

ATTACHMENT A
General Comments on Proposed Subpart I, 10 CFR Part 71
By the State of Nevada, Agency for Nuclear Projects

The State of Nevada supports proposed 10 CFR Parts 71.175 and 71.153 for dual purpose (storage and transport) spent fuel casks, designated as Type B(DP) packages. Part 71.153, patterned after a similar requirement for irradiated fuel storage casks, would require a safety analysis report that includes “an analysis of potential accidents, package response to these potential accidents, and any consequences to the public.” The information required in proposed Part 71.153 would allow a probabilistic risk analysis, in line with other regulations recently developed by the Nuclear Regulatory Commission (NRC).

Since the adoption of risk-based decision-making, the NRC has attempted to base spent fuel storage and transportation decisions on probabilistic risk analyses. The proposed Parts 71.175 and 71.153 for dual purpose casks, Type B(DP) packages, are a natural extension of this NRC process. For example, in the Private Fuel Storage (PFS) licensing proceeding, the probability of an air crash into a dual purpose cask at the proposed storage facility was evaluated; subsequent hearings will be held regarding the consequences. A sum over the consequences times the probability will determine the risk of an air crash causing fatalities. Similarly, for seismic analysis of an accident involving a Type B(DP) cask at the proposed PFS facility, the NRC has evaluated the likelihood of seismic events at the proposed Skull Valley site, and the consequences of each potential event.

The U.S. Department of Energy (DOE) has similarly employed a probabilistic risk analysis in its Environmental Impact Statement (EIS) regarding the proposed Yucca Mountain high-level waste repository. While the State disagrees with the transportation impact analysis done by DOE in both the draft¹ and final² EIS, these documents employ probabilistic analysis. In these analyses, the DOE uses outdated experimental data and improper mathematical models to arrive at unbelievable estimates of health consequences due to incident-free transportation and accident scenarios.

DOE and NRC should acknowledge that no new full-scale experiments have been performed to assess shipping cask response to postulated accident conditions or sabotage scenarios, even though the current generation of casks bears little resemblance to the casks used in the Sandia tests in the late 1970's and early 1980's. No new estimation of the frequencies of severe accidents have been made, even though rail and highway conditions, such as speed limits, and weights of shipping containers have changed since the cited studies were performed. Computer models estimating release fractions in a

¹ DOE/EIS-0250D, *Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (July, 1999)

² DOE/EIS-0250, *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (February, 2002)

successful terrorist attack are used which cannot properly model the casks involved. When the deficiencies in the EIS treatment of transportation are assessed, it becomes clear that new experimental studies are necessary to provide a realistic assessment of the impacts of spent fuel transportation. These new experiments must involve an updated Modal Study, new experiments addressing modern cask response to sabotage events, and new traffic surveys estimating the frequency of severe accidents. In addition, the inadequate treatment of transportation risks and impacts generally points to the glaring need for the NRC and DOE to produce an updated EIS on the transportation of spent nuclear fuel. It was the State's hope that the Package Performance Study would fill this gap.

In various transportation analyses, the NRC has employed the RADTRAN code to evaluate the risk of different transportation routes and modes. In its EIS for the proposed PFS facility, the staff estimated the risk of transporting irradiated fuel from nuclear reactors to the proposed PFS facility. RADTRAN multiplies the likelihood of a potential accident times the generic consequences of each severity accident. DOE has similarly used the RADTRAN code, supplemented by NUREG/CR-6672, in the Yucca Mountain EIS

Under Part 72 analyses for irradiated fuel storage containers, the NRC requires that all potential accidents, both man-made (air crashes, other hazardous facilities) and natural events (seismic events, floods, fires) be considered, together with the consequences. For transportable storage casks, Type B(DP) packages, the analysis is presently one-sided. All potential accidents and their consequences are considered for storage, but under transportation, licensees are only required to consider whether the cask can withstand hypothetical, not real, accidents. The likelihood and consequences are not considered in licensing Type B(DP) containers for transportation. The proposed Subpart I, §71.153 corrects this imbalance, by requiring a probabilistic risk analysis for both storage and transportation. The State supports this initiative by NRC staff.

