**TESTIMONY OF ROBERT J. HALSTEAD
ON BEHALF OF
THE STATE OF NEVADA**

**BEFORE THE
COMMITTEE ON ENERGY AND NATURAL RESOURCES
UNITED STATES SENATE**

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I am Robert J. Halstead, Transportation Advisor, Agency for Nuclear Projects, State of Nevada. I have worked on nuclear waste transportation issues for the past 24 years. I have been Transportation Advisor to the Nevada Agency for Nuclear Projects since 1988. My primary responsibility is assessment of the impacts and risks of transporting spent nuclear fuel and high-level radioactive wastes to the proposed Yucca Mountain repository site. In addition to reviewing the U.S. Department of Energy's Draft and Final Environmental Impact Statements for Yucca Mountain, my recent work for Nevada includes managing contractor studies on the vulnerability of shipments to sabotage and terrorist attack, on the radiological consequences of severe highway and rail accidents, and on radiation exposures from incident-free shipments.

From 1983 to 1988, I was senior policy analyst for the State of Wisconsin Radioactive Waste Review Board, an agency created by the Wisconsin Legislature to represent the State in dealings with the U.S. Department of Energy, the U.S. Nuclear Regulatory Commission, other federal agencies, and nuclear electric utilities. I advised the Board and Wisconsin's congressional delegation on federal legislation that resulted in the Nuclear Waste Policy Act of 1982, and the Nuclear Waste Policy Amendments Act of 1987. I monitored on-going spent nuclear fuel shipments; evaluated transportation impacts of repository candidate sites in Wisconsin, Minnesota, and Michigan; and represented the Board on all matters pertaining to transportation.

From 1978 to 1983, I worked for the State of Wisconsin Energy Office. I evaluated utility plans for nuclear and coal-fired power plants, and represented the State in proceedings before the Public Service Commission of Wisconsin. I prepared policy recommendations on transportation of coal, petroleum, spent nuclear fuel, and low-level radioactive wastes.

I have also worked as a consultant on nuclear waste transportation and storage for the States of Minnesota, Tennessee, and Texas. I also advised the Law and Water Fund of the Rockies on the transportation impacts of the Private Fuel Storage facility proposed for the Skull Valley Goshute Reservation in Tooele County, Utah.

The U.S. Department of Energy's Final Environmental Impact Statement for Yucca Mountain

The Department of Energy (DOE) released the Final Environmental Impact Statement (FEIS) for Yucca Mountain on February 14, 2002. The FEIS was made available from DOE's website (www.ymp.gov) shortly thereafter. DOE apparently published no paper copies of the FEIS for direct distribution to the public. DOE has apparently provided paper copies of the FEIS to DOE Reading Rooms in some cities.

The FEIS "analyzes a Proposed Action to construct, operate and monitor, and eventually close a geologic repository for the disposal of spent nuclear fuel and high-level radioactive waste at Yucca Mountain." [p. 1-3] Transportation of spent nuclear fuel and high-level radioactive waste from 72 commercial and 5 DOE sites across the United States is an integral part of DOE's Proposed Action. The Proposed Action would "require surface and subsurface facilities and operations for the receipt, packaging, possible surface aging, and emplacement of spent nuclear fuel and high-level radioactive waste" and "transportation of these materials to the repository." [FEIS, p. 2-5]

DOE has made no final decisions about the transportation options proposed in the FEIS. Decisions about "how spent nuclear fuel and high-level radioactive waste would be shipped to the repository (for example, truck or rail) and how spent nuclear fuel would be packaged (uncanistered or in disposable or dual-purpose canisters) would be part of future transportation planning efforts." [FEIS, p. 2-5] For shipments nationally, "DOE would use both legal-weight truck and rail transportation, and would determine the number of shipments by either mode as part of future transportation planning efforts." [FEIS, p. 2-13] "DOE could use one of three options or modes of transportation in Nevada to reach the Yucca Mountain site: legal-weight trucks, rail, or heavy haul trucks." [FEIS, p. 2-48]

The FEIS does not contain a specific transportation plan. DOE's discussions of potential transportation scenarios and DOE's transportation impact analyses are spread over more than 750 pages in the FEIS Summary, eight chapters, and four appendices. In order to obtain print-optimized files for the FEIS Summary and Reader's Guide, it is necessary to go to DOE's website and download 48,425 KB. To obtain the eight chapters and four appendices dealing with transportation and related issues, it is necessary to download more than 113,300 KB.

