Western Interstate Energy Board

High-Level Radioactive Waste Committee Position Paper

Full-Scale Cask Testing

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In General

This Position Paper represents the views of the Western Interstate Energy Board as developed by its High-Level Radioactive Waste Committee (HLRWC). WIEB was created under the Western Interstate Nuclear Compact in 1970, and the WIEB Board members are appointed by the governors of the Compact states. The HLRWC is composed of nuclear waste transportation experts who collaborate on this topic with the U.S. Department of Energy as well as many others. The HLRWC, in existence for over thirty years, has drawn from its members' extensive experience in order to create Position Papers. Once approved by the WIEB Board, this and the other Position Papers represent WIEB's view of how to create and maintain an ideal nuclear waste transportation campaign. Although the HLRWC only speaks on behalf of the Western WIEB member states in these Position Papers, it acknowledges the essential involvement of many partners in assuring this ideal campaign: one that is safe, uneventful, and publicly acceptable.

Statement of Policy

Prior to the commencement of any large-scale spent nuclear fuel shipping program, a production model of a rail cask and a production model of a truck cask should be subjected to regulatory tests at full-scale to demonstrate compliance with and validate the U.S. Nuclear Regulatory Commission (NRC) accident performance requirements at 10 CFR 71.73. Lessons learned from other transportation campaigns indicate a high degree of value to full-scale testing. To take full advantage of this value, the testing should be planned and performed in cooperation with stakeholders.

Background and Context

1. **None of the casks certified for use today have undergone full-scale testing.**
   The success of the U.S. regulatory system for spent nuclear fuel transportation relies on the integrity and durability of the shipping cask. Seventeen spent nuclear fuel transportation casks are currently certified for use in the United States (as of January 2016) according to a detailed report prepared by the NRC.[1] These casks were tested using computer modeling combined with scale-model testing, or computer modeling alone, to demonstrate compliance with the NRC requirements for cask performance in severe accidents. None of the 17 casks were tested at full scale.

2. **The National Academies supported full-scale testing.**
   In its 2006 expert consensus report, the National Academy of Sciences (NAS), Committee on Transportation of Radioactive Waste, after careful review of the three-decades-long debate over full-scale cask testing, stated: "The committee strongly endorses the use of full-scale testing to determine how packages will perform under both regulatory and credible extraregulatory conditions."[2] Based on that finding, the NAS Committee concluded: "Full-scale package testing should continue to be used as part of integrated analytical, computer simulation, scale-model, and testing programs to validate package performance."[3] The NAS Committee qualified both the finding and the recommendation by stating that full-scale testing of packages "to destruction" should not be required.[4]

3. **The Blue Ribbon Commission supported full-scale testing.**
   In its 2012 final report, the Blue Ribbon Commission (BRC) on America's Nuclear Future adopted the NAS Committee recommendation on full-scale cask testing. The BRC noted that "numerous parties have suggested that expanded full-scale testing of transportation casks (in addition to computer modeling) could be useful in enhancing public confidence in transport safety."[5] The BRC specifically endorsed a 2005 NRC staff proposal for full-scale testing of a rail cask "of the kind expected to be used in transporting spent fuel to a HLW repository – in a scenario involving a collision with a locomotive traveling at high speed followed by a hydrocarbon fire."[6] The BRC went on to say that test funding "should be

[1] NRC, "Physical Tests Performed on Spent Fuel Packages," Enclosure with Correspondence, Chairman Stephen G. Burns to Honorable Harry Reid, January 8, 2016, ML15345A321. Twelve casks were certified based on computer modeling and scale-model testing. Five casks were certified based on computer modeling alone.
[2] "*Going the Distance: The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States*," National Research Council, 2006, pg. 14.
[3] Ibid.
[4] Id. at 14-15.
[5] BRC Report to the Secretary of Energy, Jan. 2012, pg. 84.
[6] Ibid.

provided from the Nuclear Waste Fund so that the NRC can update these plans and proceed with those tests the NRC determines to be most useful."[7]

4. **The NRC has previously endorsed full-scale testing.**
   In June 2005, the NRC voted 5-0 to approve a staff plan for full-scale impact testing of a rail cask.[8] A majority of the Commissioners directed staff to expand the program to include a truck cask, and to subject the casks to a fire test.[9] DOE agreed to participate in the NRC testing program. The NRC-proposed tests were deferred until 2009, but "did not materialize because of budget constraints (the estimated cost of the study was approximately $15 million) and uncertainties about the Yucca Mountain project."[10]

5. **The U.S. Department of Energy (DOE) has previously deferred to the NRC on the need for full-scale cask testing, but has not indicated opposition.**
   Since 2003, DOE leadership has neither advocated for, nor opposed, full-scale cask testing. DOE stated in 2002 that the NRC "decides what level of physical testing or analysis is appropriate and necessary for each cask design. . . [I]f full-scale testing was necessary, it would be done before the Commission issued a certificate of compliance. . . DOE has the option of evaluating the need for a full-scale cask test demonstration in the future."[11] DOE restated its deference to NRC in 2008: "DOE would use NRC certified casks . . . Cask vendors . . . would conduct such testing as the NRC required."[12] Regarding the shipping casks planned for Yucca Mountain, DOE restated that it would not require testing beyond what NRC required: "DOE does not plan to conduct extraregulatory (that is, full-scale) testing . . . "[13]

6. **Two previous full-scale testing programs have significant lessons for any future testing program**.
   The primary objective of full-scale cask testing is to validate the design of the cask. Test results may illuminate deficiencies and indicate design changes needed to improve cask performance.