In order to conduct such a risk analysis, one must investigate all credible highway accidents along specific transportation routes, together with all potential consequences, that is, potential cask damage and release of radioactive inventory. Some accidents along highway and rail, such as the Baltimore Tunnel fire and the recent I-95 accident in Bridgeport, Connecticut, will be more severe than the hypothetical accidents presently evaluated under §71.73. In choosing transportation routes, licensees would be required, under §71.153, to evaluate all potential accidents and their consequences. The effect of this risk analysis would hopefully be to avoid populated areas, tunnels, high bridges, routes with high accident rates, and so forth, or to demonstrate that Type B(DP) casks can withstand potential accidents along these routes.

This analysis is not an idle theoretical exercise. Cask-specific and route-specific risk assessment would be extremely useful for emergency planning purposes. Emergency responders would then be apprised of potential accidents and their consequences along specific routes. Under the present hypothetical accident system, cask performance is a matter of guesswork. What duration and temperature of a fire leads to what release of

radioactive material is an unknown. This makes it impossible for emergency responders to appropriately plan for potential accidents.

For these reasons, the State of Nevada supports proposed Subpart I, §71.153, since it will quantify what is presently guesswork.

If a choice of a cask and route is risk-based, then it is possible for NRC staff and State governments to evaluate which cask and route changes are significant. This would minimize licensee application and staff oversight of numerous insignificant changes to a transportation cask.

Industry has argued that the costs to license a Type B(DP) cask would greatly increase under the proposed Subpart I, §71.153. This is a valid concern, but the costs would increase uniformly for all cask manufacturers and would be recovered in cask cost to licensees. Further, these costs would effectively be amortized over all casks of the same design. The greatest cost for preparation of a safety analysis report would likely occur for the first cask analyzed under the new requirements. This cost might appropriately be borne by NRC as part of the PPS. These costs might also appropriately be borne by DOE, for those casks to be used for shipments to Yucca Mountain.

The major cost for cask-specific safety analysis would be physical testing of a specific cask and analysis of potential radioactive releases under specific potential accidents. These costs should be borne by NRC and DOE under the PPS testing program.

The present RADTRAN framework for evaluating risk is completely outdated. It is based on NUREG-170 and subsequent refinements, such as NUREG/CR-6672 and the Modal Study, NUREG/CR-4859. But these studies do not consider specific casks in sufficient detail to evaluate whether radioactive materials would be released in an accident. Subpart I, §71.153 would require this analysis. Further, the computer code to evaluate potential releases has not been recently benchmarked. The code is based on 25-year old fire and impact tests on casks that were obsolete at the time, not on the present generation of casks. Moreover, casks were not tested to credible accident scenarios beyond the hypothetical regulatory accident. Truck casks were never tested for a back-breaker crash into a bridge abutment. Rail casks were never tested for a three hour fire at 1800 °F.

For this reason, the State of Nevada supports full-scale testing of the new generation shipping casks. Under the NUREG/CR-6672 and the Modal Study, generic casks are evaluated, employing the material properties. Without an appropriate benchmark, this type of analysis would not suffice under proposed Subpart I. Proper testing under the PPS would, however, directly provide much of the information needed for the new safety analysis reports. In comments on NUREG-1768, as part of the PPS, Nevada has previously recommended the following approach to full-scale testing of dual purpose casks, and multiple purpose canister transport systems, that might be used for shipments to Yucca Mountain.