Projected Nuclear Waste Inventories and Shipment Numbers

Under the Proposed Action, DOE would transport 70,000 metric tons of heavy metal (MTHM) of spent nuclear fuel and high-level radioactive waste to a repository over 24 years (2010-2034). The Proposed Action complies with Section 114(d) of the Nuclear Waste Policy Amendments Act. The FEIS also evaluates the transportation impacts of the entire projected inventory of about 120,000 MTHM over 38 years (2010-2048). [Pp. S-77 to S-78]

The FEIS estimates the total projected inventory of commercial spent nuclear fuel (SNF) and high-level radioactive wastes (HLW) to be generated through 2046. This inventory, referred to by DOE as Module 1, includes 105, 000 MTHM of commercial SNF, 2,500 MTHM of DOE SNF, and 22,280 canisters of DOE HLW (equivalent to about 11,500 MTHM). DOE also evaluates a projected inventory, referred to as Module 2, in which 2,000 cubic meters of Greater-than-Class-C (GTCC) waste, and 4,000 cubic meters of Special-Performance-Assessment-Required (SPAR) waste, are added to Module 1. [FEIS, p. S-78, and Appendix A]

Yucca Mountain, under DOE's Proposed Action, would receive the following wastes over 24 years (2010-2033): 63,000 MTHM of commercial SNF, 2,333 MTHM of DOE SNF, and 8,315 canisters of DOE HLW (equivalent to about 4,667 MTHM). [FEIS, p. S-78] At the end of DOE's Proposed Action, in 2034, there would still be about 42,000 MTHM of commercial SNF stored at 63 nuclear power plant sites in 31 states, 167 MTHM of DOE SNF stored at DOE sites in 4 states, and 13,965 canisters of DOE HLW (equivalent to about 6,833 MTHM) stored at DOE sites in 3 States. Additionally, all of the projected GTCC and SPAR wastes would also still be stored at 63 commercial and 4 DOE sites in 32 states. [FEIS, Pp. S-78, A-2 to A-16, and J-10 to J-22]

DOE developed two national transportation scenarios - "mostly legal-weight truck" and "mostly rail" - in order to estimate the number of shipments required under the Proposed Action (24 years) and under Modules 1 and 2 (38 years). DOE adopted this approach "because, more than 10 years before the projected start of operations at the repository, it cannot accurately predict the actual mix of rail and truck transportation that would occur from the 77 sites to the repository. Therefore, the selected scenarios enable the analysis to bound (or bracket) the ranges of legal-weight truck and rail shipments that could occur." [FEIS, p. J-10] DOE states that the "estimated number of shipments for the mostly legal-weight truck and mostly rail scenarios represents the two extremes in the possible mix of transportation modes." [FEIS, p. 6-35] Table 1 shows the number of shipments estimated by DOE for these transportation and inventory scenarios.

Table 1. DOE Estimated Number of Shipments for Transportation Scenario Combinations

Inventory Scenario	(Mostly Truck) Truck Shipments	(Mostly Truck) Rail Shipments	(Mostly Rail) Truck Shipments	(Mostly Rail) Rail Shipments
Proposed Action (2010-2034)	52,786	300	1,079	9,646
Module 1 (2010-2048)	105,685	300	3,122	18,243
Module 2 (2010-2048)	108,544	355	3,122	18,935

Source: DOE/EIS-0250, Table J-11

DOE's "mostly legal-weight truck" national scenario would result in the largest number of shipments. Over 24 years, there would be more than 53,000 shipments, or about 2,200 per year. Over 38 years, there would be about 108,900 shipments, or about 2,870 per year.. By comparison, over the past 40 years, there have been less than 100 shipments per year in the United States.*

DOE's "mostly rail" national scenario would result in fewer cross-country shipments than the "mostly legal-weight truck" scenario. Over 24 years, there would be more than 10,700 cross-country shipments, or about 450 per year. Over 38 years, there would be more than 22,000 cross-country shipments, or about 580 per year.

However, the "mostly rail" cross-country shipment numbers do not include barge and heavy haul truck shipments from 24 reactor that lack rail access, which would add 2,200 shipments for the Proposed Action and 4,065 shipments for Module 2. Nor do the DOE numbers include the heavy haul truck shipments required in Nevada if there is no rail spur to Yucca Mountain, which could add 9,646 shipments for the Proposed Action and 18,935 shipments for Module 2.

When the barge and heavy haul truck shipments are included, DOE's "mostly rail" total for 24 years could be more than 22,500 shipments, or about 935 per year. DOE's "mostly rail" total for 38 years could be more than 45,000 shipments, or about 1,185 per year.

