and beltways. States, in order to designate alternative routes, must follow a prescribed process and demonstrate that use of the alternates would minimize radiological risk to the public. States must also document there has been consultation with affected jurisdictions and demonstrate that alternative routes enhance overall public safety.

Rail Routing:

In April 2004, OCRWM selected rail as the preferred mode for shipping SNF and HLW[iii] to the repository, both nationally and in the State of Nevada. Currently, no routing regulations exist for railroads, in part because rail rights-of-way and infrastructure are privately owned. Under the existing system, the shipper and rail carrier can plan the route considering the factors important to service and operational requirements.

DOE M 460.2-1, the *U.S. Department of Energy Radioactive Material Transportation Practices Manual*[iv], establishes a set of standard transportation practices for use in planning and executing offsite shipments of radioactive materials. For rail routing of SNF, the following factors are considered: (1) distance traveled; (2) the number of interchanges between railroads along the route; (3) the use of higher-class track, (e.g., "key routes," as defined by the Association of American Railroads); and (4) operational input from carriers.

PLANNING PRINCIPLES

Many planning principles, including safety and security as well as operational and industrial practices need to be considered in planning the operations, and therefore routing, of the National Transportation System.

Safety and Security Planning Principles

Safety is always the key concern, and safety considerations can be grouped into four categories: operations safety, public safety, radiological safety, and regulatory compliance.

Operations Safety: Rail carriers have the best knowledge regarding the relative safety of train operations over alternative routes.

U.S. railroads have sophisticated systems for managing the flow of commodities on the rail lines they own and operate. These systems have the capability to provide managers real-time information regarding: a) the kinds of materials moving over each section of track; b) the safety status of the track and other fixed infrastructure; and c) the potential for rail-traffic interactions with respect to OCRWM shipments. All three of these factors will be important to safe rail transportation of nuclear waste.

The kinds of materials moving over a section of track can be important because of the potential for interactions with OCRWM shipments in the event of accidents. In planning for shipments to Yucca Mountain, OCRWM would likely request that railroad managers select the routes used to limit the length of time and the distance that OCRWM shipments share with other shipments of certain hazardous commodities.

Among other factors, the railroads and FRA regulations limit train speeds according to the class of the track being used. Track class encompasses track type, conditions, and geometry. Train speeds are also limited by environmental factors, train consist, and commodity. For example, Key Trains, the designation as per AAR Circular OT-55[v] required for trains transporting spent nuclear fuel and high-level radioactive waste, are limited to a maximum speed of 50 m.p.h.

Over any section of track the maximum allowable speed of trains may change due to dynamic factors such as the class of track and environmental changes. For example, track condition changes as a consequence of use and weather conditions. Railroad companies and the FRA monitor the condition of track to ensure that trains operate safely and to determine when and where to conduct track inspections and maintenance, as described in the FRA Safety Compliance Oversight Plan[vi].

Public Safety: State, Tribal, and local governments have the best knowledge regarding unique public safety vulnerabilities along routes through their jurisdictions.

States and Tribes have primary responsibility for ensuring the safety of their residents and for responding to any accident which might occur. They know best how and where to

deploy their public safety and emergency response resources. They will also know which routes will provide their response resources the greatest capabilities to recover from unusual conditions and incidents that might occur. The NWPA Section 180(c) funding and technical assistance provided by DOE for training local public safety officials in safe routine transportation and emergency response procedures will enhance State and Tribal preparedness along routes that are identified for shipments to Yucca Mountain.

Radiological Safety: Routes that reduce overall time in transit are preferred.

In its report *Identification of Factors for Selecting Modes and Routes for Shipping High-Level Radioactive Waste and Spent Nuclear Fuel*[vii], the DOT concluded that there are six primary mode and route factors that are the most important to public safety. In selecting modes and routes for shipping SNF and HLW, shippers would consider general population exposed, occupational population exposed, shipment duration, accident rate, trip length, and amount of material. The report illustrates how each of these factors affects a measure of radiological risk but noted that shipment duration most strongly affects the safety of radioactive material transportation because it has a direct relationship with incident-free radiological exposure. Shipment duration incorporates major considerations of route length, vehicle speeds, and the number and duration of both delays and stops en route.

Regulatory Compliance: Safety for highway shipments is ensured by adherence to regulatory requirements of the U.S. Department of Transportation for routing Highway Route Controlled Quantities (HRCQ) of radioactive materials.