Over the next 40 years, the overwhelming majority of spent nuclear fuel and high-level radioactive waste shipments in the United States are expected to be shipments to the proposed Yucca Mountain repository. Each of the truck and rail cask designs used for these shipments should be tested full-scale, to demonstrate compliance with existing regulations. NRC has identified five currently licensed cask designs as “most likely to be used for large shipping campaigns to a disposal facility” – the General Atomics GA-4 truck cask, and four rail casks: the NAC International NAC-STC, the Transnuclear West NUHOMS MP187, the Holtec International HI-STAR 100, and the Transnuclear TN-68. Data obtained from these regulatory tests would greatly facilitate the preparation of the new safety analysis reports required under Subpart I.

Additionally, at least one of these truck cask designs, and at least one of these rail cask designs, should be subjected to extra-regulatory test conditions to determine cask failure thresholds, and to determine if finite element analyses can accurately predict the release (or lack of release) of radioactive material from a cask. Based on the information presented in the DOE Final EIS for Yucca Mountain, the General Atomics GA-4 cask, designed to transport 4 PWR assemblies, is the most appropriate choice for extra-regulatory testing. The GA-4 could be used for about two-thirds of all shipments under the DOE “mostly legal-weight truck” national shipping scenario.

Selection of the rail cask for extra-regulatory testing should be deferred until detailed, comparative, finite element analyses are provided in a revised draft test protocol. Selection of the most appropriate rail cask, or casks, for extra-regulatory testing, is crucial to the credibility of the PPS. Although similar in overall dimensions, gross weight (125-141 tons) and payload capacity, the four rail casks exhibit differences in design (such as use of a welded internal canister) that should be fully evaluated before selection of one or more test subjects. This decision is particularly important because of the DOE stated intention to maximize use of rail for shipments to Yucca Mountain, even though DOE has not yet demonstrated the feasibility of the “mostly rail” shipping scenario.

Nevada recommends that full-scale rail casks, without impact limiters, should be used for both regulatory and extra-regulatory impact tests. The drop test proposed in NUREG-1768 was a free drop on the impact limiter. Because the impact limiter would absorb most of the impact, little deformation of the cask itself was predicted. The drop test as proposed would fail to achieve the objective of demonstrating that finite element analysis can accurately predict the performance of the cask in an accident situation.

NUREG-1768 states, “But the main concern for the impact test is how well the pretest analysis does in predicting the response of the cask body, not the impact limiter. Because deformations to the cask body will likely be small, accurate measurements (± 0.0254 mm [± 0.001 in.]) are needed to compare with the results of the pretest finite analysis. Measurements to this accuracy on a full-scale cask are difficult because the thermal expansion of cask structures caused by a change of a few degrees in temperature will

produce changes in structures of this magnitude, leading to larger inaccuracy in the measured result.” [p.10]

NUREG-1768 concludes, regarding the proposed GA-4 impact test, that “finite element analysis results may depend significantly on the response of cask features that are too small to model.” [p. 73] The same observation would appear to apply to the rail impact test as well, particularly if the test were performed on a rail cask that did not rely upon a welded MPC for containment. If the objective of the test is to verify the finite analysis, a drop without the impact limiter would result in much more deformation of the cask, reducing the effects of temperature on measurement, and the difficulty of modeling small but important features (such as bolt threads).

It should also be noted that in a severe accident, a cask could be subject to more than one severe impact. Accidents involving multiple rail cars within a train, or multiple rail cars from another train, could result in multiple impacts to a cask. A rail cask involved in an accident could also suffer damaging multiple impacts with man-made structures and/or natural objects. The first impact, if oriented correctly, could either cause significant deformation to the impact limiter, or rip the impact limiter from the cask. Therefore, it is not unrealistic to assume that once the impact limiter’s effectiveness is destroyed, a subsequent severe impact could occur.

The performance of impact limiters has been extensively evaluated in scale-model tests for currently licensed casks. Scale-model drop tests have also been performed for several cask designs. The revised draft test protocols should include an evaluation of all previous scale-model package drop tests, and scale-model impact-limiter drop tests, conducted on the TN-8, DOE 125-B, TN-BRP, TN-REG, GA-4, NAC-STC, FN-FSV, NUHOMS MP 187, HI-STAR 100, and TN-68 casks.