Yucca Mountain Shipment Modes

The DOE "mostly legal-weight truck scenario" is the only national transportation scenario that is currently feasible. All 72 power plant sites and all 5 DOE sites can ship by legal-weight truck. At present, there is no railroad access to Yucca Mountain., and the feasibility of long-distance heavy haul truck (HHT) transport of rail casks in Nevada is unproven.

The DOE "mostly rail scenario" is unlikely to occur. Even if DOE is able to develop rail access to Yucca Mountain, the objective of shipping 90 percent of the commercial SNF by rail is unrealistic. DOE acknowledges that 25 of the 72 power plant sites cannot ship directly by rail. Nevada studies show that number could be up to 32 sites. The "mostly rail" scenario assumes that DOE can ship thousands of casks by barge into Boston, New Haven, Newark, Jersey City, Wilmington (DE), Baltimore, Norfolk, Miami, Milwaukee, Muskegon, Omaha, Vicksburg, and Port Hueneme (CA). Alternately, DOE would have to move thousands of casks from reactors to rail lines using HHTs, each of which will require special state permits and route approvals.

The "mostly rail scenario" assumes that DOE can construct a new rail spur to Yucca Mountain, 99 to 344 miles in length, at a cost of more than $1 billion. Even the shortest of the five spur options would be the largest new rail construction project in the United States since World War I. Environmental approvals, right-of-way acquisition, and litigation could delay rail construction for 10 years or more. In the FEIS, DOE declined to identify a preference among the five potential rail corridors to Yucca Mountain.

The alternative to rail spur construction, delivery of thousands of large rail casks by 220-foot-long HHTs over distances of 112 to 330 miles on public highways, is probably not feasible. HHT route constraints include highly congested segments through rapidly urbanizing areas, and steep grades and sharp curves through high-mountain passes. All of the potential HHT routes would require substantial upgrading, and would likely cost more than a rail spur. State permits and operating restrictions apply to all use of HHTs in Nevada. In the FEIS, DOE declined to identify a preference among three potential locations for intermodal transfer stations.

Certain programmatic and policy factors favor truck shipment, especially during the first 10-15 years of repository operations. DOE's "hot repository" thermal loading strategy may require truck shipment of 5-10 year-cooled SNF. Some utilities may exercise contract options to ship 5-10 year-cooled SNF from storage pools by truck, rather than shipping older SNF by rail. DOE's transportation privatization plan does not require transportation service providers to ship oldest fuel first or to maximize use of rail. Indeed, under DOE's fixed-cost contracting approach to privatization, rail transportation may not be cost-competitive with legal-weight at many sites.

Yucca Mountain Transportation Routes

In the Draft EIS, DOE chose to conceal the specific routes used for impact and risk analyses in Chapter 6 and Appendix J. DOE did not identify the routes in its Federal Register notice nor in its public notices of scheduled hearings. During the public hearings that began in September, 1999, DOE provided some state-specific transportation maps at individual hearings around the country. But DOE did not release national maps showing the full cross country routes from shipping sites to Yucca Mountain until sometime in late January, 2000, near the end of the public comment process

In the Final EIS, DOE decided to reveal the routes used for risk and impact analysis. DOE included national and state maps. [FEIS, Figure J-5, and Figures J-31 to J-53] The FEIS states that "DOE has not determined the specific routes it would use to ship spent nuclear fuel and high-level radioactive waste to the proposed repository." [FEIS, p. J-23]

The FEIS truck routes were generated by the HIGHWAY computer model, and generally represent the quickest truck travel routes consistent with the current Federal routing regulations (HM-164). DOE refers to these as "representative" routes. [FEIS, p. 6-5] However, with two exceptions, DOE's cross-country routes agree with the highway routes identified in previous routing studies by DOE and Nevada contractors. Absent additional state designation of preferred alternatives or DOE policy decisions, we believe that these are the most likely highway routes to Nevada, with two notable exceptions.

