4 REFERENCES

1. "Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes," NUREG-0170, U.S. Nuclear Regulatory Commission, December 1977.

2. Fischer, L.E., et al., "Shipping Container Response to Severe Highway and Railway Accident Conditions," NUREG/CR-4829, Livermore, California, Lawrence Livermore National Laboratory, February 1987.

3. "Reexamination of Spent Fuel Shipment Risk Estimates," NUREG/CR-6672, U.S. Nuclear Regulatory Commission, March 2000.

4. Huerta, M. and Yoshimura, R., "Study and Full-Scale Test of a High-Velocity Grade-Crossing Simulated Accident of a Locomotive and a Nuclear-Spent Fuel Shipping Cask," SAND79-2291, Sandia National Laboratories, February 1983.

5. Huerta, M., "Analysis, Scale Modeling, and Full-Scale Tests of a Truck Spent-Nuclear-Fuel Shipping System in High Velocity Impacts Against a Rigid Barrier," SAND77-0270, Sandia National Laboratories, April 1978.

6. Huerta, M., "Analysis, Scale Modeling, and Full-Scale Test of a Railcar and Spent-Nuclear-Fuel Shipping Cask in a High-Velocity Impact Against a Rigid Barrier," SAND78-0458, Sandia National Laboratories, February 1980.

7. Johnson, A.B.,Jr., and Gilbert, E.R., "Technical Basis for Storage of Zircaloy-Clad Spent Fuel in Inert Gases," PNL-4835, Pacific Northwest Laboratory, September 1983.

Appendix A

ATTENDEE LIST

ATTENDEES FROM THE NUCLEAR REGULATORY COMMISSION

Office of the Commission, Edward McGaffigan, Jr. (OCM/EXM)
Office of the Commission, Richard A. Meserve (OCMRAM)
Office of the General Counsel (OGC)
Office of Nuclear Material Safety and Safeguards, Division of Waste Management (DWM)
Office of Nuclear Material Safety and Safeguards, Spent Fuel Project Office (SFPO)
Office of Nuclear Regulatory Research (RES)
Office of State Programs

NOVEMBER 19, 2002

Melanie Wong	DWM
Rosetta Virgilio	OSP
Robert K. Johnson	DWM
David Esh	DWM
Chris Grossman	DWM
Michael Waters	SFPO
Beth Schlapper	SFPO
Naiem Tanious	IMNS
Allen Hansen	SFPO
Phyllis Sobel	OCM/RAM
Rob Lewis	SFPO
Steven Baggett	SFPO
Mike Tokar	SFPO
Wayne Hodges	SFPO
Dan Dorman	RES
Charles Miller	SFPO
Rob Temps	SFPO
Bob Shewmaker	SFPO
Mahendra Shah	SFPO
Daniel Huang	SFPO
Andrew J. Murphy	RES
David Pstrak	SFPO
Julia M. Barto	SFPO
Carl Wither	SFPO
Heather Astwood	OCM/EXM
Philip Justus	DWM
Chet Poslusny	SFPO
Neil Jensen	OGC

ATTENDEES FROM THE NUCLEAR REGULATORY COMMISSION (CONT'D)

NOVEMBER 20, 2002

David Dancer	DWM
Rob Lewis	SFPO
Steven Baggett	SFPO
David Pstrak	SFPO
Melanie Wong	DWM
Rob Temps	SFPO
Chet Poslunyn	NMSS
Naiem Tanious	NMSS/IMNS
Andrew Murphy	RES
Phyllis Sobel	OC/RAM
Mike Tokar	SFPO
Rosetta Virgilio	OPA
Julia Barto	SFPO
Heather Astwood	OCM/EXM
Dinnis Galvin	DWM
Dennis Dambly	OGC

ATTENDEES FROM OTHER AGENCIES AND THE GENERAL PUBLIC

NOVEMBER 19, 2002

Craig F. Smith	Lawrence Livermore National Laboratories
Larry Kennedy	Senator Henry Reid
Allan Jolen	Holtec International
Brian Gutherman	Holtec International
Nancy Thompson	Department of Energy
Mark Holt	CRS
Ed Davis	Self/Pegasus
Marvin Resnikoff	Self
Brian O'Connell	National Association of Regulatory Utility Commission
Ray Clark	Environmental Protection Agency
Thomas Phan	General Accounting Office
Maureen Conly	McGraw-Hill/Platts
William Garfield	Bechtel - SAIC Co.
Kevin Kamps	NIRS
Jerome Roth	ENER Corp.
Robert Bernero	NRC, Retired
E.v. Tiesenhausen	CCCP
Rick Boyleston	WSMS
Norman Henderson	Bechtel SAIC Co.
Steven Kraft	Nuclear Energy Institute
Jim Pegues	City of Las Vegas
Ken Grumski	MHF Logistical Solutions, Inc.
Tom Michener	Pacific Northwest National Laboratory
William Lake	Department of Energy

ATTENDEES FROM OTHER AGENCIES AND THE GENERAL PUBLIC (CONT'D)

NOVEMBER 19, 2002 (Cont'd)

James B. Wingfield	Tri State Motor Transit
Ellen W. Ott	Department of Energy
Jose S. Pena	Department of Transportation
Eileen Supko	Electric Power Research Institute
Carol Hanlon	Department of Energy
Lisa Gue	Public Citizen
Ed Benz	SAI/BSC
Carl Bella	Nuclear Waste Technical Review Board
D. J. Feheringer	Nuclear Waste Technical Review Board
Felix Killar	Nuclear Energy Institute
M.E. Wangler	Department of Energy
Michael Conroy	Department of Energy
Ralph Best	OAI
Daniel Bullen	Nuclear Waste Technical Review Board
Kevin Crowley	National Academy of Sciences
Alan Zimmer	General Atomics
David Bennett	U.S. Transport Council
David B. Lee	U.S. Transport Council
John A. Vincent	Nuclear Energy Institute
Alan Hansen	TN
Andrea Jennetta	Fuel Cycle Week
Albert Machiels	Electric Power Research Institute
David McCarville	Booz-Allen Hamilton
Willis Brorne	DURATEK
Eric Wieser	Nuclear Waste News
Karyn Severson	Nuclear Waste Technical Review Board
Tom Danner	NAC International

NOVEMBER 20, 2002

Alan Soler	Holtec International
Brian Gutherman	Holtec International
Albert Machiels	Electric Power Research Institute
Jose Pena	Department of Transportation
Jerome Roth	ENERCORP.
Tom Griffith	Department of Energy
Rick Boyleston	WSMS
James Channell	New Mexico/EEG
Ellen Ott	Department of Energy
David McCarville	Booz-Allen
Ralph Best	JAI
Robert Benero	NRC, Retired
Rodger Comstal	EMH
Jim Pegues	City of Las Vegas
David Bennett	Tri State Motor Transit Co.

ATTENDEES FROM OTHER AGENCIES AND GENERAL PUBLIC (CONT'D)

NOVEMBER 20, 2002 (Cont'd)

John Vincent	Nuclear Energy Institute
Felix Killar	Nuclear Energy Institute
Alan Zimmer	General Atomics
Eileen Supko	ERI
Steve Kraft	Nuclear Energy Institute
Michael Conroy	Department of Energy
Darla Thompson	National Academies
E. V. Tiesenhausen	CCCP
Brian O'Connell	NARUC
D. J. Fehringer	Nuclear Waste Technical Review Board
William Lake	Department of Energy
Jim Shaffner	Parallax
Bob White	General Accounting Office
Carol Hanlon	Department of Energy
Norm Henderson	BSC
Mark Holt	CRS
Lis Gue	Public Citizen
Ed Davis	Self
Ray Clark	Environmental Protection Agency
Ed Benz	BSC/JAI
Lake Barrett	Self
David Blee	U.S. Transport Council

Appendix B

Post-Meeting
Stakeholder Written Comments

Public Citizen

Buyers Up • Congress Watch • Critical Mass • Global Trade Watch • Health Research Group • Litigation Group
Joan Claybrook, President

November 25, 2002

Dr. George Hornberger, Chairman
Advisory Committee on Nuclear Waste
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Dr. Hornberger:

This is to express our disappointment in the one-sided panel of invited speakers at ACNW's recent workshop on nuclear waste transportation, held November 19-21. We are deeply concerned that the Committee intends to draw conclusions about nuclear waste transportation having heard only from representatives of federal agencies and the nuclear industry, who are generally supportive of current contentious proposals to expand nuclear waste transportation in the U.S. Hiding behind the pretense of a technical agenda, the Committee excluded participation of non-industry stakeholders, and then went on to substantially discuss issues of public confidence – deliberations that could certainly have benefited from a more broadly composed panel. Even if the agenda had been purely technical, experts from the States of Nevada and Utah, for example, might have offered an alternative perspective, had they been invited to present.

In the coming months and years, the NRC will evaluate license applications for the Private Fuel Storage and Yucca Mountain projects, which would initiate unprecedented transports of high-level nuclear waste through most of this country. How can the public be expected to have confidence in the NRC as an objective regulator of these projects when the agency and its advisory committees appear to be guided by and primarily concerned with facilitating the interests of the nuclear industry?

Sincerely,

Lisa Gue
Senior Energy Analyst,
Public Citizen's Critical Mass Energy and Environment Program

cc. Dr. Richard Meserve, Chairman, Nuclear Regulatory Commission

Ralph Nader, Founder
215 Pennsylvania Ave SE • Washington, DC 20003-1155 • (202) 546-4996 • FAX: (202) 547-7392 • www.citizen.org

KENNY C. GUINN
Governor

STATE OF NEVADA

ROBERT R. LOUX
Executive Director

OFFICE OF THE GOVERNOR
AGENCY FOR NUCLEAR PROJECTS
1802 N. Carson Street, Suite 252
Carson City, Nevada 89701
Telephone: (775) 687-3744 • Fax: (775) 687-5277
E-mail: nwpo@nuc.state.nv.us

November 26, 2002

George M. Hornberger, Chairman
Advisory Committee on Nuclear Waste
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Dr. Hornberger:

On November 19 – 21, 2002, ACNW held a transportation workshop that brought together representatives from the U.S. Department of Energy, several other federal agencies, and industry to discuss various aspects of spent fuel and high-level radioactive waste transportation. Conspicuously missing from the workshop's agenda were experts from the state of Nevada, other states, or public interest groups – i.e., anyone who might bring a broader, albeit more critical, perspective to the issue. As a result, committee members and others attending the meeting were treated to a very one-sided and potentially skewed perspective on a matter that is of great importance, not only to the ACNW and NRC, but to the country as a whole.

To remedy this situation, I am proposing that, before the committee reports on this matter to the Commission, the state of Nevada be afforded the opportunity to organize a follow-up workshop at a future ACNW meeting for the purpose of providing the committee with views of transportation experts not employed by DOE or the nuclear industry. We would propose a one day session, with presentations on transportation policy and planning; cask safety/cask testing; security and safeguards; and public acceptance, risk, and risk perception.

