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To: <opa@nrc.gov>
Date: 8/5/03 7:46PM
Subject: comments to NUREG-1768

Dear Sir/Madam:
I am submitting comments to NUREG-1768 I prepared in association with a graduate level class I recently completed. I understand the official comment period closed 30 May 2003 however I am submitting them anyway for your consideration.
Thanks.
Patty

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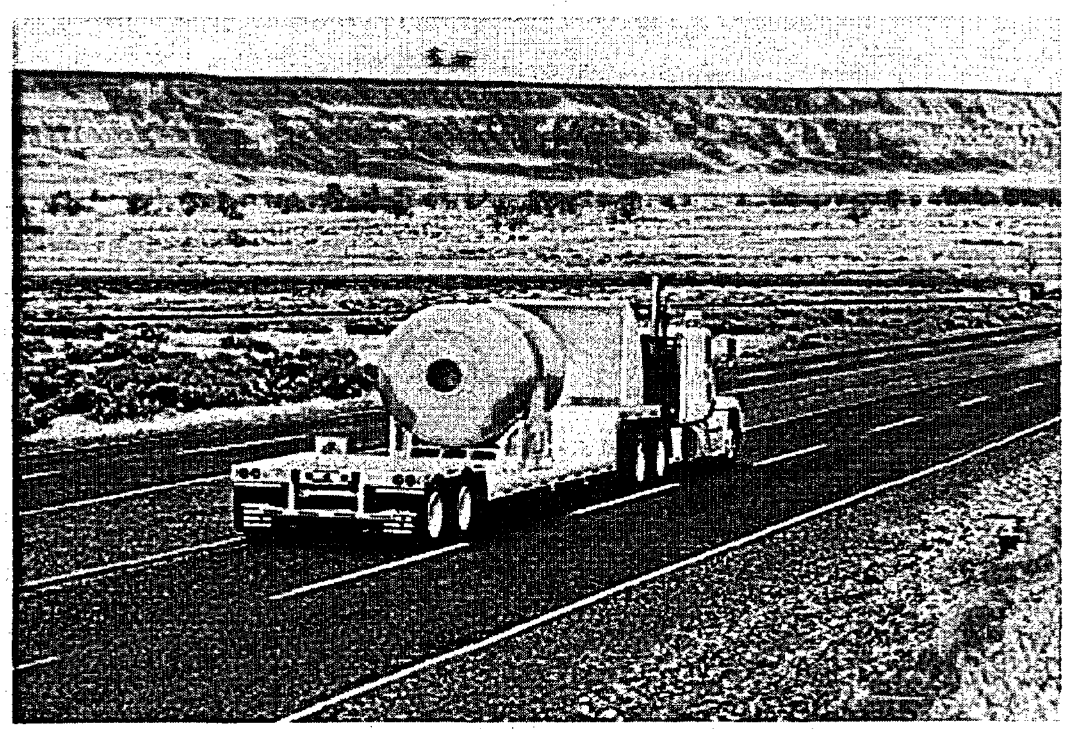
E-RFDS=ADM-03
Add = A. Snyder (AHS3)
A. Murphy (AJM1)

Template = ADM-013

ENCE 7352

Management of Radioactive Hazards

Extra Credit Project



Patricia A. Taylor

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Document Selected for Review: Draft report NUREG – 1768, United States Nuclear Regulatory Commission Package Performance Study Test Protocols published February 2003. This report presents the proposed protocols regarding field tests on the casks used to transport spent nuclear fuel and validating the use of the computer modeling. The testing proposed in this report was a result of comments received during the review of NUREG/CR 6768, Spent Nuclear Fuel Transportation Package Performance Study Issues Report, dated June 2002. Therefore, this ancillary report was also reviewed in order to provide additional background information. The following comments on NUREG-1768 are respectfully submitted.