In between publication of the Draft and Final EISs, the State of Colorado exercised its authority under U.S. DOT regulations to prohibit SNF and HLW shipments on I-70 west of Denver. Colorado took this action to avoid shipments through the Eisenhower and Glenwood Tunnels. Under the Colorado designation, shipments would be diverted north or south on I-25. Nevada routing analyses show that the new preferred route to Yucca Mountain for shipments using I-70 would be through the Northeastern Denver metropolitan area to I-25, then connecting with I-80 at Cheyenne, Wyoming. For reasons we do not understand, DOE's FEIS map has the trucks on I-70 turning north on I-29 to connect with I-680/I-80 near Omaha, so that the major stream of shipments from the Southeastern region avoids Kansas and Colorado altogether. [Figures 35, 39, and 47] Preliminary analysis indicates that DOE's route choice could add more than 20 miles to each of tens of thousands of shipments, compared to the new preferred route in Colorado. We are continuing to study this route.

A second DOE highway route of concern was called to our attention by the State of Pennsylvania. DOE's FEIS map shows shipments from six reactor sites using the Pennsylvania Turnpike (I-76) West of Harrisburg. [Figure 49] Pennsylvania authorities informed us that all placarded hazardous material shipments must use bypasses to avoid four tunnels along this segment of the Turnpike, and that no SNF shipments have ever used this route. It is not clear how DOE could have missed these restrictions, since the Pennsylvania bypass requirements are clearly stated in a U.S. DOT guidance document cited as a reference in the FEIS. We are continuing to study this route also.

Otherwise, DOE's FEIS routes agree with those identified by Nevada as most likely routes to Yucca Mountain. The primary truck routes out of New England and the Middle Atlantic states converge on I-80/90 near Cleveland, pick up shipments from Midwestern reactors, and follow I-80 west from Chicago through Des Moines, Omaha, Cheyenne, and Salt Lake City to I-15.

The primary truck routes out of the South are I-75 from Florida, I-24 from Atlanta, and I-64 from Virginia. These routes converge on I-70 near St. Louis, and follow I-70 west through Kansas City and Denver to I-25, then join I-80 near Cheyenne..

The primary route from the Pacific Northwest is I-84 to I-15 in Utah. Other major routes are I-40 and I-10 from the Mid-South and I-5 in California. These routes converge on I-15 in Southern California.

As with highway routes, DOE chose to conceal the rail routes analyzed in the Draft EIS DOE until late January 2000, near the end of the public comment process. In the Final EIS, DOE decided to reveal the rail routes used for risk and impact analysis. DOE included national and state maps. [FEIS, Figure J-6, and Figures J-31 to J-53] These routes were generated by the INTERLINE computer model, and generally represent the most direct routes to Nevada consistent with the current industry practice of maximizing freight-miles on the originating railroad.

Since DOE has not yet identified a preferred rail destination in Nevada, the map shows all potential cross-country routes from the 77 sites. For about 85 percent of the originating locations, the most likely route is unchanged by the Nevada destination. DOE's rail routes to Nevada generally agree with the rail routes identified in previous routing studies by DOE and Nevada contractors. While mergers and other rail industry developments would continue to affect routing, Nevada believes that the FEIS map shows the most likely rail routes to Nevada.

The primary rail routes out of New England and the Middle Atlantic states are the former Conrail mainlines from Buffalo and Harrisburg to Cleveland and Chicago. These shipments switch to the Union Pacific near Chicago, are joined by shipments from Midwestern reactors in Illinois and Iowa, and continue west via Fremont, Gibbon, Cheyenne, and Salt Lake City to Nevada.

The primary routes out of the South are the CSXT from Atlanta to East St. Louis, and the Norfolk Southern from Atlanta to Kansas City via Birmingham and Cairo. These two streams merge on the Union Pacific in Kansas City, and in turn merge with the northern UP shipments at Gibbon, Nebraska. Other major rail routes are the UP from Oregon via Boise, and the UP and BNSF from California and the Southwest via San Bernardino and Daggett.

The potential highway and rail routes identified in DOE's Final Environmental Impact Statement could affect 45 states and the District of Columbia. More than 123 million people currently live in the 703 counties traversed by DOE's highway routes, and 106 million live in counties along DOE's rail routes. DOE predicts that between 10.4 and 16.4 million people will live within one-half mile of a transportation route in 2035.

Recent Spent Nuclear Fuel Shipments

During the past two decades, nuclear power plants and research facilities in the United States have made relatively few off-site shipments of SNF. The U.S. Nuclear Regulatory Commission (NRC) regulates such shipments, and maintains a detailed SNF shipment database. Between 1979 and 1997, the most recent period reported by NRC, there were 1,334 domestic shipments containing 1,453 metric tons uranium (MTU) of civilian SNF. Table 2 summarizes significant characteristics of these shipments.