With the transportation of spent nuclear fuel and high-level waste set to become a high profile and potentially volatile public issue as the Private Fuel Storage project in Utah moves towards fruition and plans for nuclear waste transportation associated with

the Yucca Mountain program begin to be more visible, the need for enhanced credibility on the part of organizations charged with assuring public health and safety in things nuclear becomes increasingly important. The type of meeting ACNW held on November 19th – 21st can only fuel public skepticism and distrust about government's role in assuring the safety of such shipments and the apparently 'cozy' relationship between NRC, DOE, and the commercial nuclear industry.

I trust that this request for a follow-up transportation meeting to present information from parties excluded from the November workshop will be given favorable consideration. Please feel free to contact me to discuss the matter further and identify meeting possible dates.

Sincerely,

Robert R. Loux
Executive Director

RRL/cs
cc Governor Guinn
Senator Harry Reid
Senator John Ensign
Rep. Shelly Berkley
Rep. Jim Gibbons
Richard Meserve, Chairman, NRC

KENNY C. GUINN
Governor

STATE OF NEVADA

ROBERT R. LOUX
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December 9, 2002

Richard Meserve, Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Re: Full-Scale Physical Testing for Spent Fuel Shipping Casks

Dear Chairman Meserve:

Nevada has long urged NRC to require full-scale testing as part of the certification process for any new casks that could be used for shipments to Yucca Mountain. We understand that NRC has proposed demonstration testing of one or two "representative" shipping casks as part of the Package Performance Study (PPS) to be conducted by Sandia National Laboratories. If appropriately designed and implemented, the planned PPS tests can provide significant information for risk assessment and risk management. The PPS tests cannot, however, be considered a substitute for full-scale testing of each new cask design prior to certification.

Nevada believes that full-scale tests should be an integral part of the certification process. As we informed the NRC through our meeting statements and written comments on the PPS, Nevada proposes a four-part approach to full-scale certification testing: (1) meaningful stakeholder participation in development of testing protocols and selection of test facilities and personnel; (2) full-scale physical testing (sequential drop, fire, puncture, and immersion) prior to NRC certification; (3) additional computer simulations to determine performance in extra-regulatory accidents and to determine failure thresholds; and (4) reevaluation of previous risk study findings, and if appropriate, revision of NRC cask performance standards. Nevada also considers destructive testing of a randomly selected production cask to be a highly desirable way of ascertaining actual failure thresholds.

Nevada has previously recommended that the Commission consider full-scale testing to assess shipping cask vulnerability to terrorism and sabotage. In our 1999 petition for rulemaking , Docket No. PRM-73-10, Nevada requested a comprehensive assessment of the consequences of three types of attacks which have the potential for radiological sabotage: attacks against transportation infrastructure used by nuclear waste shipments, attacks involving capture of a nuclear waste shipment and use of high energy explosives against the cask, and direct attacks upon a nuclear waste shipping cask using antitank missiles. As part of that assessment, Nevada recommended that the Commission consider the need for physical testing, full-scale and/or scale model, to evaluate weapons capabilities, cask vulnerability to attack with high-energy explosive devices, and the response of spent nuclear fuel to such attacks (specifically, to determine fuel mass release from a cask, particle size distribution of released fuel, and special concerns associated with volatile radionuclides such as Cs-134 and Cs-137). NRC has yet to take any action on Nevada's petition, despite the added urgency brought about by the events of September 11th and their implications for potential terrorism against spent fuel and/or high-level waste shipments.

During the preliminary phase of the Package Performance Study, 1999 - 2000, the NRC repeatedly acknowledged the importance of establishing stakeholder confidence in the PPS study process and in its findings. The upcoming PPS testing program could provide an important opportunity for NRC to demonstrate its commitment to stakeholder participation. Yet the NRC has still not issued the draft PPS testing protocol for public review and comment, as promised in June-July, 2002, nor has NRC rescheduled the promised PPS public meetings in Nevada, originally planned for August-September, 2002. On the other hand, it appears that NRC presented "draft predecisional" PPS testing protocols to the Advisory Committee on Nuclear Waste (ACNW) in June 2002, but to our knowledge this document has not been provided to any of the stakeholders who previously participated in the PPS public meetings. The process to date does not inspire confidence, nor does it come close to meeting NRC stated commitment to public and stakeholder involvement in development and review of testing protocols.

We would like to take this opportunity to make several recommendations regarding the proposed PPS cask tests:

(1) Stakeholder Participation

The only way to assure that a testing program is not just an engineering exercise but has relevance to real world conditions is to provide for the substantive and meaningful participation of stakeholders not part of the NRC and DOE "family" in specifying the objectives of the tests, developing the testing protocols, selecting the testing contractors, and overseeing the implementation of the test program. A model for effective stakeholder involvement is the approach used for testing of the TRUPAC shipping container used for transporting transuranic waste to the Waste Isolation Pilot Plant facility in New Mexico. In that case, representatives

from affected states as well as outside consultants identified by the states were fully involved in the design of the test program and in overseeing its implementation. Not only did such involvement assure greater public acceptance of cask safety and the entire WIPP shipping program, but it also resulted in the identification of engineering and safety flaws that likely would not have been found absent the involvement of these "outside" participants.

(2) Selection of Cask Testing Facilities

Public statements by NRC representatives (for example, by Chester Poslusny, in Las Vegas, on 11/14/02) suggest that the decision has already been made to conduct the proposed tests at Sandia National Laboratories in New Mexico. Before a final selection of test facilities, Nevada believes that NRC should discuss the relevant issues with stakeholders. Nevada believes that the accessibility of the test facilities to stakeholders, and the willingness of facility personnel to facilitate stakeholder participation in testing, are just as important as the facilities technical testing capabilities. Nevada contractors have identified and evaluated existing cask test facilities in the United States and abroad. Nevada contractors and SNL personnel have identified limitations in SNL's capabilities to perform drop and fire tests on large rail casks.

(3) Selection of Casks to Be Tested

Nevada believes that the PPS should test the actual cask designs most likely to be used for spent nuclear fuel and HLW shipments to the proposed Yucca Mountain repository. Highest priority should be given to testing a truck cask, since legal-weight truck is the only transport mode for Yucca Mountain that is currently feasible. All 72 power plant sites and all 5 DOE sites can ship by legal-weight truck. At present, there is no railroad access to Yucca Mountain., and the feasibility of long-distance heavy haul truck (HHT) transport of rail casks in Nevada is unproven. Based on the information presented in DOE's Final EIS for Yucca Mountain, the General Atomics GA-4 cask, designed to transport 4 PWR assemblies, is the most appropriate choice for testing. The GA-4 could be used for about two-thirds of all shipments under DOE's "mostly legal-weight truck" national shipping scenario. To our knowledge, no GA-4 casks have yet been fabricated, although NRC has certified the design.

Selection of the appropriate rail cask for PPS testing is also important. Although DOE has not yet formally selected a preferred mode, DOE representatives have stated that DOE intends to issue a Record of Decision designating rail as the preferred mode for shipments to Yucca Mountain. DOE's FEIS identified a number of potential rail cask designs for repository shipments, some similar and others dissimilar to rail casks currently certified by the NRC. Nevada strongly recommends that NRC defer selection of a rail cask for PPS testing until after extensive discussions with the affected stakeholders.

(4) Selection of Test Scenarios

Nevada strongly supports the position that the PPS tests should evaluate cask performance in extra-regulatory accident environments, that is, performance under accident conditions that could cause failure of both the cask and the spent fuel cargo. Nevada has not yet, however, made final decisions on precisely what test scenarios the PPS should evaluate. Based on NRC commitments made in 2000 and 2001, Nevada expects NRC to defer final decisions on the PPS test protocols until after extensive discussion with the affected stakeholders.

Nevada is currently reexamining its position on full-scale fire testing, based on analyses of the July 2001 Baltimore rail tunnel fire, and we urge NRC to likewise. Previous contractor studies sponsored by Nevada assessed the potential consequences of severe fire accidents involving truck and rail casks. Preliminary analyses of the July 2001 Baltimore accident by Nevada consultants and by the NRC both conclude that fire temperatures in the Baltimore tunnel reached or exceeded 1500°F, although estimates of the fire duration at this temperature vary from seven hours to more than 24 hours. Performance envelope analyses indicate that large rail casks involved in such fire environments (temperature exceeding 1500°F) for more than 20 hours could result in failure of cask seals and oxidation of fuel pellets.

Nevada is also reviewing historical accidents involving high-speed collisions and massive infrastructure failures and potential accident conditions along shipping routes identified in the DOE FEIS in order to more precisely characterize maximum credible, "real-world" accident scenarios. As we have previously stated in our comments during the PPS public meetings, and in our comments on NRC documents such as NUREG/CR-6672, we believe that NRC and SNL have failed to adequately characterize potential severe accident conditions based on "real-world" experience and on the specific hazards along potential routes identified by DOE. One example that we have previously brought to the NRC's attention in the 10CFR71 proposed "Harmonization" rulemaking concerns DOE's proposal for barge shipments on Lake Michigan, where maximum depths exceed the IAEA 200 meter immersion performance standard.

Conclusion

In your testimony before Congress last summer, you indicated that NRC was committed to a meaningful compliance testing program for casks intended for shipping spent fuel and high-level waste to Yucca Mountain. That, however, does not appear to be what NRC is proposing in the package performance study. While it has been difficult to ascertain exactly what NRC hopes to accomplish in the study, it seems from public pronouncements by NRC staff that the planned cask test program will be little more than a one-time public relations exercise designed to produce dramatic videos, with questionable utility for testing the tolerances and survivability of new cask designs. Nor does the NRC proposal represent a commitment to requiring full-scale tests as part of the cask certification process.

Nevada believes that comprehensive full-scale testing would not only demonstrate compliance with NRC performance standards. It would improve the overall safety of the cask and vehicle system and generally enhance confidence in both qualitative and probabilistic risk analysis techniques. It could potentially increase acceptance of shipments by state and local officials and the general public, and potentially reduce adverse social and economic impacts caused by public perception of transportation risks.

It nears noting that none of the SNF shipping casks currently used in the United States have ever been tested full-scale. This fact was confirmed by you in letters to Senator Harry Reid dated April 2, 2002 and April 24, 2002. As DOE has no plans to require full-scale testing of new casks that would be used for shipments of spent nuclear fuel to Yucca Mountain – and is actively resisting calls for such tests, the country could be faced with a situation where no meaningful full-scale tests of spent fuel shipping containers are conducted, despite the potentially massive shipping campaign DOE will need to implement as part of the Yucca Mountain program.

Because of serious credibility problems related to past federal government-sponsored cask testing, Nevada will be proposing a testing program, concurrent with NRC's propose package performance study, using Nevada universities to carry out an independent series of full-scale regulatory compliance and failure threshold cask tests as a way of overseeing and verifying NRC's findings.

I would urge the NRC to reassess its planned cask testing demonstration and commit to undertake a truly meaningful approach to full-scale cask testing as an integral part of the cask certification process.