Nevada recommends that the impact tests should be conducted as drops from a tower. Nevada generally agreed with the NUREG-1768 discussion of the advantages and disadvantages of drop tests versus rocket sled tests. However, the discussion of the "newly constructed target" to be used for drop tests should have included cost data. Further, NUREG-1768 should have identified other potential drop testing facilities in the United States and abroad (such as those at Oak Ridge National Laboratories, and at Cheddar Gorge in the United Kingdom), their lift and drop capabilities, and the cost of using and/or upgrading existing facilities other than those at Sandia National Laboratories.

Nevada recommends that the drop orientation for the four rail cask regulatory impact tests (drop from 9 meters), should be drop onto the lid end, with center of gravity-over-corner impact, without impact limiters. For the rail cask extra-regulatory impact test or tests, final specification of impact speed and orientation should be deferred until detailed, comparative, finite element analyses are provided in a revised draft test protocol. NRC should evaluate both end-impact and back breaker drop test orientations for rail casks, at impact speeds of 75 mph or greater, without impact limiters.

NUREG-1768 asked stakeholders to respond to this question: Is 26.8 to 40.2 m/s (60 to 90 mph) a reasonable speed range for the rail cask impact test, given that the frequency for a rail cask impacting a hard rock surface within this speed range is 10^{-6} to 10^{-8} per year? Nevada responded that the 60 to 90 mph speed range was reasonable, but that train accidents are known to have occurred at speeds in excess of 90 mph. AAR also agreed with the reasonableness of the speed range, but commented: "Freight trains operate up to 70 miles per hour. For that reason, trains on opposite tracks could be operating at a relative speed of 140 miles per hour." Nevada criticized the basis of the NRC stated frequency of a rail cask impacting a hard rock surface within this speed range, 10^{-6} to 10^{-8} per year. Nevada noted that the actual historical accident rate for U.S. spent fuel shipments by rail is about 4.6 accidents per million cask-miles, or ten times greater than the projected accident rate used by NRC.

For both the rail and truck cask extra-regulatory impact tests, Nevada recommends that final specification of impact speed and orientation should be deferred until detailed, comparative, finite element analyses are provided in a revised draft test protocol. Based on preliminary analyses, cask impact speeds of 75 mph or greater, without impact limiters, would likely result in significant cask deformation.

Nevada recommends for the five cask regulatory fire tests, the fire duration should be 30 minutes at 1475°F (800°C). For the truck and rail cask extra-regulatory fire tests, final specification of fire duration and temperature should be deferred until further analyses are provided in a revised draft test protocol. The fire tests should be designed considering both predicted temperature failure thresholds and historical accident fire conditions.

Extra-regulatory fire test design should assess potential temperature failure thresholds for critical cask components (such as lid seals) and fuel cladding, assuming both intact and damaged neutron shields and impact limiters. Since rail cask designs with and without internal welded canisters could perform differently in severe fire environments, both types of rail casks (with and without internal canisters) must be tested.

Based on preliminary analyses of the July 2001 Howard Street Rail Tunnel fire in Baltimore, the minimum extra-regulatory test fire conditions should be 3 hours at 1800°F (1000°C), or 6 hours at 1475°F (800°C). NANP and NRC are separately sponsoring additional studies of the Baltimore fire.

For the five cask regulatory fire tests, the cask position should be one meter above a fuel pool, one to three meters beyond the side of the cask. For the extra-regulatory fire tests, final specification of cask position should be deferred until further analyses are provided in a revised draft test protocol. NRC should consider cask placement at the edge of the fuel pool under various wind conditions. NRC should also consider furnace testing as an alternative to fuel pool fire testing.

Since PWR fuel will be the predominate form shipped to the repository, PWR fuel should be in the truck cask and in at least one of the rail casks during the tests. Each cask should contain one real, fresh fuel assembly. The remaining fuel basket cells could be loaded with the correct weight of dummy and/or surrogate fuel and heaters.