General Comments:

The Nuclear Regulatory Commission (NRC) should be commended for involving the public and stakeholders in their proposed test protocols and decision-making. Such involvement should not only improve the tests, but also ease public concerns and bolster confidence in the testing program and actual transportation as long as the comments are acknowledged, reviewed, carefully considered, and responded to. Conducting field tests as well as examining other methods to evaluate cask performance such as utilizing software and simulations in an effort to conserve resources is also a smart management decision and should enable the analysis of more conditions and accident scenarios. Actual field testing and simulating some of the most extreme accident scenarios should assist in relieving some of the public concerns over transportation of large quantities of spent nuclear fuel to safe and permanent storage. The full scale testing protocol proposed within this report is definitely needed to validate the computer analysis and simulations. Testing the rail and truck casks should definitely be accomplished since accident severities are very different for different modes of transportation.[2] The typical size and weight of the casks themselves (188 inches long, 40 inches in diameter, and weighing around 27.5 tons filled[4] or a rail cask that is 22 feet long, 8-12 feet in diameter, and 70-100 tons filled[5]) present some testing challenges.

In the Executive Summary Section, this document states the final plan will reflect public comments as well as constraints imposed by programmatic priorities and available funding to support the tests. Lack of funds and programming challenges should not impact this test, as this is a matter of national security and protection of human health and the environment. Additional comments regarding this issue are provided below in Section 1.0.

The Executive Summary Section also states three criteria were developed to determine the speed for the impact and thermal tests. The three criteria were identified as (1) enhancing public confidence, (2) validating the computer models, and (3) ensuring realism in the probability of the occurrence of the test parameters. Presenting the criteria in this order appears to be misguided. The number one criteria should not be to enhance public confidence. If the testing protocols are sound and perceived to reflect actual or most likely extreme conditions, increased public acceptance of shipments and confidence is more likely.

Since a cask design has not been finalized, the proposed test is unable to actually test the containers that will actually be used for transportation. Although the designs may be similar, the likelihood that different cask designs would perform in a similar manner is

questionable. Once the cask design is finalized and selected, it may be necessary to conduct this expensive field testing and associated computer simulations and calibrations again. This full-scale testing event may be somewhat premature in light of the uncertainty of the cask selections. Additional specific comments on this issue are provided below in Section 2.0.

Comments to Section 1.0 - Introduction

On page 2, the report states the field tests will reflect public comments and constraints posed by programmatic priorities and available funding. Acknowledging budgetary constraints in the current economy, the integrity of the transportation cask after a catastrophic event is an issue of public safety and protection of human health and the environment. Field-testing is definitely needed and should not be severely restricted because of lack of money.

Also on page 2, the report states NUREG/CR-6672, *Reexamination of Spent Fuel Shipment Risk Estimates* (Sprung et al., 2000) provides a current assessment of the risks associated with the transport of spent nuclear fuel. This report was completed one year prior to the events of September 11, 2001. It should be verified that the risks quantified and utilized in this report take into account potential acts of terrorism and factor in the increased likelihood of more catastrophic events than previously anticipated.

Comments to Section 2.0 – Impact Test Protocol

The NRC proposes to use free drop impact testing instead of a horizontal impact test and is specifically seeking comments on this proposed issue. On page four, the report provides one advantage for the horizontal sled test and four technical reasons for using the drop impact test. The reasons for using the impact test appear to focus more on calibrating and confirming the software simulations instead of determining the actual performance of the cask. There is little doubt the free drop tests are easier to perform and may provide more data for model calibration however the casks will be transported using trucks and rail. NUREG/CR-6768 (page 16) states full-scale tests have the advantage of higher public acceptance. "They (the tests) would need to be performed horizontally on a sled track."[2] In order to adequately conduct a field test to determine how the casks will actually perform, the field test should be conducted with the casks moving horizontally on a track, the same manner in which they will be transported. On page 11, the report states the primary concern for the impact tests is to demonstrate the ability of the system to maintain containment of its radioactive contents. This concern would best be demonstrated to the public by simulating actual accident conditions, a horizontal impact. By limiting the full-scale field test to a drop impact, it could be perceived that the NRC is limiting the testing and modeling into preconceived scenarios and not fully field testing the casks.