Sincerely,

Robert R. Loux
Executive Director

RRL/cs
cc. Governor Guinn
Nevada Congressional Delegation
Nevada Commission on Nuclear Projects
George Hornberger, ACNW

Appendix C

TWG Letter Report to the Commission
and
NRC Staff Response

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON NUCLEAR WASTE
WASHINGTON, D.C. 20555-0001

January 7, 2003

The Honorable Richard A. Meserve
Chairman
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

SUBJECT: TRANSPORTATION WORKING GROUP MEETING

Dear Chairman Meserve:

During its 138th meeting on November 19-20, 2002, the Advisory Committee on Nuclear Waste (ACNW) conducted a Transportation Working Group Meeting. The meeting convened experts in spent nuclear fuel transportation package design, analysis, and testing methods to evaluate the current evidence regarding the mechanical and thermal capabilities of transportation packages. In addition, the experts reviewed the history of domestic and worldwide spent fuel and high-level radioactive waste transportation experience. Topics included the number and types of shipments made, problems encountered, and the consequences of these problems.

DISCUSSION

The risks associated with the transportation of spent nuclear fuel and other high-level radioactive waste are of significant public concern. The Committee decided that a focused meeting of the Transportation Working Group would be the most efficient and encompassing way to gather information on various risks associated with such shipments.

The Transportation Working Group Meeting, which took place over 1½ days, was attended by a variety of stakeholders (see the attached agenda and attendance list). Several stakeholders took advantage of the time that was set aside during the meeting for members of the public to address the Working Group

The meeting had two objectives: (1) to assess the available test data and analysis methods for package performance to determine if additional tests or enhanced analytical methods are necessary to ensure safety of transportation packages; and (2) to review the actual experience with the transportation of spent nuclear fuel and high-level radioactive waste.[1]

The meeting included presentations by experts in spent nuclear fuel transportation package design, testing, and analysis, as well as individuals with experience in shipping spent nuclear

[1]The security of transportation and its protection from terrorism is a separate issue and was not addressed during the meeting.

fuel and high-level radioactive waste.[2] The Transportation Working Group will document the proceedings from the meeting in a NUREG-series report.

Analysis and Testing

The spent fuel transportation tests performed at Sandia National Laboratories (Sandia) in 1977 and "Operation Smash Hit" performed in the United Kingdom in 1984 provided compelling demonstrations of the structural integrity of spent fuel transportation packages. Those tests involved rail and truck accidents using full-scale packages. The packages sustained only minor damage. The packages tested by Sandia were of no more robust design than the packages used today. We concluded that similar tests, performed using a current package design, would adequately demonstrate transportation safety.

Information presented at the meeting demonstrated that transportation of packages that meet regulatory requirements does not pose a threat to public health and safety. While there was some disagreement about methods of testing and analysis, the presenters unanimously agreed that spent nuclear fuel and high-level radioactive waste are being transported safely.

We concluded that several tests using scale models of casks would be preferable to a single full-scale test for purposes of code validation. Such tests may be needed if unique designs are submitted for licensing.

We also concluded that current analysis techniques are adequate to provide reasonable assurance that transportation packages meet the current regulations. Notwithstanding, future analyses may be enhanced using simulation modeling techniques developed for nuclear weapons research.

Transportation Experience

Over the past 50 years substantial experience has been gained in the transportation of spent nuclear fuel and high-level radioactive waste. In the United States, government agencies and industry have safely made thousands of shipments. None of these shipments has resulted in the release of the radioactive contents. Similarly, thousands more shipments have been made safely throughout the world.

Both domestic and worldwide statistics are available on spent nuclear fuel and high-level radioactive waste shipments. These statistics include information on consequences associated with transportation accidents and incidents. However, there currently is no comprehensive database that can be used to compare shipments and quantify trends. We concluded that information contained in such a database would be useful in performing risk-informed analyses and should be available to all stakeholders.

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[2]Sandia National Laboratories, Lawrence Livermore National Laboratory, Holtec International, NAC International, Transnuclear, Inc., the Association of American Railroads and the NRC's Spent Fuel Project Office participated in the discussions of package design, testing, and analysis. The Department of Transportation, the Department of Energy, Progress Energy, and Cogema participated in the discussions of transportation experience.

RECOMMENDATIONS

1. The full-scale test of a shipping package now being proposed by the NRC staff should be a public demonstration performed under credible accident conditions. An example of such a test would be crashing a transportation vehicle and package into a target (e.g., a concrete wall, a steel bridge, or another vehicle).

2. Advantage should be taken of the enhanced analytical capabilities that have been developed as part of the nuclear weapons program. Application of these computational tools to transportation package performance analysis would augment confirmatory testing and increase confidence in safety.

3. A centralized database for past and future spent fuel and high-level radioactive waste shipments should be developed. This database should record all data regarding the number and types of shipments, as well as the consequences associated with any accidents or incidents.

Sincerely,

/RA/

George M. Hornberger
Chairman

References:

1. Sandia National Laboratories Report SAND77-0270, "Analysis, Scale Modeling, and Full Scale Tests of a Truck Spent-Nuclear-Fuel Shipping System in High Velocity Impacts Against a Rigid Barrier," April 1978.
2. Sandia National Laboratories Report SAND78-0458, "Analysis, Scale Modeling, and Full-Scale Test of a Railcar and Spent-Nuclear-Fuel Shipping Cask in a High-Velocity Impact Against a Rigid Barrier," February 1980.

Attachments:

1. ACNW Transportation Working Group Agenda for Meeting held 11/19-20/02
2. Attendance List for Meeting of Transportation Working Group on 11/19-20/02

ADVISORY COMMITTEE ON NUCLEAR WASTE
TRANSPORTATION WORKING GROUP WORKSHOP
NOVEMBER 19 & 20, 2002,
TWO WHITE FLINT NORTH, AUDITORIUM, ROCKVILLE, MARYLAND

Contact: Tim Kobetz (301-415-8716, tjk1@nrc.gov)

-PROPOSED SCHEDULE-
NOVEMBER 19, 2002

	Topics	Presenters	Time
I.	Opening Remarks	G. Hornberger, Chairman, ACNW M. Levenson, ACNW	8:30-8:40 a.m. (10 min)
II.	Analysis and Testing		
a.	Overview of Research Program Objectives	E. William Brach, SFPO	8:40-9:00 a.m. (20 min) Presentation Time 9:00-9:20 a.m. (20 min) Discussion Time
b.	Summary of Sandia National Laboratory Research	Doug Ammerman, Sandia	9:20-10:05 a.m. (45 min) Presentation Time 10:05-10:35 a.m. (30 min) Discussion Time
	BREAK		10:35-10:50 a.m.
c.	Summary of Lawrence Livermore Laboratory Research	Larry Fischer, LLNL	10:50-11:35 a.m. (45 min) Presentation Time 11:35 a.m.-12:05 p.m. (30 min) Discussion Time
d.	Public Comments		12:05-12:30 (25 min)
	LUNCH		**12:30-1:30 p.m.**
e.	Vendor Analysis and Testing	Kris Singh, Holtec International Peter Shih, Transnuclear Michael Yaksh, NAC Intl.	1:30-1:50 p.m. (20 min) Presentation Time 1:50-2:10 p.m. (20 min) Presentation Time 2:10-2:30 p.m. (20 min) Presentation Time 2:30-3:15 p.m. (45 min) Discussion Time

	BREAK		**3:15-3:30 p.m.**
f.	Analysis of Fires	Chris Bajwa, SFPO	3:30-3:50 p.m. (20 min) Presentation Time 3:50-4:10 p.m. (20 min) Discussion Time
g.	Comparison of Analysis and Testing to Actual Railway Experience	Robert Fronczak, AAR	4:10-4:30 p.m. (20 min) Presentation Time 4:30-4:50 p.m. (20 min) Discussion Time
h.	Public Comments		4:50-5:15 p.m. (25 min)
i.	Committee Discussions	Milt Levenson, ACNW	5:15-5:45 p.m. (30 min) Discussion Time

ADVISORY COMMITTEE ON NUCLEAR WASTE
TRANSPORTATION WORKING GROUP WORKSHOP
NOVEMBER 19 & 20, 2002,
TWO WHITE FLINT NORTH, AUDITORIUM, ROCKVILLE, MARYLAND

Contact: Tim Kobetz (301-415-8716, tjk1@nrc.gov)

-PROPOSED SCHEDULE-
NOVEMBER 20, 2002

	Topics	Presenters	Time
I.	Opening Remarks	M. Levenson, ACNW	12:30-12:35 p.m. (5 min)
II.	Transportation Safety in the U.S. and Worldwide		
a.	Summary of DOT Experience with Spent Nuclear Fuel Shipments	Rick Boyle, DOT Kevin Blackwell, DOT	12:35-12:55 p.m. (20 min) Presentation Time 12:55-1:15 p.m. (20 min) Presentation Time 1:15-1:45 p.m. (30 min) Discussion Time
b.	Summary of DOE Shipping Experience		
	i. Waste Isolation Pilot Plant	Alton Harris, DOE	1:45-2:05 p.m. (20 min) Presentation Time
	ii. Foreign Fuel	Maureen Clapper, DOE	2:05-2:25 p.m. (20 min) Presentation Time
	iii. Navy Fuel	Don Doherty, DOE	2:25-2:45 p.m. (20 min) Presentation Time 2:45-3:30 p.m. (45 min) Discussion Time
	BREAK		**3:30-3:45 p.m.**
c.	Summary of Utility Experience	Robert Kunita and Steven Edwards, Progress Energy	3:45-4:15 p.m. (30 min) Presentation Time 4:15-4:45 p.m. (30 min) Discussion Time
d.	Summary of International Experience	Ian Hunter, Transnuclear/ Cogema	4:45-5:05 p.m. (20 min) Presentation Time 5:05-5:25 p.m. (20 min) Discussion Time
e.	Public Comments		5:25-5:45 p.m. (20 min) Discussion Time
f.	Committee Discussions	Milt Levenson, ACNW	5:45-6:30 p.m. (45 min) Discussion Time

138TH ACNW MEETING
NOVEMBER 19–21, 2002

WORKING GROUP MEETING ON TRANSPORTATION OF SPENT NUCLEAR FUEL

ACNW WORKING GROUP AND STAFF

George Hornberger, ACNW Chairman
Raymond Wymer, ACNW Vice-Chairman
Milton Levenson, Working Group Chairman
John Garrick, ACNW Member
Mike Ryan, ACNW Member

Sher Bahadur
Neil Coleman
Michele Kelton
Timothy Kobetz
John Larkins
Howard Larson
Michael Lee
Richard Major
Richard Savio

INVITED EXPERTS

NOVEMBER 19, 2002

E. William Brach	Spent Fuel Project Office (NRC)
Doug Ammerman	Sandia National Laboratory
Larry Fischer	Lawrence Livermore National Laboratories
Kris Singh	Holtec International
Peter Shih	Transnuclear
Michael Yaksh	NAC International
Chris Bajwa	Spent Fuel Project Office (NRC)
Robert Fronczak,	Association of American Railroads

NOVEMBER 20, 2002

Rick Boyle	Department of Transportation
Kevin Blackwell	Department of Transportation
Alton Harris	Department of Energy
Maureen Clapper	Department of Energy
Don Doherty	Department of Energy
Robert Kunita	Progress Energy
Ian Hunter	Transnuclear/Cogema

