# INDUSTRY PERSPECTIVE ON THE UPDATE OF THE "MODAL STUDY"

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## BACKGROUND

The U.S. Nuclear Regulatory Commission (NRC) is in the process of seeking pubic comments regarding the proposed study on Spent Nuclear Fuel Cask Responses to Severe Transportation Accidents. This proposed study is meant to revisit the conclusions of the study, "Shipping Container Response to Severe Highway and Railway Accident Conditions", NUREG/CR-4829, February 1987 (Modal Study), to assure their continued validity.

This paper will provide the nuclear industry's perspective regarding the update of the Modal Study, including comments on the six topics used for discussion purposes during NRC's pubic workshops on this subject during late 1999.

## OVERVIEW

The original Modal Study concluded *"at least 99.4% of truck and train accidents involving a spent fuel shipment will result in negligible radiological hazards which are less than those implied by the current 10 CFR 71 regulations. Of the remaining spent fuel shipment accidents, the overall radiological risk is less than that risk estimated in NUREG-0170"* (Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes, NUREG-0170, December 1977). As the NRC and its contractors, the Sandia National Laboratory (SNL) move forward with the update of the Modal Study, it is important for NRC to clearly state that the current regulatory framework for spent nuclear fuel transportation cask design and certification provides assurance that the transportation of spent nuclear fuel will be conducted in a manner that protects the public and the environment during normal transportation and in the event of a severe accident. The safety of spent nuclear fuel transportation has been demonstrated by the proven safety record associated with more than 30 years of safe spent nuclear fuel transportation in the U.S. and internationally.

NRC should also consider the impact of the Modal Study update on international regulations for spent nuclear fuel package certification and transportation, such that the study does not appear to undermine the current international regime for safely transporting spent nuclear fuel. The public should be confident that the current U.S. and international regulatory framework for spent fuel transportation protects human health and the environment.

NRC's focus in its update of the Modal Study should be directed to those aspects of transportation cask design and analyses or transportation risk that have changed since the

completion of the Modal Study in 1987. These areas might include: physical testing of new materials or new designs to benchmark analytical codes, the use of modern analytical techniques, the use of updated accident date, etc. While full scale cask testing may have some public perception benefits, the use of scale models to test new components and materials is sufficient to accomplish NRC's goal of providing a benchmark for analytical codes.

In addition, any actions related to the update of the Modal Study should be consistent with the NRC's risk-informed regulatory process and should result in measurable benefits that concentrate on those areas of spent nuclear fuel transportation cask response that are most important to safety. Since this program will be funded through NRC licensee fees, the use of a risk-informed approach for the development of the proposed study will ensure that limited resources are used in the most cost-effective manner.

More specific comments regarding the six topics used for discussion purposes during the NRC's public workshops held in late 1999 on the update of the Modal Study are provided below.

## HIGHWAY AND RAILWAY ACCIDENT LIKELIHOOD, SEQUENCES, AND SCENARIOS

In assessing highway and railway accident likelihoods, NRC should ensure that the accident rate data realistically bounds the probability of accidents in urban, suburban, and rural areas. Accident statistics for one state or region of the country may not reasonably represent accident statistics in other areas or regions. To the extent that new accident data is available and can be cost-effectively included in the study, NRC should use new accident data in its analysis if it can be used to realistically bounds potential rail and highway accident statistics.

Some parties have suggested that the proposed study address route conditions along specific spent fuel transportation routes. Since possible transportation routes will vary depending upon the point of origin and point of destination of future shipments and since NRC will not play a role in the actual selection of transportation routes, it is not appropriate for NRC to examine specific spent fuel transportation route conditions in the proposed study. While there is considerable detail available on highway and rail environmental conditions through the Geographical Information System (GIS), the proposed study should not include an exhaustive analysis of specific route conditions but should reflect realistic rail and highway conditions expected during spent fuel transport.

Care should be taken by NRC and its contractor to ensure that any update of the truck and train accident sequences reflects real-world accident conditions and does not consider improbable or extraordinary events as part of the scenarios. It was also suggested that NRC consider other transport modes (such as barge shipments, or transport of truck casks by rail). If other modes of transportation are bounded by the truck and train accident sequences, there should be no need to specifically analyze these additional modes. In

addition, if other modes of transport are not realistic, there is no need to analyze these additional transport modes as part of the Modal Study update.

It has also been suggested that the proposed study include sabotage as a bounding accident scenario. The NRC should not consider sabotage as an accident. Sabotage is not an "accident" to which probabilities can be assigned, but is a deliberate act. NRC has considered the issue of sabotage in other studies and is planning additional research in this area under a separate study. Therefore, it would not be appropriate to include the issue of sabotage in the update of the Modal Study.

## CONTAINER PERFORMANCE DURING COLLISIONS

The original Modal Study did not specifically model cask closure response due to the limited computational capabilities available at that time. To compensate for this uncertainty in cask response model, the Model Study included conservative assumptions regarding spent nuclear fuel release fractions. SNL has proposed modeling certain cask design features, such as the cask closure system, in more detail in order to take advantage of the advanced computational capabilities available today. If this is done, the conservatism in the spent fuel release fractions should be adjusted accordingly to reflect the fact that there would be more certainty in the modeling of cask closure systems.