As stated in the report, the NRC has certified several transportation cask designs that could be used to transport spent fuel with additional designs still under review. The testing protocol only focuses upon one design. The likelihood that different designs would perform the same way under the same conditions is not fully addressed. On page 12, the report states that as-built material properties may be different than the design materials requiring rerunning

pretest analysis. This is an indication the field testing may be a little premature and additional resources would be expended rerunning the tests since the actual materials used in the casks may change.

Section 2.4 discusses the computer modeling to be conducted with finite element analysis. It is common practice in modeling to make several assumptions to simplify the calculations however it is important to assure these assumptions are valid. The values for material properties input into the finite element model are based upon the assumption that the cask materials are isotropic. This is a common assumption for example in groundwater modeling since it is nearly impossible to adequately characterize the subsurface. However, due to manufacturing and fabrication issues, and the possibility of human error in production of materials, it is possible assuming isotropic materials may not be valid and oversimplifies the situation.

The highly technical discussion on the finite element model appears to be very dependent upon the specific cask design and materials to be used, as well as the proposed impact speed. Again, it may be premature to conduct this test without the selection of the final cask design and materials actually used. Although this author is not a structural engineer, it is common practice that material testing or simulations often proceed to the point of failure in order to determine factors of safety. Testing to failure also often provides additional valuable information on performance. For example, it would be important to know what items fail first on the cask, the closure bolts, the cask walls, the seal or closure lid, etc. The cask does not have to fail catastrophically in a structural manner for a hazard to occur. If the radioactive material leaks from the casks due to seal failure, damage to public health and the environment may result even though the cask is structurally intact, or appears to be intact.

The testing protocol only provides for one field test. This one field test will be used to validate the finite element model results. Although this author is not familiar with the use of finite element models and their capabilities, typical calibration of computer models to simulate events such as floods etc. definitely require more than one value to confirm calibration of the model parameters. It is common principle that one value defines a point, two values define a line, and three values define a curve. It is difficult to understand how one test (one point) can effectively validate a modeling scenario.

The proposed cask impact velocity is between 60 and 90 miles per hour. This speed may not be adequate (too low) especially if you consider the resulting impact of a truck traveling down the highway at 70 miles per hour that crashes head on into another vehicle traveling 70 miles per hour from the opposite direction. The impact speed the cask is subjected to could actually be greater if an airplane is intentionally flown into the cask while it is being transported by truck or rail.

Section 3.0 – Fire Tests

The package performance tests provide for a 30-minute fully engulfing fire test on a full-scale rail and full-scale truck cask. Nuclear facilities are often in remote locations and spent

fuel will be transported to a central facility several thousands miles away. As a hazardous cargo, the truck transport will most likely follow the hazardous cargo routes which are often circuitous routes outside of major population centers and away from emergency response equipment. A 30-minute fire test may not be adequate due to the remote nature of the transportation routes and location of the storage facility. Extended emergency response times to extinguish the fire should be considered due to the remote conditions.

The fire test time should also consider the likelihood and availability of a fueling source for the fire making it likely that an accident fire could last longer than 30 minutes. In light of the events of September 11, 2001, it is not inconceivable that an aircraft could intentionally crash into a rail shipment or truck transporting casks containing spent nuclear fuel which would then subject the casks to a long and intense fire (greater than 30 minutes in duration) as well as possible structural damage. The World Trade Center Towers were able to withstand the initial impact of the Boeing 767 jets however the structural steel was unable to withstand the intense, super hot fires resulting from the jet fuel. The buildings collapsed within two hours after super-hot fires.[1] The field test protocols addressed in this report are based upon risk information determined prior to September 11, 2001 and therefore may not address the added risks and increased magnitudes of catastrophic events due to deliberate acts of terrorism.