ATTACHMENT 2

ATTENDEES FROM THE NUCLEAR REGULATORY COMMISSION

NOVEMBER 19, 2002

Melanie Wong	NMSS/DWM
Rosetta Virgilio	OPA
Robert K. Johnson	NMSS/DWM
David Esh	NMSS/DWM
Chris Grossman	NMSS/DWM
Michael Waters	NMSS/SFPO
Beth Schlapper	NMSS/SFPO
Naiem Tanious	NMSS/MNS
Allen Hansen	NMSS/SFPO
Phyllis Sobel	OCM/RAM
Rob Lewis	NMSS/SFPO
Steven Baggett	SFPO
Mike Tokar	SFPO
Wayne Hodges	SFPO
Dan Dorman	RES
Charles Miller	SFPO
Rob Temps	SFPO
Bob Shewmaker	SFPO
Mahendra Shah	SFPO
Daniel Huang	SFPO
Andrew J. Murphy	RES/DET
David Pstrak	SFPO
Julia M. Barto	SFPO
Carl Wither	SFPO/NMSS
Heather Astwood	OCM/EXM
Philip Justus	NMSS/DWM
Chet Poslusky	NMSS/SFPO
Neil Jensen	OGC/RFC

NOVEMBER 20, 2002

David Dancer	NMSS/DWM
Rob Lewis	NMSS/SFPO
Steven Baggett	NMSS/SFPO
David Pstrak	NMSS/SFPO
Melanie Wong	NMSS/DWM
Rob Temps	NMSS/SFPO
Chet Poslunsy	NMSS
Naiem Tanious	NMSS/IMNS
Andrew Murphy	RES/DET
Phyllis Sobel	OC/RAM
Mike Tokar	NMSS/SFPO
Rosetta Virgilio	OPA
Julia Barto	NMSS/SFPO
Heather Astwood	OCM/EXM
Dinnis Galvin	NMSS/DWM
Dennis Dambly	OGC

ATTENDEES FROM OTHER AGENCIES AND GENERAL PUBLIC

NOVEMBER 19, 2002

Craig F. Smith	Lawrence Livermore National Laboratories
Larry Kennedy	Senator Henry Ried
Allan Jolen	Holtec
Brian Gutherman	Holtec
Nancy Thompson	Department of Energy
Mark Holt	CRS
Ed Davis	Self/Pegasus
Marvin Resuilkeff	Self
Brian O'Connell	National Association of Regulatory Utility Commission
Ray Clark	Environmental Protection Agency
Thomas Phan	General Accounting Office
Maureen Conly	McGraw-Hill/Platts
William Garfield	Bechtel - SAIC Co.
Kevin Kamps	NIRS
Jerome Roth	ENER Corp.
R. M. Bernero	NRC, Retired
E. V. Tiesenhausen	CCCP
Rick Boyleston	WSMS
Norman Henderson	Bechtel SAIC Company
Steven Kraft	Nuclear Energy Institute
Jim Pegues	City of Las Vegas
Ken Grumski	MHF Logistical Solutions INC.
Tom Michener	Pacific Northwest National Laboratory
William Lake	Department of Energy
James B. Wingfield	Tri State Motor Transit
Ellen W. Ott	Department of Energy
Jose S. Pena	Department of Transportation
Eileen Supro	Electric Power Research Institute
Carol Hanlon	Department of Energy
Lisa Gue	Public Citizen
Ed Benz	SAI/BSC
Carl Bella	Nuclear Waste Technical Review Board
D. J. Feheringer	Nuclear Waste Technical Review Board
Felix Killar	Nuclear Energy Institute
M. E. Wangler	Department of Energy
Michael Conroy	Department of Energy
Ralph Best	OAI
Daniel Bullen	Nuclear Waste Technical Review Board
Kevin Crowley	NAS
Alan Zimmer	General Atomics
David Bennett	USTC - TSMT
David B. Lee	USTC - U.S. Transport Council
John A. Vincent	Nuclear Energy Institute
Alan Hansen	TN
Andrea Jennetta	Fuel Cycle Week

NOVEMBER 19, 2002 (cont.)

Albert Macitiels	Electric Power Research Institute
David McCarville	Booz-Allen Hamilton
Willis Brorne	DURATEK
Eric Wieser	Nuclear Waste News
Karyn Severson	Nuclear Waste Technical Review Board
Tom Danner	NAC International

NOVEMBER 20, 2002

Alan Soler	Holtec International
Brian Gutherman	Holtec International
Albert Machiels	Electric Power Research Institute
Jose Pena	Department of Transportation
Jerome Roth	ENERCORP.
Tom Griffith	Department of Energy
Rick Boyleston	WSMS
James Channell	New Mexico/EEG
Ellen Ott	Department of Energy
David McCarville	Booz-Allen
Ralph Best	JAI
Robert Benero	Self
Rodger Comstal	EMH
Jim Pegues	City of Las Vegas
David Bennett	Tri State Motor Transit Co.
John Vincent	Nuclear Energy Institute
Felix Killar	Nuclear Energy Institute
Alan Zimmer	General Atomics
Eileen Surko	ERI
Steve Kraft	Nuclear Energy Institute
Michael Conroy	Department of Energy
Darla Thompson	National Academies
E. V. Tiesenhausen	CCCP
Brian O'Connell	NARUC
D. J. Fehringer	Nuclear Waste Technical Review Board
William Lake	Department of Energy
Jim Shaffer	
Bob White	General Accounting Office
Carol Hanlon	Department of Energy
Norm Henderson	BSC
Mark Holt	CRS
Lis Gue	Public Citizen
Ed Davis	Self
Ray Clark	Environmental Protection Agency
Ed Benz	BSC/JAI
Lake Barrett	Self
David Blee	U.S. Transport Council

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

February 21, 2003

Dr. George M. Hornberger
Chairman
Advisory Committee on Nuclear Waste
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: TRANSPORTATION WORKING GROUP MEETING

Dear Dr. Hornberger:

I am responding to your letter to Chairman Meserve dated January 7, 2003, on the Transportation Working Group Meeting. In that letter, you made three recommendations which resulted from deliberations at the Advisory Committee on Nuclear Waste (ACNW or Committee) Transportation Working Group Meeting, which took place during ACNW's November 2002 meeting.

In your first recommendation, you stated that the full-scale testing that the staff has proposed should be a public demonstration performed under credible accident conditions. We agree with your recommendation. The examples and suggestions for the test conditions will be considered with additional comments the staff receives on the Package Performance Study (PPS) test protocols. Staff published the draft test protocols for public review and comment earlier this month. During the 90-day review period, the staff will hold four public meetings on the draft PPS test protocols. The staff will consider your suggested test conditions as part of the comment review process.

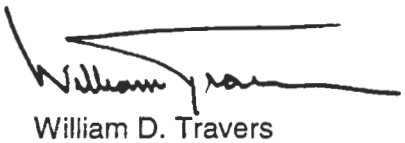
Your second recommendation addressed taking advantage of analytical tools developed as part of the nuclear weapons program by applying them to the transportation package performance analysis. The staff notes that the PRONTO code, used by Sandia National Laboratories (Sandia) in developing the PPS protocols, was developed as part of the nuclear weapons program. Per your suggestion, we will further pursue the availability and uses of such tools with Sandia, in the context of the PPS. Such tools also need to be evaluated against the public confidence objectives of the PPS including the public availability of these tools. The current PPS plan calls for the relevant modeling information to be provided publicly, so that any party can predict the test results, with a wide range of modeling tools.

Lastly, you recommended that a centralized database be developed, recording all data regarding the number and types of shipments, as well as the consequences associated with any accidents or incidents, for past and future spent fuel and high-level radioactive waste shipments. The staff agrees that development and subsequent maintenance of such a centralized database would provide useful information for future spent nuclear fuel transportation risk assessments. The U.S. Nuclear Regulatory Commission (NRC) obtains and compiles information on shipments of irradiated reactor fuel transported under an NRC general license. This information includes origination/designation pairs, the number, quantity and mode of shipments, and shipment routing. NRC has periodically published this information in

NUREG-0725, most recently in revision 13, dated October 1998. We have not considered the policy or resource implications of attempting to collect such information for non-licensed shipments. An effort to do so would require coordination and support efforts by the Department of Energy and the Department of Defense (Navy). Resources for development of a centralized database have not been budgeted at this point in time, but your recommendation will be considered by the staff in our efforts to develop a basis for risk informing our materials licensing program.

We appreciate the ACNW's interest in this important program and we look forward to continuing interactions with the Committee as we address your comments.

Sincerely,



William D. Travers
Executive Director
for Operations

cc: Chairman Meserve
Commissioner Dicus
Commissioner Diaz
Commissioner McGaffigan
Commissioner Merrifield
SECY

Appendix D

Transportation Working Group Follow-On Meeting
April 22, 2003

140th ACNW MEETING
APRIL 22–23, 2003

PARTICIPANTS

Transportation Working Group

George M. Hornberger, ACNW Chairman
Milton Levenson, Working Group Chairman
B. John Garrick
Michael T. Ryan

ACNW Staff

Sher Bahadur
Neil Coleman
Michele Kelton
Timothy Kobetz
John Larkins
Howard Larson
Michael Lee
Richard Major
Richard Savio

Invited Experts

Robert R. Loux	State of Nevada
Kevin D. Crowley	The National Academies
Robert Halstead	State of Nevada
Marvin Resnikoff	State of Nevada
James Hall	State of Nevada
Meritt Birky	State of Nevada
Hank Collins	State of Nevada

D.1 Introduction

The Advisory Committee on Nuclear Waste (ACNW) Transportation Working Group (TWG) met on April 22, 2003, at 11545 Rockville Pike, Rockville, Maryland. The meeting was convened at 12:30 p.m. and recessed at 5:10 p.m.

This was a follow-on to the TWG's November 2002 meeting and featured presentations by representatives of the State of Nevada (Nevada or the State) of their perspectives on spent fuel transportation. In addition, staff from the National Research Council presented an overview of a study it proposes to perform on the risks associated with the transportation of spent nuclear fuel.

The transportation of radioactive materials has a number of aspects, therefore, Congress divided the responsibility for those aspects among the U.S. Department of Energy (DOE), the U.S. Nuclear Regulatory Commission (NRC), the U.S. Department of Transportation (DOT), the States, and now the U.S. Office of Homeland Security. The TWG is limited to addressing those issues for which NRC is responsible.

As with the November 2002 meeting, the TWG again focused on the technical aspects of spent fuel transportation package design, analysis, and testing methods, as well as on transportation experience, to determine whether sufficient evidence exists or additional evidence should be obtained to substantiate that spent fuel can be transported safely. The TWG did not address relevant experience gained from tens of thousands of nuclear weapons multiple times around the country.

The TWG received no written comments prior to the meeting or requests for time to make oral statements from members of the public or other stakeholders. However, stakeholders were given the opportunity to ask questions and make statements during several portions of the meeting. Mr. Timothy Kobetz was the cognizant ACNW staff engineer and Designated Federal Official for this meeting

D.2 Transportation of Radioactive Waste: Background Briefing

Mr. Crowley opened by stating that the proposed transportation study is a self-initiated study of the National Academies because it believes that the transportation of spent nuclear fuel and high-level waste (HLW) could, in fact, be the rate-limiting step for efforts to dispose of radioactive waste. This could be true not only in the United States, but also in other countries.