Table 2. U.S. Civilian SNF Shipment Experience, 1979 - 1997

Amount Shipped	1,453 MTU (76.5 MTU per year)
Total Shipments	1,334 (70 per year)
Truck Shipments	1,181 (62 per year)
Rail Shipments	153 (8 per year)
Truck Share of SNF Shipments	88.5%
Rail Share of MTU Shipped	75.5%
Average Truck Shipment Distance	684 miles (82%<900 miles)
Average Rail Shipment Distance	327 miles (80%<600 miles)
Shipment Origin & Destination	70% East of Mississippi River (935/1334)
Number of Reactor Sites Making One or More Shipments	27 (9 sites>2 shipments)

Source: NRC, NUREG-0725, Rev. 13 (October 1998)

During the same period, the U.S. Department of Energy made several dozen shipments of Three Mile Island reactor core debris and intact commercial reactor SNF. These shipments were not regulated by NRC, and were therefore not included in the NRC database. There were also an undisclosed number of naval reactor fuel shipments, estimated at several hundred.

Radiological Characteristics of Spent Nuclear Fuel

Spent nuclear fuel (SNF) from commercial power reactors would comprise about 90 percent of the wastes shipped to the repository. DOE acknowledges that SNF is "usually intensely radioactive." [FEIS, Pp. S-3, 1-6] Otherwise, the Final EIS provides little information on the radiological characteristics of SNF that affect transportation safety until the reader reaches Appendices A, F, and J.

Fission products, especially strontium-90 (half-life 28 years) and cesium-137 (half-life 30 years), account for most of the radioactivity in SNF for the first hundred years after removal from reactors. Fission products, which emit both beta and gamma radiation, are the primary sources of exposure during routine transportation operations. Cesium-137 is the major potential source of irradiation and contamination if a shipping cask is breached during a severe transportation accident or successful terrorist attack.

Table 3, based on data developed by DOE, illustrates the general relationship between SNF age (cooling time) and the two radiological characteristics most important for assessing SNF transportation risks, total activity and surface dose rate. The table is based on average characteristics of older SNF (pressurized water reactor fuel with a burn-up of 33,000

MWd/MTHM). The average SNF assumed by DOE in the FEIS [p. A-13] (pressurized water reactor fuel with a burn-up of 41,200 MWd/MTHM), for shipments to Yucca Mountain, would be even more radioactive.

Table 3. Radiological Characteristics of Commercial Spent Nuclear Fuel

SNF Age (Years Cooled)	Total Activity (Curies)	Surface Dose Rate (Rem/Hour)
1	2,500,000	234,000
5	600,000	46,800
10	400,000	23,400
50	100,000	8,640

Source: U.S. DOE, DOE/NE-0007, 1980.

After one-year in a water-filled storage pool, unshielded SNF is so radioactive that it delivers a lethal, acute dose of radiation (600 rem) in about 10 seconds. After 50 years of cooling, the total radioactivity (measured in curies) and the surface dose rate (measured in rem/hour) decline by more than 95 percent, but SNF can still deliver a lethal radiation exposure in minutes. The lethal exposure time for unshielded SNF is less than one minute after 5 years cooling, less than 2 minutes after 10 years, and less than 5 minutes after 50 years.

DOE assumes that the average age (cooling time) of SNF shipped to the repository would be about 23 years. [FEIS, p. A-13] DOE calculates that the average rail cask shipped to the repository would contain a total radioactivity of 2.1 million curies, including 816,000 curies of Cesium-137. [FEIS, p. J-33] While DOE does not provide specific data for the average truck cask, it would about one-sixth as much as the rail cask (355,000 curies total activity, including 136,000 curies of Cesium-137). For accident and sabotage consequence analysis, DOE assumed that the casks would be loaded with SNF aged 14-15 years, [FEIS, p. J-52] which would double the radiological hazard, compared to average SNF. [FEIS, p. 6-46] However, repository shipments could include 5-year cooled SNF in truck casks and 10-year cooled SNF in rail casks, resulting in significantly greater radiological hazards than those evaluated by DOE.

Routine Transportation Impacts

NRC regulations allow a certain amount of neutron and gamma radiation to be emitted from shipping casks during routine operations and transport (1,000 mrem/hr at the cask surface and 10 mrem/hr 2 meters from the cask surface). The dose rate allowed under NRC regulations results in near-cask exposures of about 2.5 mrem per hour at 5 meters (16 feet), in measurable exposures (less than 0.2 mrem per hour) at 30 meters (98 feet), and calculated exposures (less than 0.0002 mrem per hour) at 800 meters (one-half mile) from the cask surface. [FEIS, p. J-38] Cumulative exposures at these rates can result in adverse health affects for some workers and some members of public. Moreover, the very fact that these exposures would occur has been shown to cause adverse socioeconomic impacts, such as loss of property values, even though the dose levels are well below the established thresholds for cancer and other health effects.

