

U.S. House of Representatives
Committee on Transportation and Infrastructure
Subcommittee on Highway and Trust
Subcommittee on Railroads

Joint Hearing on Transportation of Spent Rods to the Proposed
Yucca Mountain Storage Facility

Testimony by Marvin Resnikoff, Ph.D.
Radioactive Waste Management Associates
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I thank the Chair of the Committee on Transportation and Infrastructure, Rep. Don Young, the Chair of the Subcommittee on Highway and Trust, Rep. Thomas Petri, and the Chair of the Subcommittee on Railroads, Rep. Jack Quinn, for holding this hearing and bringing these important matters to the attention of the Congress.

Good morning. My name is Marvin Resnikoff. I am a physicist and Senior Associate at Radioactive Waste Management Associates. We are technical consultants to the State of Nevada on transportation issues, and also technical consultants to the State of Utah on transportation and storage issues. Many of the estimates of the health and economic consequences of transporting spent nuclear fuel used by Nevada were calculated by us. In this statement I would like to summarize our work and compare it to the calculations reported by the Department of Energy (DOE) in its Environmental Impact Statement on Yucca Mountain. The more detailed calculations appear on the Nevada Office of Nuclear Waste Projects web site.

Beginning with standard truck and train accident rates and the number of expected truck and train shipments, we estimate between 100 and 450 truck and train accidents over the life of the proposed Yucca Mountain repository. The Department of Energy estimates less. A large majority of these accidents would be fender-denters, but some could be severe enough to release radioactive materials, particulates and gases. Spent fuel shipping containers or casks are extremely rugged, but they are not designed to withstand every credible accident. A severe accident could be a high impact accident or a long duration fire, such as the Baltimore Tunnel fire that occurred July 18th of last year. Shipping casks are designed to withstand a 1475 °F fire for ½ hour, but the Baltimore Tunnel fire burned for several days at flame temperatures that exceeded 1500 °F.

Two points are important in discussing the hazard of transporting spent fuel:

- 1) A rail cask like the ones proposed for the Yucca Mountain repository contains an enormous inventory of radionuclides, about 240 times the cesium and strontium released by the Hiroshima bomb.

- 2) Maybe lost in any discussion of casks and accidents is the nature of radiation, that radioactivity is a carcinogen. The overwhelming scientific opinion states the more radiation dose a person receives, the more likely that a fatal cancer will result.

Credible severe accidents could result in a significant release of radioactive materials. The July 2001 Baltimore rail tunnel fire is one example. The fire temperatures exceeded the cask design criteria, 1475 °F for ½ hour. According to the *Baltimore Sun*, temperatures in the tunnel fire reached 1500°F, “hot enough to cause some of the CSX rail cars to glow, according to Battalion Chief Hector L. Torres, a Fire Department spokesman.”¹ One firefighter described the glowing cars as “a deep orange, like a horseshoe just pulled out of the oven.”² These descriptions are extremely useful because the color of glowing steel can be used to determine its temperature. For example, steel begins to glow at around 1000°F, with a dark red color, and begins to glow orange around 1650°F.

Our report³ for the State of Nevada traced the progressive degradation of a hypothetical rail cask in the tunnel fire. We estimated the release of radionuclides, primarily cesium, from the cask. We determined that a single rail cask in such an accident could have contaminated an area of 32 square miles. Failure to cleanup the resulting 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. The Baltimore Tunnel fire report is attached to this testimony.

Our study assumed that ½ the released radioactivity exited the Baltimore Tunnel and contaminated the Baltimore area. The remainder we assumed plated out. Anyone entering the tunnel, such as firefighters, emergency personnel, and CSX workers, would have received a dose due to the tunnel plateout. If one assumes 50% of the released cesium plates out in the tunnel, and one distributes this cesium over the entire area of the curved roof of the tunnel, the average gamma dose rate within the tunnel is 80 mr/h, not counting the released cobalt-60. In addition, if the neutron absorbing material on the shipping cask melts, the neutron dose near the cask greatly increases, to 500 mrem/h. These doses should be compared to the allowable dose to the public, or the allowable dose to nuclear workers, 5 rems/yr. Firefighters are not nuclear workers. One 50 hour week in the tunnel amounts to the allowable yearly dose to a nuclear worker. Note: these doses are just due to direct gamma and neutrons. If first responders get to the accident scene while radioactive particulates are still in the air, they would incur an additional dose due to inhaling radioactive particulates.

A successful terrorist attack on a shipping cask in an urban area could also cause serious impacts. To estimate the consequences of a terrorist attack, we first used the

¹ Ettlin, D.M. July 20, 2001. “Burning Cars in Rail Tunnel Resist Control.” *Baltimore Sun*.

² *Ibid.*

³ Lamb, M and M Resnikoff, “Radiological Consequences Of Severe Rail Accident Involving Spent Nuclear Fuel Shipments To Yucca Mountain: Hypothetical Baltimore Rail Tunnel Fire Involving SNF,” Radioactive Waste Management Associates, September 2001

identical computer models, such as RISKIND and RADTRAN, to reproduce the numbers in the Yucca Mountain EIS. We then altered the inputs to bound the radiation dose to the maximally exposed individual. Some major assumptions were: realistic release height, fuel cooled only 10 years (not 15, the Yucca Mountain EIS value), and an increased cesium release fraction. The latter change accounts for much of our differences with calculations by Sandia Labs and requires an explanation.