With respect to the U.S. program, many decisions have yet to be made in terms of modes, routes, and schedules for transporting spent fuel and HLW. Potentially affected parties, including corridor States and Nevada, are concerned about the potential impacts of a large-scale transportation program.

The initiation of a program to transport spent fuel and high-level waste to Yucca Mountain is at least 7 years in the future, and probably closer to a decade. Therefore, time still exists to impact any plans that DOE develops to transport spent fuel and HLW. Thus, the National Academies believes that starting a study now would be timely.

The Board on Radioactive Waste Management and Transportation Research held a workshop in September 2000, where it heard from various Federal agencies, States, and nongovernmental organizations (NGOs). It was clear from that workshop that an "opinion gap" exists, resulting from a wide range of views about the safety and security of spent fuel and high-level waste transportation. Some experts believe that because spent fuel and HLW have been transported safely in the past, they will continue to be transported safely in the future. However, another group, including Nevada and some States on the transportation corridor to Yucca Mountain, believe that past experience is not necessarily indicative of future success. This latter group believes that certain factors have not been considered in the studies done to date, particularly on the risks of spent fuel transportation, and that these factors require further examination.

The National Academies developed a prospectus for this study. To support development of the prospectus, staff conducted a survey through the National Academies Press of approximately 36 organizations, including States, NGOs, and professional organizations. These groups were asked for their concerns about a transportation program and what they thought should be addressed in a National Academies study.

The National Academies initiated the study project in November 2002 by soliciting nominations for the study committee. Approximately 250 nominations were received for about 15 slots. The committee slate has been approved by Bruce Alberts, the Chairman of the National Research Council and President of the National Academy of Sciences. (The published slate of committee members is included in this appendix.) The National Academies tried to balance the committee. The chairman is a strong leader with national policy experience and is not associated with either nuclear waste or transportation issues. The National Academies looked for someone to chair the committee who understood very broadly how national policy is made and how technical issues contribute to its development. In addition, the National Academies did not want to select someone who was perceived to have a stake in the outcome of the study.

The committee's vice chairman is also a strong leader and a nationally recognized transportation expert. However, he is not associated with the transportation of nuclear waste. A number of committee members have nuclear experience, but several committee members do

not. The National Academies attempted to balance the committee in this way, rather than by ensuring that all sides of the transportation question were represented on the committee.

The study receives funding from a wide range of sponsors, including DOT, DOE, NRC, Nye County (Nevada), the National Cooperative Highway Research Program, and the Electric Power Research Institute. The National Academies continues to talk to other potential State and local sponsors.

The formal task statement for the study addresses the following:

1. What are the risks for spent fuel and high-level waste transportation, both in terms of accidents or terrorism and what might be called routine exposures? How well do we know those risks, and how do they compare with other societal risks? This comparative approach is very important.

2. What are the principal technical and societal concerns for transporting spent nuclear fuel and HLW over the next couple of decades? The study will look at the Package Performance Study (PPS) currently being performed by NRC.

3. What can or should be done to address these concerns?

4. The study will focus on transportation in the United States; however, one committee member is from a foreign country.

The study should take 2 years to complete, and a formal report will be issued in early 2005. The committee will hold seven or eight meetings. The first organizational meeting will take place on Friday, May 16, 2003, and Saturday, May 17, 2003, in Washington, D.C., at the National Academies building. The May 16th meeting will comprise of an open session, during which the study sponsors and other interested groups can discuss the study with the committee. The National Academies has not scheduled any other committee meetings at this time. The second meeting will likely be held in Las Vegas, Nevada.

The National Academies hopes that the study will make the risk analyses for transportation of spent fuel and high-level waste transparent. Some past reports on spent fuel transportation have been somewhat opaque. In addition, Mr. Crowley hopes that the committee will be able to suggest changes to transportation systems to improve both their technical soundness and their safety, as well as ways to improve public participation and trust-building activities. Certainly, public participation, trust-building, and societal confidence are very important issues for radioactive waste transportation.

Mr. Crowley concluded by mentioning another study. The fiscal year 2003 Omnibus Appropriations Act included a Congressional request to the National Academies for a study of the procedures used by DOE to select transportation routes for research reactor spent nuclear fuel. This study was not requested by the National Academies, but was added by a concerned Senator. The study request originally appeared in the energy bill which failed. However, it was resurrected in the Omnibus Act.

The study would be conducted over a 6-month time period and will be funded by DOT. Once the funding is provided, estimated to be within a month, the National Academies will begin the study.

For more information on the National Academies' activities, see www.nationalacademies.org . This web site allows the user to access a database of current projects, committee meeting dates, meeting agendas, and abbreviated minutes from closed sessions conducted by the committee.

TWG Questions

Dr. Hornberger noted that the National Academies' study will focus on the United States, although there is at least one committee member who is a foreign national. He questioned whether the committee will only consider international radioactive waste transportation experience within the context of the study, or whether it will perform an in-depth study of international experience. Mr. Crowley responded that the study will focus on the United States with respect to its findings and recommendations (e.g., recommendations on how the U.S. program can be improved). However, a wealth of transportation experience exists, not only in the United States, but also abroad. That experience includes direct experience with transporting spent fuel, as well as international safety studies on terrorism. The National Academies hopes to take advantage of this material. Approximately five members of the committee have the appropriate security clearances to review classified documentation if needed. The National Academies does not plan to produce a classified report; however, performing an appropriate job in the security area may require reviewing some classified material.

Dr. Garrick commented that the study will be a very important piece of work and asked Mr. Crowley to elaborate on the forum that he intends to employ for answering some of the questions mentioned in his presentation. Dr. Garrick was particularly interested in the question concerning how the risks for spent nuclear fuel and high-level waste transportation compare with other societal risks. Will it be a qualitative list of contributors to risk and, if so, will the list be ranked by importance? Mr. Crowley replied that he expected the study to be more than just a qualitative ranking of risks. The committee includes three quantitative risk analysts and the study should characterize these risks in a quantitative form.

Dr. Ryan agreed that the study would be very important and questioned whether one aim of the study was to develop a database on transportation risks and accident information. Mr. Crowley acknowledged that the study would compile the risk and accident information and stated that the National Academies has already started collecting such information. In fact, some of the sessions that the ACNW had in November 2002 were very useful in helping the National Academies to jump start this process. However, the National Academies has found that some of the data are relatively soft. Once they are examined closely, it may be difficult to know exactly what they mean. For example, does 3000 trips mean one cask transported 3000 times or 3000 casks transported once?

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Transportation Of Radioactive Waste: Background Briefing

Kevin D. Crowley
Director, Board on Radioactive Waste Management
Joseph R. Morris
Senior Staff Officer, Transportation Research Board

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

Motivations for Study ...

Joint study by the Board on Radioactive Waste Management & Transportation Research Board

Study was motivated by DOE's plans to open a Yucca Mountain repository:

- Many decisions remain to be made in the U.S. transportation program (e.g., modes, routes, schedules)
- Potentially affected parties (corridor states, Nevada) are concerned about the potential impacts of a large and sustained transportation campaign on safety, security, and other quality-of-life issues
- The first shipments to Yucca Mountain (assuming it is licensed) are at least seven years into the future
- There is time to develop a transportation program that minimizes these potential impacts and addresses public concerns

Study Development

Board on Radioactive Waste Management & Transportation Research Board organized mini-workshop on radioactive waste transportation in September 2000

Federal agencies (DOE, USNRC, DOD), states, and NGOs made presentations on issues and perceived problems

It was clear from this workshop that an opinion gap exists between some "experts" and "public groups" with respect to views on transportation risks:

- SNF/HLW has been and can continue to be transported safety.
- Past experience is not necessarily indicative of future success. Previous studies are incomplete and do not take into account important public values with respect to issues such as routing and economics/quality of life concerns

More Study Development

Final version of prospectus was approved by National Research Council in fall 2001

- A survey of potentially interested organizations was undertaken to better understand issues and potential data sources

Fundraising for project began in 2002

Project was officially started in November 2002 with solicitation of nominations for committee

About 250 nominations were considered

Committee slate has been approved by NAS President and NRC Chair Bruce Alberts

Study Sponsors

- Project budget is $842,000
- Sponsors to date
  - USNRC
  - DOE
  - DOT
  - EPRI
  - NCHRP
  - Nye County, Nevada (committed)

Other state/local sponsors still in play

Questions to be Addressed

What are the risks (i.e., from accidents, terrorism, routine exposures) for spent nuclear fuel/high-level waste (SNF/HLW) transportation? How well do we know them? How do they compare with other societal risks?

What are the principal technical and societal concerns for transporting SNF/HLW over the next two decades?

What can/should be done to address them?

Study has a U.S. focus.

Transportation Issues

Risk (accidents, terrorism, routine exposures)

Waste package (shipping cask) performance

Modes (highway vs. rail) and routing, especially through highly populated regions

Public participation and communication in transportation programs

- Emergency response capabilities
- Economic/quality-of-life impacts
- Trust (or lack thereof) in government agencies responsible for transportation

What Can Study Accomplish?

- Help make risk analyses transparent; assess their technical soundness

Suggest changes to transportation "systems" to improve technical soundness and safety

Suggest ways to improve public participation and trust-building activities

Committee Expertise

Decision Analysis
Emergency response
Health physics
International practices
Nuclear security
Public participation
Public policy
Risk assessment (quantitative)
Risk perception and communication
Transportation operations
Transportation safety

Committee Composition and Balance

- Chair: Strong leader with national policy experience who is not associated with either nuclear waste or transportation issues
- Vice-chair: Strong leader and nationally recognized transportation expert who is not associated with nuclear waste issues

Committee balance factors:

- Technical, social science, and policy experience
- Federal and state experience
- International experience
- Nuclear and non-nuclear experience

Preliminary Study Plan

- 7-8 meetings planned
  - First (organizational) meeting in Washington, DC on May 16-17
  - Second meeting likely in Las Vegas. Date TBD
  - Dates, times, and topics of remaining meetings TBD
- Final report to be issued in early 2005

Transportation Routing

- Congressionally requested study
- Will examine procedures used to select routes for transporting research reactor SNF to/between DOE facilities
- Study will examine the extent to which procedures utilize assessments of risk
- 6-month study
- Awaiting funds from DOT to begin work
- Study to be coordinated with broader transportation study

Contacts

To be added to project notification list, contact Ms. Laura Llanos at lllanos@nas.edu

Check the current projects database at www.nationalacademies.org. Search on project name (Transportation of Radioactive Waste)

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THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

PROJECT ANNOUNCEMENT

Transportation of Radioactive Waste

Board on Radioactive Waste Management
Transportation Research Board

A National Research Council study committee has been formed under the auspices of the Board on Radioactive Waste Management and Transportation Research Board to examine the transportation of spent nuclear fuel and high-level radioactive waste in the United States. The committee will develop a high-level synthesis of key technical and societal issues for spent nuclear fuel and high-level radioactive waste transport and will identify technical and policy options for addressing these issues and managing transportation risks. Although the principal focus of this study will be on the transportation in the United States, the study also will draw on international experiences as well as experiences with transporting other waste types.