From 1979 to 1997, 1,334 spent fuel shipments were made in the U.S.[5] In more than four decades of transporting spent nuclear fuel within the United States, no accident has ever occurred in which a "Type B" spent nuclear fuel transportation cask was punctured or spent nuclear fuel contents released, even in actual highway accidents.[3] This fact may not provide an adequate assessment of future risk since shipments will increase as the permanent storage facility is opened. Currently, only small shipments of spent nuclear fuel are made such as individual fuel rods or assemblies[5]. Future shipments will contain more fuel assemblies. More shipments will be made increasing the frequency of travel and related probabilities of accidents.

It is important to subject the casks first to an impact, then followed by a fire. Fires often follow impact crashes and this would represent a realistic scenario. The condition of the casks after a catastrophic impact and the temperature that the casks are then exposed to are related to many factors including the duration of the fire. The escape of radionuclides from failed rods would most likely be caused by rod depressurization or by thermal expansion of rod gases.[2] If the cask is severely damaged or weakened by impact, a subsequent fire may have greater impact on a damaged cask than on a new, undamaged cask. If the casks are to be used for multiple shipments, the testing should consider wear and tear on the cask as well as transportation units.

The stakeholders raised similar questions regarding the 30-minute fire duration during public meetings and comment period for NUREQ/CR-6768. The Transportation Package Performance Study stated the Department of Transportation (DOT) Hazardous Waste Shipping requirements were based upon a 1-hour fire which is twice as long as the thirty minutes proposed for the casks. The official NRC response was that the intent of the DOT tests conducted on tank cars and tank trucks for the transportation of hazardous materials are

different than the thermal tests conducted on shipping containers for spent nuclear fuel. Unlike the casks, DOT wants to prevent sudden releases of materials by ensuring the insulation surrounding the tank limits total heat input so relief valves function properly and in a controlled manner. Casks are not permitted to have a relief system. What happens to a cask containing spent nuclear fuel that has undergone impact of some sort and is then subjected to an intense fire for one hour or more? The implications of a radioactive release can be much more serious than a hazardous material release. The question still remains regarding the cask testing protocols. It stands to reason the cask testing protocols should be at least as stringent, if not more stringent than DOT regulations for containers of hazardous materials.

The report also states containment will not be verified after the fire tests. The only reason given is due to the fact the tests will exceed the regulatory limits. Not verifying containment after the fire tests appears to conflict with the statement on page 11 that states "the primary concern for the impact tests is to demonstrate the ability of the cask system to maintain containment of its radioactive contents". Due to the expense and effort already planned, it stands to reason containment should also be measured during the fire tests.

Summary of Comments:

The casks that are actually going to be used for transportation should be the ones field-tested. If the casks are unknown, consider delaying the tests until the models are known. A minimum of one full-scale rail and one full-scale truck test should be accomplished. The impact tests should be conducted along a horizontal track using a rocket sled or other means to represent actual field transportation conditions. If data from drop impact tests is needed or desired, this could also be accomplished. The probabilities used in selecting the impact speed range should be re-evaluated as they may not adequately represent present day risks. The impact speed may then need to be re-evaluated accordingly. The duration of the cask fire test should be at least one-hour. A listing of the structural and thermal peer review panel members is provided in Appendix B of the report. This independent technical review is an important part of quality control and the NRC should be commended for ensuring this is accomplished.

References:

1. CNN on line; http://www.cnn.com/2003/US/Northeast/06/30/towers.safety

2. Spent Nuclear Fuel Transportation Package Performance Study Issues Report, NUREG/CR-6768, June 2002.

3. Characteristics of Spent Nuclear Fuel Management, U.S. Department of Energy, Office of Environmental Management, http://www.em.doe.gov/eis/s27.html

4. General Atomics Press Release dated November 9, 1998, http://www.ga.com/news/NRC.html

5. ENCE 7352, Management of Radioactive Hazards, Southern Methodist University,

Lecture Notes, Blair Spitzberg, Ph.D., July 2003.