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**State of Nevada
Office of the Governor
Agency for Nuclear Projects
Additional General Comments
On
Spent Fuel Transportation Risk Assessment,
NUREG-2125,
Draft Report for Comment,
Docket ID: NRC-20212-0108
July 15, 2012**

ADDITIONAL GENERAL COMMENTS

Accident Scenarios Underestimate Potential Fire Durations and Temperatures

Nevada believes that the Draft Report underestimates the potential fire durations and fire temperatures to which casks may be exposed in transportation accidents.

The NAS 2006 report underscored the importance of assessing and managing the radiological risks from “releases in extreme accidents involving very long duration, fully engulfing fires. While the likelihood of such extreme accidents appears to be very small, their occurrence cannot be ruled out based on historical accident data for other types of hazardous material shipments.” The NAS recommended a combination of administrative controls, route-specific risk analyses, studies of real-world accident conditions, computer analyses of cask performance, and full-scale testing to address these risks. (Pp. 10-15) The NRC has prepared a number of studies since 2006 that implement some of the NAS recommendations, particularly studies of specific accidents such as the 2001 Baltimore Tunnel rail fire and the 2007 MacArthur Maze highway fire.

The Draft Report specification of accident fire scenarios raises questions about how the authors considered and incorporated the findings of other NRC reports, particularly regarding the Baltimore Tunnel rail fire and the MacArthur Maze highway fire.

Underestimation of fire durations and temperatures challenge the Draft Report conclusion: “Probable worst-case fire accident scenarios for a rail cask transported by railway and for a truck cask transported by roadway were represented within the cases analyzed.” (p. 107)

Underestimation of fire durations and temperatures also challenge the Draft Report conclusion: “If there were an accident during a spent fuel shipment, there is only about a one in a billion chance that the accident would result in a release of radioactive material.” (p. 139)

Moreover, since the Draft Report did not evaluate the NAC LWT truck cask and the IF-300 rail cask, which are currently used for most spent fuel shipments in the United States, there is no basis for the far-reaching claim in the Draft Report that “the results demonstrate that SNF casks designed to meet current regulations will prevent the loss of radioactive material in realistic severe fire accidents.” (p. 107)

The cask designs chosen for analysis in the Draft Report were the GA-4 truck cask, the NAC-STC rail cask, and the HI-STAR 100 rail cask. The Draft Report evaluated the responses of the two rail casks to the hypothetical accident fire specified in 10CFR71 (engulfing 30-minute fire at 800°C, 1472°F) and to three variations of an extra-regulatory fire (3 hours at 800°C, 1472°F). The Draft Report evaluated the response of the truck cask to an extra-regulatory fire (1 hour at 800°C, 1472°F). The Draft Report characterizes these combinations of fire conditions and cask damage assumptions as representing “worst-case” scenarios. “The neutron shield material of each cask analyzed was assumed to melt and flow out of the cask instantly at the beginning of the fire.” (p. 107) Impact limiters were however “modeled as undamaged (not deformed).” (p. 77)

The Draft Report cites the primary NRC study of the Baltimore Tunnel rail fire, NUREG/CR-6886, Revision 2, but it is not clear exactly how the authors used NUREG/CR-6886 in designing their analyses. NUREG/CR-6886, Revision 2, carefully avoided categorizing the Baltimore Tunnel rail fire as a “worst case” tunnel fire accident, describing it as a “a ‘beyond design-basis’ scenario.” (p. 1.9) Building upon previous NRC studies, including a fire study prepared by the National Institute of Standards and Technology (NIST), NUREG/CR-6886, Revision 2, evaluated the performance of three different cask designs subjected to a hypothetical accident based on the conditions estimated to have occurred in the Baltimore tunnel fire, and concluded that there would have been no release of radioactive material from one of the casks (HI-STAR 100), and only minor releases from two other casks (TN-68, and NAC-LWT shipped inside an ISO container). A critical assumption in NUREG/CR-6886, Revision 2, was that the casks could be no closer than 20 meters (66 feet) to the hottest region of the fire, because of FRA regulations governing placement of spent fuel casks in mixed freight trains and because of the geometry of the single track tunnel.

Based on the Baltimore Tunnel rail fire, Nevada believes that a credible maximum accident fire scenario for a rail cask would be an engulfing fire for 2-3 hours at 800-1,000°C, followed by 3-4 hours at 600-800°C, and at least 24 hours of cool-down. While respectful of the methodology and findings of NUREG/CR-6886, Revision 2, there are numerous uncertainties about the calculated fire conditions and possible rail tunnel, track, and train configurations. The Baltimore Tunnel fire was clearly not a “worst case” rail fire, because its duration and temperature were limited by a water main break, tunnel oxygen supply, and other factors. The burning tank car contained enough fuel for a 6-7 hour fire. NUREG/CR-6886, Revision 2, significantly underestimated the potential radiological consequences of the fire by assuming the casks would be located at least 20 meters from the hottest region of the fire. Even at 20 meters distance, the NRC analysis may have underestimated potential radiological consequences for all three casks because of uncertainties in the NIST fire model, assumptions about impact limiter damage, assumptions about SNF cladding performance, and assumptions about release pathways from casks. Administrative controls, in the form of AAR operating protocols for trains carrying spent fuel, are intended to prevent a spent fuel fire accident involving two trains in a single-bore, double-track tunnel.

The MacArthur Maze highway fire is still being studied by NRC. However, the fire conditions appear to have been significantly greater than those specified in 10CFR71 or those assumed in the Draft Report for a fire accident involving a truck cask. NRC has estimated that the fire burned for about 17 minutes at 1,100°C (2012°F), followed by 71 minutes at 900°C (1,652°F), followed by a cool-down period. Preliminary results reported by NRC in February 2012, for a spent fuel truck accident assuming a similar fire, suggest that “fuel rods are expected to rupture before the end of the fire.” The peak fuel cladding temperature “would almost certainly exceed the short-term limit of 570°C (1058°F), and would likely exceed the zircaloy burst temperature limit of 750°C (1382°F) assumed in previous transportation studies.” The NRC analysis assumed that the impact limiters remained intact. (Attachment 6) In finalizing the Draft Report, the results of the MacArthur Maze fire studies must be considered.

Accident Scenarios Underestimate Consequences on Damage to Cask Impact Limiters

Nevada believes that Draft Report underestimates the potential damage to casks in accident fire environments following damage to cask impact limiters.

The Draft Report evaluates rail and truck cask performance in accident severe fires assuming that the impact limiters are intact. The NRC studies of the Baltimore Tunnel rail fire and the MacArthur Maze highway fire make similar assumptions, although those reports correctly point out the significance of the impact limiter on the lid end of the cask as an important source of thermal insulation for the lid bolts and seals. The attached report by Dr. Miles Greiner uses the CAFÉ-3D fire model to measure the significance of the impact limiter, intact and damaged in different scenarios, relative to the temperatures of concern for the containment seal, for a legal-weight truck cask modeled on the NAC LWT. (Attachment 7) In future efforts to model the performance of both rail and truck casks in long-duration, high-temperature fires, Nevada suggests that the accident fire scenarios include impact limiter damage and/or loss.