The committee will hold up to eight meetings over the next 20 months to gather information, deliberate on the issues, and produce a final report containing its findings and recommendations. The first committee meeting will be held on May 16 at the National Academies' Keck Center at 500 Fifth Street, NW in Washington, DC. Future information-gathering meetings will be held in other regions of the United States to enhance opportunities for input to the study.

The provisional committee slate, including committee bios, has been posted for a 20-day public comment period on the National Academies' current projects website (www.nationalacademies.org). Additional information about the May 16 and future committee meetings, including meeting agendas, will be posted on this website as it becomes available. Please contact Ms. Laura Llanos at (202) 334-3066 or, via e-mail, at lllanos@nas.edu if you would like to arrange to receive this information automatically.

The committee roster follows:

Neal F. Lane, Rice University, *committee chair*
Thomas B. Deen, independent transportation consultant, *committee vice chair*
Julian Agyeman, Tufts University
Lisa M. Bendixen, ICF Consulting
Dennis C. Bley, Buttonwood Consulting, Inc.
Hank Jenkins-Smith, Texas A&M University
Ernest J. Moniz, Massachusetts Institute of Technology
John W. Poston, Sr., Texas A&M University
Lacy E. Suiter, Federal Emergency Management Agency (retired)
Joseph M. Sussman, Massachusetts Institute of Technology
Elizabeth Q. Ten Eyck, ETE Consulting, Inc.
Seth Tuler, Clark University
Detlof von Winterfeldt, University of Southern California
Thomas R. Warne, Tom Warne & Associates LLC
Clive Young, Department for Transport of the United Kingdom

Committee on Transportation of Radioactive Waste

Biographical Sketches of Committee Members

Neal Lane is a nationally recognized leader in science and technology policy development and application. He is now a university professor in the Department of Physics and Astronomy and fellow of the James A. Baker III Institute for Public Policy at Rice University, and he previously served as university provost. He also served as assistant to the president for science and technology, director of the White House Office of Science and Technology Policy, director of the National Science Foundation, and chancellor of Colorado College. Dr. Lane earned his B.S., M.S., and Ph.D. degrees in physics from the University of Oklahoma and is a fellow of the American Physical Society, the American Academy of Arts and Sciences, the American Association for the Advancement of Science, and the Association for Women in Science.

Thomas B. Deen is a transportation consultant and former executive director of the Transportation Research Board, a position he held from 1980 to 1994. He is former chairman and president of PRC-Voorhees, a transportation engineering and planning consulting firm. During this period he was in charge of his firm's activities in major urban highway and rail transit projects both in this country and abroad. Later he was chairman of the national interagency committee that prepared the strategic plan for America's development of intelligent transportation systems. In recent years the governor of Maryland has appointed him as chair of several blue ribbon committees investigating significant rail and road projects in the state. His research interests include intermodal planning of urban transportation systems, integration of transportation and land use in urban areas, national transportation policy, and intelligent transportation systems. He holds a B.S. degree from the University of Kentucky, a certificate from Yale University's Bureau of Highway Traffic, and is a member of the National Academy of Engineering.

Julian Agyeman is currently an assistant professor in the Department of Urban and Environmental Policy and Planning at Tufts University. He earned a B.Sc. degree in geography and botany from the University of Durham, UK; a post graduate certificate in geography and environmental studies from the University of Newcastle-on-Tyne, Enfield, UK; an M.A. degree in conservation policy from the Middlesex University, Enfield, UK; and a Ph.D. degree in environmental education from the University of London. He is the editor of Local Environment, an international peer review journal and the author and editor of many books and articles. He is a practitioner and researcher in sustainable development and environmental justice at local, national, and international levels. His practical experience was gained through work in the UK as a consultant on environmental and sustainable development; environmental education adviser and head of curriculum support for the Education Department in the London Borough of Islington; senior environmental education officer for the Directorate of Environmental Health in the London Borough of Lambeth; and as chair and founder of the Black Environment Network.

Lisa M. Bendixen is an expert in hazmat risk and safety and has worked on risk assessment and management problems in numerous industries covering both fixed facilities and transportation systems. She was the project manager and primary author of the Guidelines for Chemical Transportation Risk Analysis, published by the American Institute of Chemical Engineers' Center for Chemical Process Safety and has served on the center's technical steering committee. She is currently a vice president with ICF Consulting and previously spent

22 years in Arthur D. Little, Inc.'s environment and risk practice. Ms. Bendixen holds a B.S. degree in applied mathematics and an M.S. degree in operations research, both from the Massachusetts Institute of Technology.

Dennis C. Bley has more than 30 years of experience in applying quantitative risk analysis to nuclear and electrical engineering problems. His current research involves the application of risk analysis to diverse technological systems, uncertainty modeling, technical risk communication, and human reliability analysis. He is president of Buttonwood Consulting, Inc. and a principal of the WreathWood Group, a joint venture company that supports multidisciplinary research in human reliability. He also serves on the board of directors of the International Association for Probabilistic Safety Assessment and Management. Dr. Bley has a Ph.D. degree in nuclear engineering from the Massachusetts Institute of Technology and is a registered professional engineer in the state of California.

Hank Jenkins-Smith is a nationally recognized expert on public perception of environmental and technical risks. His research involves measurement of public and elite risk perceptions of transportation of hazardous and radioactive materials, nuclear waste, and national security issues. He is a professor of public policy and holds the Joe R. and Teresa Lozano Long Chair of Business and Government at the George H.W. Bush School of Government and Public Service at Texas A&M University. Previously, he was professor of political science and director of the Institute for Public Policy at the University of New Mexico. Dr. Jenkins-Smith received a B.S. degree in political science and economics from Linfield College and an M.S. and Ph.D. degrees in political science, both from the University of Rochester.

Ernest J. Moniz is widely recognized for his work in theoretical nuclear physics and, more recently, on science and technology policy formulation. He joined the Massachusetts Institute of Technology (MIT) faculty in 1973 and is currently a professor of physics. He previously served as the chair of the MIT physics department; as Undersecretary of the U.S. Department of Energy; and as Associate Director for Science in the Office of Science and Technology Policy. Dr. Moniz received a B.S. degree in physics from Boston College and a Ph.D. degree in theoretical physics from Stanford University. He received honorary doctorate degrees from the University of Athens and from the University of Erlangen-Nurenburg, and is a fellow of the American Association for the Advancement of Science, the Humboldt Foundation, and the American Physical Society.

John W. Poston, Sr. is a nationally recognized expert in health physics, occupational dosimetry, and health effects of radiation releases from accidents and terrorist events. He is professor and past chair of the Department of Nuclear Engineering and a consultant at the Veterinary Teaching Hospital at Texas A&M University, where he teaches health physics and conducts research on dosimetry. He chaired the National Council on Radiation Protection and Measurements committee that produced the 2001 report *Management of Terrorist Events Involving Radioactive Material* and is president emeritus of the Health Physics Society. Dr. Poston has been selected to receive the 2003 Loevinger-Berman Award from the Society of Nuclear Medicine.

Lacy E. Suiter has over three decades of experience in emergency planning and response at both state and federal levels. He spent 30 years as a career employee of the Tennessee Emergency Management Agency, the last 12 years as that agency's director. He also served as executive associate director for Response and Recovery for the Federal Emergency Management Agency until his retirement in 2002. In that capacity he was responsible for planning and executing the federal government's response to major disasters and emergencies

and managing that agency's multi-billion-dollar individual and public assistance grant programs. Mr. Suiter earned his B.S. degree in business from Middle Tennessee State University and is the recent recipient of the United States Army Meritorious Civilian Service Award and the United States Army Corps of Engineers D. De Fleury Medal.

Joseph M. Sussman is an internationally recognized transportation operations expert whose research has covered a wide range of transportation issues, including transportation systems and institutions; regional strategic transportation planning; intercity freight and passenger rail; intelligent transportation systems; simulation and risk assessment methods; and complex systems analysis. He is currently the Japan Rail East Professor in the Department of Civil and Environmental Engineering and Engineering Systems Division at the Massachusetts Institute of Technology (MIT). He previously served as director of MIT's Center for Transportation Studies and head of the Department of Civil and Environmental Engineering. Dr. Sussman received a B.C.E. degree from City College of New York; an M.S.C.E. degree from the University of New Hampshire; and a Ph.D. degree in Civil Engineering Systems from MIT.

Elizabeth Q. Ten Eyck is an expert in domestic and international nuclear safeguards and security for government-owned and licensed commercial nuclear facilities. She has over 30 years of career federal service--first as a security engineer for the U.S. Secret Service; then as director of the Office of Safeguards and Security for the U.S. Department of Energy; and, until she retired in 2000, director of the Division of Fuel Cycle Safety and Safeguards of the U.S. Nuclear Regulatory Commission, where she managed the safety and safeguards regulatory program for commercial fuel cycle facilities. During her career at NRC she also managed transportation activities and the safeguards program for nuclear power reactors. She is currently president of ETE Consulting, Inc. Ms. Ten Eyck received her B.S. degree in electrical engineering from the University of Maryland.

Seth Tuler is an expert in public participation, environmental decision-making, and community responses to risk communication. He is interested in public and worker health risks associated with U.S. nuclear weapons production, and he is doing research on and education and training of community members in public participation mechanisms. He is a research fellow in the Center for Technology, Environment, and Development at the George Perkins March Institute at Clark University (Worcester, Massachusetts) and a researcher for the Social and Environmental Research Institute (Leverett, Massachusetts). He received a B.A. degree in mathematics from the University of Chicago; an M.S. degree in technology and policy from the Massachusetts Institute of Technology; and a Ph.D. degree in environmental science and policy at Clark University.

Detlof von Winterfeldt is an internationally recognized expert in applying decision and risk analysis to technology and environmental management problems—both as a researcher and practitioner. He is a professor of public policy and management and an associate dean for faculty affairs and research of the School of Policy, Planning, and Development at the University of Southern California. He also is president of Decision Insights, Inc., a management consulting firm specializing in decision and risk analysis. He received M.A. and B.A. degrees in psychology from the University of Hamburg, Germany, and a Ph.D. degree in mathematical psychology from the University of Michigan. He is the 2000 recipient of the Ramsey Medal for distinguished contributions to decision analysis by the Decision Analysis Society.

Thomas R. Warne is known nationally for his expertise in transportation administration, public policy, and large project and program delivery. He is the founder and president of Tom Warne and Associates LLC, a management consulting company. His previous positions include

executive director of the Utah Department of Transportation and deputy director and chief operating officer of the Arizona Department of Transportation. Mr. Warne holds a bachelor's degree in civil engineering from Brigham Young University and a master's degree in civil engineering from Arizona State University and is a registered professional engineer in Arizona and Utah.

Clive Young is an internationally recognized expert in safety standards for transport of radioactive materials. He has worked at the Department for Transport of the United Kingdom since 1978 and, since 1996, has been head of the Radioactive Materials Transport Divisicn and Transport Radiological Adviser to the Secretary of State for Transport. He serves as chairman of the Transport Safety Standards Committee of the International Atomic Energy Agency and chairman of the Radioactive Material Working Group of the International Maritime Organization. He previously held the position of research engineer at the UK Atomic Energy Authority. Mr. Young earned his B.Sc. in mechanical engineering from the University of Leeds. He is a member of the Institution of Mechanical Engineers and is a chartered engineer.