The FEIS acknowledges that routine radiation from shipping casks poses a significant health threat to certain transportation workers. In the most extreme example, motor carrier safety inspectors could receive cumulative doses (200 rem over 24 years) large enough to increase their risk of cancer death by 10 percent or more, and their risk of other serious health effects by 40 percent or more. DOE proposes to control these exposures and risks by severely restricting work hours and doses for certain jobs. [FEIS, Pp. J-44 to J-45]

Expected Number of Accidents

DOE and the nuclear power industry are quick to point to their record of safely shipping limited quantities of spent fuel during the past 30 years. What DOE and the industry do not publicize is that, prior to 1971, there were, in fact, transportation accidents and incidents that resulted in radiation releases. Between 1957 and 1964, there were 11 transportation incidents and accidents involving spent fuel shipments by the US Atomic Energy Commission and its contractors. Several of these incidents resulted in radioactive releases requiring cleanup, including leakage from a rail cask in 1960 and leakage from a truck cask in 1962. There is no comparable data for the period from 1964 to 1970, when utility shipments to reprocessing facilities began.

Between 1971 and 1990, there were six accidents and 47 regulatory incidents involving spent fuel cask shipments. Most of the regulatory incidents involved excess radioactive contamination of cask surfaces (often referred to as "weeping"), but a few involved violations that could have contributed to increased accident risks. Three accidents (two truck, one rail) involved casks loaded with spent fuel. Fortunately, no radioactivity was released in these accidents, although one truck accident was severe enough to kill the driver. However, the record clearly indicates that accidents do happen and that the potential for accidents involving radiation releases exists.

DOE contractors evaluated these SNF accidents and incidents, and developed historical SNF accident and incident rates for use in projecting the impacts of future shipments to a Yucca Mountain repository. [OCRWM, YMP/91-17] These accident and incident rates have not changed appreciably, because of the relatively small number of shipments and shipment-miles during the 1990s. DOE chose to ignore this information in preparing the transportation impact analysis for the FEIS.

Table 4 shows the results of applying the historical accident rates for U.S. SNF shipments to the projected shipment-miles for DOE's "mostly legal-weight truck" and "mostly rail" scenarios, plus an additional scenario developed by Nevada which assumes that each site ships based on its current modal capability. The Nevada analysis concludes that 160 - 390 accidents and 850 - 2,400 regulatory violations would be expected over 38 years if future shipments were to be as safe as past shipments.

Table 4. Projected Repository Transportation Accidents and Incidents, 2010-2048.

Scenario & Mode	Shipments	Shipment-Miles	Accidents	Incidents
Mostly Truck (Sites)				
Truck (77)	108,544	227,735,000	159	2,391
Rail to NV (1)	355	181,000	2	4
HHT in NV	355	118,000	Not Available	Not Available
Mostly Rail (Sites)				

Truck (6)	3,122	8,657,000	6	91
Rail to NV (77)	18,935	37,484,000	364	727
Rail in NV	6,312	2,039,000	20	40
Current Capabilities (Sites)				
Truck (25)	27,435	65,784,000	46	691
Rail to NV (52)	14,886	28,353,000	275	550
Rail in NV	4,962	1,603,000	16	31

Transportation Accident and Terrorism Impacts

In the Draft and Final EISs, DOE acknowledges that a very severe highway or rail accident, or a successful terrorist attack using high energy explosives, could release radioactive materials from a shipping cask, resulting in radiation exposures to members of the public and latent cancer fatalities (LCFs) among the exposed population

In the Draft EIS, DOE evaluated a" maximum reasonably foreseeable accident scenario" involving a rail at a generic urban location. Following the accident severity categories designated by the NRC Modal Study, DOE estimated the consequences of the most severe (category 6) rail accident using the RISKIND computer code. DOE estimated that the accident would release and disperse enough radioactive materials to inflict a collective population dose of 61,000 person-rem (enough to give 61,000 persons a one rem dose) and cause about 31 latent cancer fatalities.