When fuel is heated in reactors, a percentage of volatile radionuclides, such as cesium, will migrate out of the fuel matrix under the influence of temperature gradients and concentrate in the fuel-clad gap.⁴ This “gap cesium” inventory is directly related to the respirable aerosol release fraction in the event of an accident because this cesium is volatile, and it can be released in the event of any cladding breach. In fact, virtually all of the cesium released from the fuel in the event of a spent fuel shipping accident will be this “gap cesium.” For the fuel matrix, the Sandia study⁵ assumes 0.3% of the cask inventory of cesium will be present between the cladding and the fuel pellet. However, other studies have estimated higher fractions. For example, one older Oak Ridge study estimated a cesium gap inventory of up to 20%.⁶ Another NRC study estimates the gap cesium inventory to be in the range of 10-27%.⁷ Finally, a more recent study performed as part of the Yucca Mountain site assessment, which involved actual measurements of the cesium content in fuel rods, estimated the gap cesium inventory in LWR rods to be as high as 9.9%⁸, 33 times higher than that assumed in the Luna sabotage study. We believe that this estimate, based on measurements of different types of fuel with different burnup histories, is the more appropriate model to use for the estimate of the “gap cesium” inventory. Assuming the cesium release fraction is directly proportional to the gap inventory, the release fraction posited in the Sandia Study must be increased by a factor of 33.

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 \$17 billion. It would be easier for terrorists to attack these shipments than to attack storage facilities at power plants, and these DOE shipments may be symbolically more attractive targets than civilian facilities. The sabotage paper is attached to my testimony.

⁴ Gray and Wilson, *Spent Fuel Dissolution Studies, FY1994 to 1994*. Pacific Northwest Laboratories. PNL-10540, 1995.

⁵ Luna, Neuhauser, and Vigil, *Projected Source Terms for Potential Sabotage Events Related to Spent Fuel Shipments*. SAND99-0963, 1999. . Sandia National Laboratory.

⁶ ORNL-3981. Parker, et al, 1967. *Out-of-Pile Studies of Fission-Product Released from Overheated Reactor Fuels at ORNL, 1955-1965*

⁷ NUREG/CR-0811. Rhyne et al, 1979. *A Scoping Study of Spent Fuel Cask Transportation Accidents*. Science Applications, Inc. pp. 101.

⁸ Gray and Wilson, *Spent Fuel Dissolution Studies, FY1994 to 1994*. Pacific Northwest Laboratories. PNL-10540, 1995.

A further study we did for the State of Nevada discussed emergency response with fire and police department and emergency response officials. Discussions with emergency personnel in Las Vegas and Clark County clearly indicate the accident would overwhelm local response capabilities. Before local emergency responders could accurately assess the problem, the radioactive plume would have already contaminated an extensive area. Radioactive particulates settling on roads and highways are likely to be spread by traffic, possibly contaminating distant locations and extending the area of contamination past that assumed in this study. This may result in the contamination of many more people than was estimated in our report. There is little precedent for emergency response to a severe transportation accident involving irradiated fuel leading to the release of radioactive particulates. The technical literature regarding decontamination following a major radioactive release in a transportation accident is almost non-existent.⁹ However, emergency response in the event of a major nuclear reactor accident has been analyzed extensively, particularly for the purpose of determining liability and Price Anderson coverage. While a nuclear reactor accident could lead to far greater releases of radionuclides than transportation casks, reactors are generally sited far from population centers. A transportation accident could happen in a city center. Issues involving emergency response and evacuation are therefore critical.

Our report showed that areas exceeding 5 rem long-term dose (this is EPA's Protective Action Guide) could range from 40 to 500 square miles, depending on the severity of the accident. The maximally exposed person could receive a dose from 22.5 to 224 rems. The expected latent cancer fatalities could run into the 10's of thousands, depending on the cleanup undertaken.

In light of these numbers, the Committee on Transportation and Infrastructure should ask the question, are there safer ways to move spent nuclear fuel? The answer is definitely yes. Casks can be designed and tested to withstand realistic highway and rail accidents. No casks presently being used on the highway and rails in the United States has actually been physically tested. There is still time. There is no rush to ship radioactive waste from nuclear power plants. Storage of nuclear fuel in dry storage casks takes only ½ acre of land; reactors are not running out of space. Storing radioactive waste at reactors has a benefit; over time, radioactive decay allows safer handling and shipping, particularly in the event of a transportation accident.

The debate about cask safety reminds me of the debate in the 1970's concerning the safety of shipping plutonium by air. New York Attorney General Lefkowitz took the NRC to court on the matter of plutonium being flown out of JFK airport in containers designed to withstand a 30' drop. Against all logic and valid safety concerns we raised, the NRC fought New York until Congress (Rep. Scheuer) directed the NRC to design containers that could withstand an air crash. In other words, the matter was taken out of the NRC and put into the Congressional arena where a sensible solution emerged. Similarly here, the NRC has no plans to require testing of these new generation nuclear

⁹ Chanin, DI and WB Murfin, "Site Restoration: Estimation of Attributable Costs from Plutonium Dispersal Accidents," SAND96-0957, May, 1996.

fuel shipping containers. The NRC has no plans to conduct an environmental impact statement on transportation. But Congress can direct the NRC to increase safety.

A careful reading of the Department of Energy's environmental impact statement for the proposed Yucca Mountain repository shows that it is not the Nevada geology that holds radioactive waste from reaching humans, but the engineered containers. Once they degrade, the aquifer becomes contaminated. That being the case, these containers can be stored anywhere, including reactor sites, while careful safety studies proceed, while radioactivity decays, and while shipping casks are designed and constructed to withstand credible highway and rail accidents.

Again, thank you for holding this hearing and considering these points.