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REMARKS OF ROBERT R. LOUX, EXECUTIVE DIRECTOR
NEVADA AGENCY FOR NUCLEAR PROJECTS
TO THE
U.S. NUCLEAR REGULATORY COMMISSION'S
ADVISORY COMMITTEE ON NUCLEAR WASTE

April 22, 2003

Introduction

Let me preface my remarks this afternoon by saying the State of Nevada contends that DOE should have fully and adequately addressed transportation of spent nuclear fuel (SNF) and high-level radioactive waste (HLW) to Yucca Mountain in the Final Yucca Mountain Environmental Impact Statement (FEIS). Instead, the transportation analysis contained in the FEIS is legally and substantively deficient and entirely inadequate.

We contend that the only acceptable vehicle for engaging in planning for SNF and HLW shipments in Nevada or nationally is the process set forth by the National Environmental Policy Act (NEPA) and its implementing regulations.

That means DOE must commit to the preparation of an Environmental Impact Statement (EIS) for the transportation program. Such EIS must encompass an integrated transportation program that covers both the national transportation system and the transportation system within Nevada.

The EIS must show how the national and Nevada components function in a consistent and integrated manner, and how decisions with respect to the national system affect the Nevada system, and vice versa. What DOE appears to be doing instead is a piecemeal approach to transportation planning, crafting the message to fit whatever audience the Department is trying to appease at the time.

That being said, for the better part of two decades, the State of Nevada has consistently and repeatedly recommended specific measures that the Federal government should take to manage the risks associated with transportation of spent nuclear fuel and high-level radioactive waste.

Despite our opposition to construction of a repository at Yucca Mountain, and to construction of an interim storage facility at the Nevada Test Site, the State of Nevada has taken virtually every possible opportunity to make constructive proposals to the appropriate Federal agencies: DOE, the U.S. Nuclear Regulatory Commission (NRC), and the U.S. Department of Transportation (DOT).

In addition, the Western Interstate Energy Board and the Western Governor's Association have done extensive work on nuclear waste transportation and provided DOE with detailed and substantive guidance over the past 15 or more years.

WIEB has even developed an extensive High-Level Waste Transportation Primer that provided DOE with a comprehensive framework for an adequate transportation system.

WGA has passed numerous resolutions urging DOE to adopt an integrated and comprehensive approach to transportation planning, including adequate preparations to deal with terrorism and to prevent catastrophic accidents through meaningful cask testing.

Nevada's Recommendations

Since 1997, Nevada's recommendations regarding high-level nuclear waste transportation risk management have been focused on four areas:

1) A comprehensive approach to risk assessment, risk management, and risk communication;

2) Development of a preferred transportation system;

3) Full-scale, physical testing of shipping casks; and

4) Accident prevention and emergency response.

The presentations you will hear from other Nevada transportation experts today will address specific Nevada issues and recommendations in more detail. But let me point out that the basis for any meaningful spent fuel and high-level waste transportation planning must be veracity and accuracy in disclosing the nature, scope, and extent of the effort. Unfortunately, DOE's pronouncements on the transportation aspects of the Yucca Mountain program, meager as they have been, appear more designed to obscure and minimize the challenges for political reasons than to illuminate them.

The Numbers Game

For example, Nevada believes that DOE's recently-devised estimate of 175 shipments per year to a Yucca Mountain repository is not only inaccurate, but grossly underestimates the nature, magnitude, and scope of the shipping campaign required to support the repository program.

To realize such a low number of shipments, DOE will, among other things, have to ship over 90% of all SNF by rail; assure that each shipment is made up of at least 3 rail cars per train; make thousands of barge and/or heavy-haul truck shipments to move SNF from reactor sites without rail access to rail heads; create staging areas in rail yards and ports around the country in order to assemble the trains; and construct a 300 – 400 mile rail access line in Nevada at the cost of over $1 billion.

Nevada has carefully reviewed the estimates of future spent fuel shipments contained in the DOE Final Environmental Impact Statement for Yucca Mountain and believes these

estimates to be far more realistic than the shipment numbers DOE is currently using. The FEIS includes projections of spent nuclear fuel and high-level radioactive waste shipments for two inventory disposal scenarios (24 years and 38 years) and two national transportation modal scenarios ("mostly legal-weight truck" and "mostly rail").

According to the DOE FEIS, about 70,000 MTHM of spent fuel and high-level nuclear waste could be shipped to Yucca Mountain over 24 years, and about 119,000 MTHM could be shipped over 38 years (2010-2048).

The DOE "mostly legal-weight truck" scenario would result in the largest number of shipments, about 108,900 shipments over 38 years, or about 2,865 per year.

The DOE "mostly rail" scenario, over 38 years, could result in more than 45,000 shipments (about 1,185 per year) or as few as 13,500 (about 355 per year). Commercial spent fuel would compromise about 88% of the wastes shipped to the repository, and about 73 % of repository cask-shipments.

We conclude that estimates of projected shipments to Yucca Mountain must continue to consider a range of modal scenarios and shipment numbers.

Rail Access Issues

DOE's blithe assumption that the shipping campaign will involve mostly rail transportation is equally suspect. At present, there is no railroad access to Yucca Mountain. Construction of a new rail spur, 99 to 344 miles in length, could take 10 years and cost more than $1 billion. The alternative to rail spur construction, delivery of thousands of large rail casks by 220-foot-long, heavy-haul trucks, over distances of 112 to 330 miles on public highways, is probably not feasible.

Maximum utilization of rail for cross-country transportation, as described in the FEIS, appears unlikely. Even if DOE is able to develop rail access to Yucca Mountain, the objective of shipping 90 percent of the commercial SNF by rail is unrealistic. DOE acknowledges that 25 of the 72 power plant sites cannot ship directly by rail. Nevada studies show that number could be up to 32 sites.

The "mostly rail" scenario assumes that DOE can ship thousands of casks by barge into the Ports of Boston, New Haven, Newark, Jersey City, Wilmington (DE), Baltimore, Norfolk, Miami, Milwaukee, Muskegon, Omaha, Vicksburg, and Port Hueneme (CA).

Alternately, DOE would have to move thousands of casks from reactors to rail connections using large heavy-haul trucks, which will require special state permits and route approvals.

In the end, even if rail access to Yucca Mountain and all of the other impediments to rail transport can be resolved, "mostly rail" would mean moving no more than 60-75 percent

of the commercial spent fuel by rail, and moving the remaining 25-40 percent by legal-weight truck.

The DOE "mostly legal-weight truck scenario" is the only national transportation scenario that is currently feasible and is the one Nevada believes to be most likely in the event the Yucca Mountain program goes forward. All 72 power plant sites and all 5 DOE sites can ship by legal-weight truck.

Cask Safety and Shipment Safeguards

Nevada, together with other western states and regional groups, has long advocated full scale testing of shipping casks as part of the cask certification process. In light of the new terrorist threats facing the nation and the unprecedented nature and scope of the planned Yucca Mountain shipping campaign, it is imperative that NRC immediately address this issue, and we are gratified that the Commission staff if moving ahead with the Package Performance Study. Nevada experts have been, and will continue to be, closely involved with this effort.

We remain concerned, however, that the Commission has yet to act on the State of Nevada's rulemaking petition asking NRC to reassess and strengthen protections against and terrorism with respect to spent fuel shipments. That petition was filed in 1999 and, to date, no action has been taken despite the increased urgency occasioned by the events of September 11th and subsequent developments.

I trust that you will find the information provided today by Nevada transportation consultants useful and enlightening. I appreciate the Committee's willingness to provide this opportunity to present information and perspectives not afforded to you at your transportation workshop in December.

D.3 State of Nevada Introduction and Overview

Mr. Loux, Director of the State of Nevada Agency for Nuclear Projects, in the Governor's Office, stated that the State of Nevada has four cases currently in the U.S. Court of Appeals in Washington, D.C., regarding the proposed geological repository at Yucca Mountain, Nevada. One case is against DOE, one is against NRC, one is against the U.S. Environmental Protection Agency, and the fourth is a constitutional case challenging the entire Nuclear Waste Policy Act (NWPA), including the joint resolution by Congress.

All four cases are nearing closure in terms of the briefing schedule and should be heard in tandem by the Court sometime in September 2003. The State expects decisions in those cases by the close of the year or early January 2004.

The State has recently filed a petition for rulemaking with NRC to establish fair procedures in the licensing hearing for a Yucca Mountain facility. The State has asked NRC to appoint administrative law judges from outside the Commission, experts in the various fields that are concerned with Yucca Mountain, and people who have unique and specialized knowledge in those arenas. The State believes that such appointments would be very helpful in a very complex licensing hearing on Yucca Mountain. In addition, the State asked that the NRC staff be removed as a party advocate in the proceeding. The State is concerned that when the staff advocates for the applicant, as in this case, it tarnishes the perception that the Commission is unbiased in its review of the license application. The State of Nevada is quite concerned about this after having witnessed the activities that took place with the licensing of Private Fuel Storage (PFS) in Utah. Many Nevadans went to those hearings and observed the actions of the NRC staff, which indicated to the State that the Commission was far from neutral and objective in that proceeding, at least at the staff level.

The State of Nevada contends that DOE should have fully and adequately addressed transportation of spent fuel and high-level waste to Yucca Mountain in the Yucca Mountain Final Environmental Impact Statement (FEIS). Instead, the State believes that the transportation analysis, as well as other parts of the FEIS, are legally and substantially deficient and entirely inadequate. The State further contends that the only acceptable vehicle for planning this kind of campaign in Nevada on a national level is the process set forth in the National Environmental Policy Act (NEPA) and its implementing regulations. The State does not believe this has been done to date. If the State prevails, DOE must commit to the preparation of an Environmental Impact Statement (EIS) for the transportation program. The EIS must encompass an integrated transportation program that covers both a national system as well as the transportation system in Nevada.

In the EIS, DOE must show how the national and Nevada component functions of the transportation program are interrelated, how decisions with respect to the national system affect the Nevada system, and vice versa. Currently, DOE appears to be using a piecemeal approach to the waste transportation issue and seems to plan and craft different messages to fit different audiences at different times, depending on the circumstances. The State of Nevada has been involved in this issue for more than two decades and has consistently and repeatedly recommended a very specific, comprehensive measure that the Federal Government should take to manage the risks associated with the transportation of spent fuel and high-level waste.

The State of Nevada has taken every possible opportunity to make constructive proposals to DOE, NRC, and DOT. In addition, the Western Interstate Energy Board and the Western

Governors' Association (WGA) have also performed extensive work on nuclear waste transportation and provided DOE with detailed and substantial guidance over the last 15 years.

The Western Interstate Energy Board, in a project funded by DOE, developed an extensive high-level waste transportation primer that provided a comprehensive framework for an adequate transportation system. In addition, WGA has passed numerous resolutions urging DOE to adopt an integrated, comprehensive approach to transportation planning, including adequate preparations that deal with terrorism or prevent catastrophic accidents through meaningful cask testing.