In the Final EIS, DOE changed the basis of its transportation risk assessment, relying solely upon a controversial new NRC contractor report prepared by Sandia National Laboratories (NUREG/CR-6672). As a result, DOE's estimated consequence of the " maximum reasonably foreseeable accident scenario" involving a rail cask was reduced to a collective dose of 9,900 person-rem and 5 latent cancer fatalities. [FEIS, Pp. 6-45 to 6-47, 6-49 to 6-50]

The FEIS acknowledges that the July 2001 Baltimore rail tunnel fire was so severe that it would have resulted in a release of radioactive materials if a rail cask had been involved. [FEIS, p. 6-50] The FEIS also acknowledges that clean-up costs following a severe transportation accident could range from $300,000 to $10 billion. [FEIS, p. J-73]

As part of its review of the Draft EIS, the State of Nevada commissioned several SNF accident consequence analyses by Radioactive Waste Management Associates (RWMA). In 2000, RWMA reexamined the DEIS truck and rail accident estimates, using the RADTRAN and RISKIND computer models and a range of credible alternative assumptions. In 2001, RWMA estimated the consequences of a rail SNF accident similar to the July 2001 Baltimore rail tunnel fire. Also in 2001, RWMA studied the consequences of credible worst case truck and rail accidents at representative urban and rural locations along potential Nevada highway routes. These studies concluded that DOE systematically underestimated the consequences of severe transportation accidents. The results of these studies are reported in State of Nevada impact report, A Mountain of Trouble, which can be accessed on the web at www.state.nv.us/nucwaste, or obtained in hardcopy by request from the Nevada Agency for Nuclear Projects (phone: 775-687-3744).

The Nevada-sponsored study of the July 2001 Baltimore rail tunnel fire concluded that it would have resulted in significant release of radioactive materials. It burned for more than three days with temperatures as high as 1500°F. A single rail cask in such an accident could have released enough radio-cesium to contaminate an area of 32 square miles. Failure to cleanup the contamination, at a cost of $13.7 billion, would cause 4,000 to 28,000 cancer deaths over the next 50 years. Between 200 and 1,400 latent cancer fatalities would be expected from exposures during the first year.

In both the Draft and Final EISs, DOE acknowledges that SNF truck casks are especially vulnerable to terrorist attack and sabotage. DOE and NRC testing in the 1980s demonstrated that a high-energy explosive device (HED) such as a military demolition charge could breach the wall of a truck cask. DOE sponsored a 1999 study of cask sabotage by Sandia National Laboratories (SNL) in support of the DEIS. The SNL study demonstrated that HEDs are "capable of penetrating a cask's shield wall, leading to the dispersal of contaminants to the environment." [DEIS, p. 6-33] The SNL study also concluded that a successful attack on a truck cask would release more radioactive materials than an attack on a rail cask. [DEIS, p. 6-34]

In the Draft EIS, DOE estimated that a successful attack on a GA-4 truck cask in an urbanized area under average weather conditions would result in a population dose of 31,000 person-rem, causing about 15 cancer fatalities among those exposed to the release of radioactive materials. In the Final EIS, DOE updated its sabotage analysis, assuming the cask contained more radioactive SNF and assuming a higher future average population density for U.S. cities. The Final EIS estimated that the same successful attack on a truck cask would result in a population dose of 96,000 person-rem and 48 latent cancer fatalities. [FEIS, Pp. 6-50 to 6-52] In neither case did DOE evaluate any environmental impacts other than health effects. In particular, DOE ignored the economic impacts of a successful act of sabotage in both the Draft and Final EIS.

Analyses prepared for Nevada by RWMA estimated sabotage impacts would be considerably greater than DOE's estimate. RWMA replicated both the Draft and Final EIS sabotage consequence analyses, using the RISKIND model for health effects and the RADTRAN model for economic impacts, the SNL study average and maximum inventory release fractions, and a range of population densities and weather conditions.

The Nevada-sponsored study of the Final EIS scenario concluded that an attack on a GA-4 truck cask using a common military demolition device could cause 300 to 1,800 latent cancer fatalities, assuming 90% penetration by a single blast. Full perforation of the cask, likely to occur in an attack involving a state-of-the art anti-tank weapon, such as the TOW missile, could cause 3,000 to 18,000 latent cancer fatalities. Cleanup and recovery costs would exceed $10 billion.

Public perception of transportation risks could result in massive economic costs in communities along transportation routes. Even without an accident or incident, property values near routes could decline by 3% or more. In the event of an accident, residential property values along shipping routes could decline between 8% and 34 %, depending upon the severity of the accident.