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[7] Ibid.
[8] NRC, Commission Voting Record, Details and Projected Cost of a Demonstration Test of a Full-Scale Spent Nuclear Fuel Rail Transportation Cask Under the Package Performance Study, SECY-05-0051 (June 9, 2005), MOL.20070913.0508.
[9] Ibid.
[10] BRC, 2012, pg. 84.
[11] DOE, Yucca Mountain Final Environmental Impact Statement, 2002, pp. CR8-153, CR8-300; see also pp. M-17 to M-18.
[12] DOE, Yucca Mountain Final Supplemental Environmental Impact Statement, 2008, pg. H-29.
[13] Id. at CR-287. The NRC regulations require a spent fuel cask to maintain substantial containment and shielding following exposure to hypothetical accident conditions including "in sequence, a 9-meter (30-foot) drop onto an unyielding flat surface, a 1-meter (40-inch) drop onto a vertical steel bar, exposure of the entire package to fire for 30 minutes [at 1,475 degrees Fahrenheit], and immersion in 0.9 meter (3 feet) of water. In addition, an undamaged cask must be able to survive submersion in the equivalent pressure of 15 and 200 meters (50 and 650 feet) of water." DOE and NRC believe that compliance with these hypothetical accident conditions would demonstrate successful cask performance in more than 99.99 percent of expected accidents. Id. at H-13 to H-14.

Previous full-scale cask tests have identified design flaws that, when corrected, improved cask safety. An example was the TRUPACT II testing program, which included full-scale drop and fire testing for packages used to transport transuranic wastes to the Waste Isolation Pilot Plant.[14] These full-scale tests continue to serve as an important element in the "WIPP transportation model," a successful large-scale transportation campaign of radioactive waste. The full-scale test program built confidence not only in the TRUPACT-II but in other related cask designs[15] for transport of transuranic wastes.

The "Operation Smash Hit" Magnox cask testing program involved full-scale regulatory tests of a cask design to transport spent nuclear fuel. Those casks continue to be used in the United Kingdom.

7. **Full-scale testing can improve public confidence in the performance of a cask in accident conditions.**
   The TRUPACT-II and Magnox cask tests succeeded in enhancing stakeholder confidence and acceptance. The test results were accurately portrayed in public information materials, especially through films and videos. The testing program and the test results were endorsed by key stakeholders in the Western United States and in the United Kingdom, especially government officials, emergency response personnel, and law enforcement officers in affected jurisdictions along shipping routes.

8. **Simulations are useful tools, not a replacement for full-scale testing.**
   Simulations are modeled imitations of a real-world process or system.[16] Simulating a system requires a model, derived from known or theoretical information, which represents relevant characteristics, behaviors and functions of the targeted real system.[17] Simulations are, at best, approximate imitations of real-world systems with the following limitations: simulations never perfectly mirror or represent the system and simulations do not test the relationship between the modeled and real system. Due to these constraints, both the model and simulation require robust, real-world verification and validation. Full-scale, real-world testing is the requisite verification and validation process for simulations.

Policy Recommendations

1. **Full-scale testing should be performed in addition to regulatory analysis.**
   Computer modeling and scale-model testing provide data that is vital to assess the ability of a cask to survive severe accident conditions. The information derived from computer

[14] "Interagency Conflicts in the Regulation of Hazardous Materials in Transport: The Nuclear Materials Example," Melinda Kassen, presented at Hazmat '91: A National Conference on the Transportation of Hazardous Materials and Wastes, Northwestern University, 1991. Norwell, Massachusetts: Kluwer Academic Publishers.
[15] The halfPACT, the TRUPACT-III, and the RH 72-B.
[16] J.A. Sokolowski & C.M. Banks, "*Principles of Modeling and Simulation,*" Hoboken, NJ: Wiley, 2009, pg. 6.
[17] Robert G. Sargent, "*Verification and Validation of Simulation Models,*" Proceedings of the 2011 Winter Simulation Conference.

modeling and scale-model testing must be validated by data obtained through full-scale testing.

2. **Full-scale tests should be performed on casks used for current and future shipments.**
   Testing conducted in the late 1970s by Sandia National Laboratories subjected retired truck and rail casks to a series of impact and fire tests. Those tests were intended to verify computer simulation programs used for structural analysis, and cannot be used to assess the performance of current and future casks.

3. **Full-scale tests should be designed to subject the packages to the hypothetical accident conditions as specified in the NRC regulations.**
   Regulatory testing provides valuable data necessary to validate computer modeling and scale-model testing. The hypothetical accident conditions specified in the NRC regulations, when performed in sequence, likely represent more than 99 percent of expected transportation accidents.

4. **Demonstration testing is acceptable only in conjunction with regulatory testing.**
   A regulatory thirty-foot drop test does not provide the visual reinforcement of a high-speed collision involving trucks and/or trains. A "demonstration" test showing a real-world collision would likely be more impactful with the public and with emergency responders. However, demonstration tests should not be conducted without also generating confirmatory data through regulatory testing.

5. **Stakeholders should be involved in the testing program.**
   Stakeholders such as the Western Interstate Energy Board, along with other state, tribal, and industry representatives, have a long history of participation in all aspects of radioactive material transportation planning. The design and implementation of any full-scale testing program should make use of this expertise.

6. **Independent peer review of the test program must be provided.**
   Independent assessment and validation of the test program is necessary to achieve public credibility in the robustness of the casks.[18] Although technical review may involve sensitive or classified information, security concerns should not be allowed to hinder a thorough independent evaluation. All resulting publications and multimedia materials should be subject to rigorous peer review.

7. **Safety claims should not be exaggerated in test reports, films, and videos.**
   The public has become quite adept at recognizing when government agencies are being less than forthcoming. The test results need to stand on their own, without hyperbole or exaggeration.

[18] For a review of the social risk literature on public credibility, see "Going the Distance?", National Research Council, 2006, pp. 149-161.