SNL has proposed including cask testing at speeds greater than 60 miles per hour. Any tests performed as part of this study should reflect real-world conditions whether considering impacts with stationary objects, impacts with other vehicles or impact speeds. While a range of scenarios for possible collision sequences can be envisioned, it is not the speed at which the cask is traveling that is important but the force of the impact that must be absorbed by the cask. Any cask testing that would result in impact speeds greater than those that occur during the regulatory drop test should not assume an unyielding impact surface since this would not be realistic. NRC should clearly identify the intended purpose of testing casks at greater impact speeds and should state that extra-regulatory test conditions should not be construed as regulatory conditions for cask certification.

## CONTAINER PERFORMANCE DURING FIRES

NRC should apply real-world conditions for accident sequences used to determine cask thermal response. SNL has proposed modeling an optically dense, one hour, 1000°C fire, as part of the package performance study. The regulations for spent nuclear fuel transportation cask certification require testing cask response to a fully-engulfing, 800°C fire for 30 minutes. Thus, NRC should clearly state the purpose of modeling any extra-regulatory thermal tests. For example, if a specific test is proposed to provide additional data points to benchmark computational models, this purpose should be clearly identified. NRC should clearly state that any extra-regulatory test conditions should not be construed as regulatory conditions for cask certification.

## SPENT NUCLEAR FUEL ASSEMBLY BEHAVIOR IN ACCIDENTS

SNL has proposed the performance of laboratory-scale experiments that examine fuel rod failure and fuel pellet behavior during accidents. NRC should ensure that fuel characteristics used to calculate the source term realistically represent the range of possible fuel inventories with respect to fuel burnup, enrichment, and fuel age. Given the high cost of irradiated rod testing, NRC should consider the cost-benefit of proposed experiments.

## PHYSICAL TESTING AND COMPUTER SIMULATION

SNL has proposed performing physical testing of casks as part of the proposed study. Any physical tests performed in conjunction with the proposed study should only be performed, if necessary, to reflect changes in cask design, components, materials, etc. in order to benchmark analytical models used for cask design and analysis. Due to the high cost associated with physical tests, NRC should consider the cost-benefits of any test proposed.

Prior to beginning a physical testing program, NRC should clearly identify:

- The purpose of the test (e.g., to perform benchmark calculations on an identified cask component or material);
- The acceptable testing requirements that would yield the results needed to meet the stated purpose (e.g., scale model parameter, type of test, etc.)
- The analytical codes planned to predict the physical test results;
- The testing parameters to be used during the physical test and the justification for the parameters used (e.g., fire temperature, drop height, angle of drop, etc.)
- The estimated cost of the proposed test.

While full scale cask testing may have some public perception benefits, the use of scale models to test new components and materials is sufficient to accomplish NRC's goal of providing a benchmark for analytical codes.

As discussed earlier, the original Modal Study made conservative assumptions in certain areas, such as spent nuclear fuel release fractions, in order to compensate for uncertainties in modeling cask response. Since advanced computational capabilities are available today that will allow more specific analysis of cask components and cask response, conservative assumptions made in the original modal study should be adjusted accordingly to reflect the fact that there would be more certainty in the models used in the updated study.

Both physical testing and computer simulation are used to perform the regulatory tests required for transportation cask certification. There appears to be some confusion by the general public regarding the roles of both physical testing and computer model simulation in assessing cask performance – regarding not only cask certification but also their role in the updated Modal Study. It may be beneficial for NRC to include a description of the role of physical testing and engineering analysis in cask design and certification. For example, physical testing provides a limited number of data points that can be used to benchmark analytical codes to ensure that the predicted results are conservative. Engineering analyses

using these benchmarked analytical codes allows cask designers and regulators to look at multiple scenarios and determine cask safety margins.

## OTHER ISSUES

The proposed study should use a risk-informed approach to determine the aspects of spent nuclear fuel cask design that are most important to safety during severe accident conditions. Since this program will be funded through NRC licensee fees, the use of a risk-informed approach for the development of the proposed study will ensure that limited resources are used in the most cost-effective manner such that the major issues are addressed.

Some individuals have suggested that NRC form an advisory committee to provide input ad oversight to NRC staff and contractors regarding the update of the Modal Study. Instead of forming a separate advisory committee, NRC staff and consultants could consult with NRC's Advisory Committee on Nuclear Waste (ACNW), if necessary.

## CONCLUSIONS

The safety of spent nuclear fuel transportation has been demonstrated by the proven safety record associated with more than 30 years of safe spent nuclear fuel transportation. The proposal to update the Modal Study should be limited to the examination of those parameters in the original study that have changed, the use of updated computer modeling capability, and the examination of new cask designs, materials and components that might affect cask response during severe accident conditions. The proposed study should use a risk-informed approach to determine the aspects of spent nuclear fuel cask design that are most important to safety during severe accident conditions.