Rail Shipments, Dedicated Trains, and Railroad Safety

Even if DOE is able to implement the "mostly rail" transportation plan, DOE's opposition to dedicated trains and other accident prevention measures raise grave concerns about DOE's commitment to transportation safety. The Association of American Railroads (AAR) has long contended that spent fuel should only be shipped in so-called special trains - dedicated or unit trains hauling only spent fuel and other radioactive materials, operating under special safety protocols such as speed restrictions (now 35 to 55 mph), buffer car specifications, and train passing rules.

Current USDOT regulations allow shipment of spent fuel casks in general freight service. The July 19-23, 2001, Baltimore rail tunnel fire has been cited as a prime example of the dangers of shipping spent fuel in mixed freight trains. The Baltimore fire has also rekindled calls for Federal regulation of spent fuel rail routing.

Nevada believes the following safety measures should be mandatory: (1) spent fuel should never be shipped in mixed freight trains; (2) spent fuel should always be shipped in dedicated trains; (3) these trains should operate under strict speed limits (35-55 mph) and special passing rules; (4) US DOT should regulate the selection of rail routes to minimize shipments through urban areas; (5) federal emergency response teams and security escorts should accompany all rail shipments at all times. DOE and the nuclear industry oppose these mandatory safety regulations.

Full-Scale Physical Testing for Spent Fuel Shipping Casks

NRC does not currently require full-scale physical testing of shipping casks as part of its certification process. Cask designers are allowed to demonstrate compliance with the NRC performance standards through a combination of scale-model testing and computer simulations. Nevada has long urged NRC to require full-scale testing as part of certification. Alternately, Nevada has suggested that DOE require full-scale testing as part of the procurement process. NRC is currently proposing demonstration testing of a "representative" shipping cask as part of the Package Performance Study being conducted by Sandia National Laboratories. Nevada has not formally opposed NRC's proposal, but it is not an acceptable substitute for full-scale testing of each new cask design prior to certification.

Nevada has proposed a five-part approach to full-scale testing: (1) meaningful stakeholder participation in development of testing protocols and selection of test facilities and personnel; (2) full-scale physical testing (sequential drop, fire, puncture, and immersion) prior to NRC certification; (3) additional computer simulations to determine performance in extra-regulatory accidents and to determine failure thresholds; (4) reevaluation of previous risk study findings, and if appropriate, revision of NRC cask performance standards; and (5) evaluation of costs and benefits of destructive testing of a randomly-selected production model cask.

Nevada believes that comprehensive full-scale testing would not only demonstrate compliance with NRC performance standards. It would improve the overall safety of the cask and vehicle system, and generally enhance confidence in both qualitative and probabilistic risk analysis techniques. It could potentially increase acceptance of shipments by state and local officials and the general public, and potentially reduce adverse social and economic impacts caused by public perception of transportation risks.

Nevada estimates that the cost of a full-scale regulatory fire test for a truck cask would be less than $5 million. Comprehensive regulatory testing (drop, fire, puncture, and immersion) of a truck cask (up to 30 tons) would be between $8 million and $15 million. Comprehensive regulatory testing of a large rail cask (up to 125 tons) would cost $12 million to $25 million for the first cask, including the cost of required upgrading at the testing facility. By comparison, Nevada estimates the life-cycle cost of the repository transportation system at about $9.2 billion.

None of the SNF shipping casks currently used in the United States have ever been tested full-scale. This fact was confirmed by NRC Chairman Richard Meserve in letters to Senator Harry Reid dated April 2, 2002 and April 24, 2002. DOE has no plans for full-scale testing of the casks which would be used for shipments to Yucca Mountain. DOE and the nuclear industry oppose mandatory full-scale testing.

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*There were about 3,025 shipments in the United States between 1964 and 1997, about 92 per year. Reliable estimates of worldwide cask-shipments, through 1998, range from 24,000 to 40,041. Most of the international cask-shipments moved in trains carrying multiple casks, so the actual number of shipments would be considerably less, but precise information is unavailable. The estimate of 40,041 cask-shipments worldwide was published by the International Atomic Energy Agency in July 1999 and includes the following country totals: United Kingdom, 28,854; U.S.A, 2,425; Germany, 1,612; France, 1,570; Japan, 1,399; and Sweden, 900. Source: R. Pope, IAEA, "International Experience with SNF/HLW Transport," Presentation before the U.S. National Academy of Sciences, National Transportation Research Board, Washington, DC, September 11, 2000.

Nevada's transportation studies are available on the web at www.state.nv.us/nucwaste/trans.htm