Rules in 49 CFR 397.101 regulate motor carriers that transport highway route controlled quantities of radioactive materials, which include spent nuclear fuel and high-level radioactive waste. Commercial carriers must follow these rules when selecting the routes used, including pick-up routes used to access the nearest preferred route, preferred routes that reduce time in transit, and delivery routes. OCRWM shipments of commercial spent nuclear fuel or high-level radioactive waste by truck will follow these requirements.

Operations and Commercial Principles

Apart from matters of safety, OCRWM has identified and is discussing with stakeholders some additional consideration of concern for shipment operations. These are security and operational flexibility, operational efficiency, operational utility, and commercial practicability.

Security and Operational Flexibility: More than one unique and practical route from each site to Yucca Mountain should be available for shipments.

Transportation security will be enhanced if persons who do not have a need to know are unable to predict the routes that will be used by specific shipments. Also, weather or other unforeseeable events could make a specific route unsafe, impassable, or undesirable for use. Such conditions can arise quickly and require rerouting of shipments. For such cases,

alternative routes will be used. In some cases, only one practicable mode or route may be available, but that does not mean shipments cannot be made securely.

Operational Efficiency: Direct routes that reduce time in transit and (for rail shipments) minimize the number of interchanges of shipments between different carriers should be preferred.

Shipments are expected to employ and involve substantial DOE, federal, State, Tribal, local, and transportation carrier resources. It will be important and necessary to make efficient use of these resources. Time in transit will possibly be the most important factor that will affect requirements in several resource areas including, carrier operations, transportation security, shipment tracking, and vehicle and cask fleet utilization. Time in transit will be affected by the number of rail carrier interchanges, distance traveled, type and amount of other traffic using the route, route conditions, and environmental conditions. Some of these factors will be dynamic and could change over time.

Practicability: More than one commercially practicable route from each site to Yucca Mountain should be available so that in the event of an emergency or route disruption shipments can be rerouted.

Occasionally, events and conditions (e.g., inclement weather, construction or maintenance, accidents, security, and public events) along a route may render it temporarily unusable for shipments to Yucca Mountain. Temporary adjustments will need to be described in planning documents. Considerations for these conditions are detailed in the *Radioactive Material Transportation Practices Manual* (DOE M 460.2-1).

The special requirements for shipping SNF and HLW can impact the usual business practices and operations of transportation carriers. These operations involve routine, often time-sensitive, continuous movements of commodities for all sectors of the U.S. economy. It is important to ensure Yucca Mountain shipments do not disrupt other rail traffic.
In order to decrease the potential for OCRWM shipments to impact "normal" operations, the routes that are used will likely be those determined able to accommodate the special needs of the shipments while also allowing routine, safe flow of other rail traffic and operations. OCRWM expects to coordinate extensively with the carriers on these issues.

FUTURE REGULATORY AND LEGISLATIVE CONSTRAINTS

Given the changed security climate, regulatory agencies and legislative bodies are giving greater attention to routing issues, and future developments in this area may impact how OCRWM routing decisions are made. Two current Notices of Proposed Rulemaking from the U.S. Departments of Transportation and Homeland Security reference radioactive materials being transported by rail and are due to be issued in December of 2007. In addition, Congress passed, and the President signed, the "Implementing the 9/11 Commission Recommendations Act" (Public Law No: 110-53) on August 3, 2007. In brief, the legislation requires that carriers annually provide written analysis of the safety and security of routes used, and at least every three years conduct a review of the routes for safety and security concerns in consultation with State, local and Tribal officials. The

reviews are meant to identify practicable alternatives and provide comparative safety and security assessments which consider mitigation, remediation, potential economic effects and the utilization of carrier interchange agreements.

CONCLUSIONS

The path toward developing a safe, secure, and efficient transportation system for shipments of SNF and HLW to Yucca Mountain will require the participation of many interested parties. Real cooperative planning is sometimes contentious, and requires a commitment from all involved parties to act in good faith and to employ their best efforts in developing mutually beneficial solutions. Identifying routes to Yucca Mountain, and engaging in planning and preparedness activities with affected jurisdictions and other stakeholders, will take time. OCRWM is committed to a cooperative approach that will ultimately enhance safety, efficiency and public credibility.

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