The goal of both of these organizations has been a safe and uneventful shipping campaign of any materials that might travel through the West. Nevada has played a key role with both of these organizations.

Since 1997, the State recommendations regarding the high-level waste transportation risk management program have focused on four areas:

1. a comprehensive approach to risk management, risk assessment, and risk communication

2. Development of a preferred national transportation system

3. full-scale physical testing of shipping casks

4. an accident prevention and emergency response program

The basis for meaningful spent fuel and high-level waste transportation planning must be veracity and accuracy in disclosing the nature, scope, and extent of the effort. Unfortunately, DOE's pronouncements to date on the transportation program have appeared to be designed to obscure and minimize the challenges for political reasons, rather than illuminating the issues involved.

For example, in Spring 2002, the Secretary of Energy, at the announcement of the recommendation of the Yucca Mountain site, estimated that 175 shipments of waste would be made annually to a Yucca Mountain repository. The State knows the reasons for those pronouncements, but they serve to undercut the veracity and the accuracy of any program. The estimates are not only inaccurate, but they grossly underestimate the nature, magnitude, and scope of the campaign required to support the program.

For this estimate to be true, DOE would have to ship over 90 percent of the spent fuel by rail, assure that each shipment is made up of at least three rail cars per train, make thousands of barge and heavy haul truck shipments to move spent fuel from reactor sites which do not have rail access to rail heads, and create staging areas in rail yards and ports around the country in order to assemble the trains would also need to be constructed at a cost likely to exceed $1 billion.

On the other hand, Nevada has reviewed the estimates of the shipping campaign in the FEIS and believes those numbers are far more realistic than the numbers DOE has stated to the Secretary.

The State concluded that estimates of projected shipments to Yucca Mountain must continue to consider a range of modal scenarios and shipment numbers. The State is also disturbed by DOE's assumption that at this point the shipping campaign will involve mostly rail transport to Yucca Mountain. No rail access to the site currently exists. Construction of a new rail spur, reaching between 100 and 344 miles, could take 10 years and cost well in excess of $1 billion. The alternative to rail spur construction is hauling thousands of large rail casks by 220-foot long heavy-haul trucks over distances ranging from 112 to 330 miles on Nevada public highways. This is not a particularly feasible alternative.

Based on the FEIS, maximum use of rail for cross-country transportation appears unlikely. Even if DOE were able to assemble rail access to Yucca Mountain, the objective of shipping 90 percent of the commercial spent fuel by rail is unrealistic. DOE is aware that perhaps a third of the reactor sites cannot ship by rail. In Nevada, studies show that as many as 32 sites may be unable to do so.

Ultimately, if rail access to Yucca Mountain could be achieved, and if all of the other impediments to rail transport could be resolved, shipping mostly by rail would involve shipping no more than 60 percent of the commercial spent fuel by rail; the remainder of the waste would be moved by legal weight truck.

The mostly legal-weight truck option described in the FEIS is really the only national transportation scenario that is currently feasible. Nevada believes this option is the most likely to be used in the event that Yucca Mountain goes forward. All 72 power plants and all DOE sites can ship waste by legal weight truck.

Lastly, Nevada, together with other Western states and regional groups, has long advocated for full-scale testing of shipping casks as a part of the cask certification process. In light of new threats facing the nation, and the unprecedented nature and scope of the planned Yucca Mountain shipping campaign, it is imperative that NRC immediately address this issue. The State is gratified that the Commission staff is moving ahead with the PPS.

Nevada's experts have been, and will continue to be, closely involved in this effort. The State remains concerned that the Commission has yet to take action on the State of Nevada's rulemaking petition asking NRC to assess and strengthen protections against terrorism with respect to spent fuel shipments. That petition was filed in September 1999, and to date, no action has taken place, despite the increased urgency.

Dr. Garrick noted that the ACNW does not have a responsibility to, and are more or less forbidden from, providing advice to DOE. The ACNW is an advisory committee to NRC. Many of the issues raised by the State of Nevada are appropriate issues, however, they are not within the scope of the ACNW. Mr. Loux acknowledged this.

D.4 Yucca Mountain Transportation Safety Issues

Mr. Halstead introduced the consultants hired by the State of Nevada to advise on spent fuel and high-level waste transportation issues.

Dr. Marvin Resnikoff advises the State on the consequences of transportation accidents, on terrorism and sabotage incidents, and on transportation shipping cask testing. Dr. Resnikoff is a nuclear physicist by training and has 28 years of experience as a nuclear waste consultant.

Mr. Jim Hall advises the State on transportation safety regulations and policy. A lawyer by training, Mr. Hall is a former chairman of the National Transportation Safety Board (NTSB). He is currently a member of the National Academy of Engineering's Panel on Homeland Security Issues.

Dr. Meritt Birky advises the State on fire analysis and cask testing. Dr. Birky is a thermal chemist by training. He recently retired from the NTSB, where for 18 years he was a technical advisor specializing in fire and explosion investigations.

Mr. Hank Collins advises the State on radiation health effects and spent fuel behavior. Mr. Collins is a registered professional engineer and certified health physicist. He was trained as a physicist and nuclear engineer.

Mr. Bob Halstead has been transportation adviser to the State of Nevada's Agency for Nuclear Projects for the past 15 years. He has 25 years of experience in energy facility siting. Most of his practice has been in impact assessment, both for fixed facilities and transportation systems. Mr. Halstead is an environmental historian by training.

Mr. Halstead asked that the TWG consider and evaluate the following four items:

1. the way in which the State has grouped its recommendations for safety enhancement into four areas which concern the use and misuse of probabilistic risk analysis and the State's recommendations for a broader, more comprehensive approach to risk assessment

2. the State's recommendations for the construction of a preferred transportation system designed to reduce and manage risk

3. the State's recommendations on full-scale cask testing

4. the State's recommendations on accident prevention and emergency response

In addition, Mr. Halstead asked that the TWG consider the information that the State will provide regarding site-specific transportation issues associated with Yucca Mountain. He asked the TWG to remember that most, if not all, of the important decisions will still need to be made, even after the Working Group receives assurances from DOE, or any other party, that they know exactly how the transportation system for Yucca Mountain will work and how many shipments will be involved.

Mr. Halstead raised a number of issues. He noted that the State is concerned about a recent NRC contractor report, NUREG/CR-6672, "Reexamination of Spent Fuel Shipment Risk Estimates," dated March 2000. The State is concerned about the procedural way in which the report was developed and about the substantive research and findings that are contained in the document. In addition, the State is uneasy about the way in which the Commission, and other parties who practice before the Commission, are using this report.

Furthermore, the State remains concerned that its petition for rulemaking PRM 73-10, filed with the Commission in June 1999, still has not been addressed. This petition asked the Commission to review its counterterrorism safeguards regulations and requested the Commission to conduct a new and updated reexamination of the risks of a successful terrorist attack on a spent fuel shipping cask.

The State is not only concerned about the substantive issues that it has presented, but it is also concerned procedurally about the way in which the Commission is handling the petition for rulemaking. It is the State's understanding that disposition of petitions for rulemaking normally occurs within 12 months after receipt. The only response from the Commission to date was a letter in Fall 2002 advising the State that the Commission staff was looking at the petition. The State understands that the world was changed on September 11, 2001, with the attacks in Washington, D.C. and New York. However, the Commission received the petition 26 months before those attacks occurred. The State does acknowledge that some immediate changes in the regulations have been addressed by the Commission through emergency orders to licensees in light of the September 11, 2001, terrorist attacks.

The State is also concerned about correspondence dated May 10, 2002, from former NRC Chairman Meserve to Senator Durbin of Illinois. In that letter, Chairman Meserve states that if DOE accepts title to spent fuel at the reactors, then the only portion of the NRC transportation regulations that specifically apply to DOE's transportation program is the requirement that all DOE shipments be made in NRC-certified casks. The State believes that this minimalist approach by the Commission to its regulatory responsibility will have profound implications. Mr. Halstead stated that he was involved in developing the language in the NWPA in 1982 and in 1987. He noted that the legislative record clearly indicates the Congressional intent that the Commission fully regulate DOE's transportation program as if it were a utility licensee. This issue has many implications for the way in which DOE's transportation system would operate and the way in which that system would interface with NRC's regulatory framework.

With regard to rail access to Yucca Mountain, Figure D-1 presents the most obvious reason why most transportation planners and safety experts believe that rail is the mode of choice for the operation of either a national repository or a national storage facility.

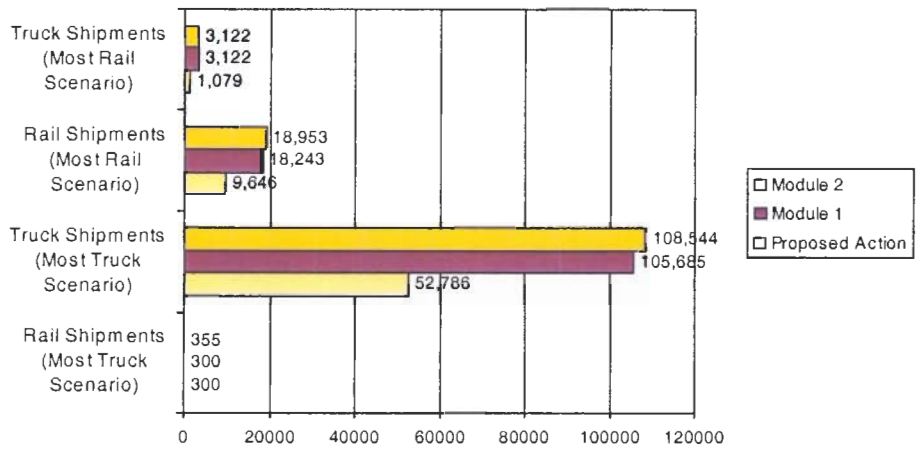


Figure D-1

Using rail reduces the number of shipments by a factor of 4 or 5, depending on the comparisons between the specific casks. If there is no rail access to Yucca Mountain, and everything is shipped by legal-weight truck, there will be about 109,000 shipments over 38 years, or approximately 2,900 per year. Under an unrealistic optimized rail system, there will be a total of 22,000 combined rail and truck cask shipments over the course of 38 years.

Most people looking at technical safety issues will stress that shipping as much of the waste as possible by rail keeps it on a privately controlled system, which is quite different than the interstate highway system. Rail transportation provides the option of additional safety enhancements through the use of dedicated trains and other safety protocols that have been developed by the Association of American Railroads. In addition, it allows the shipper to take advantage of the latest technology in the design of rolling stock, particularly special cars that are specifically designed to carry large casks and buffer cars.

However, if a mostly rail option is used for transportation, more radioactive material is transported in every package. Further, if the shipments are made in dedicated trains, it creates the possibility for accidents that may involve multiple heavy cars. The State believes that,in an accident, a large rail cask may be damaged by coming into contact with another large rail cask. Therefore, some rail safety issues still need to be addressed. However, as a general rule, most people who have studied transportation safety for a large system like a repository agree that rail is desirable.

DOE's current approach to developing rail access to Yucca Mountain is somewhat ambiguous. DOE identified five potential rail corridors in the FEIS, but then stated that the FEIS was essentially an information document and that DOE had not made any decisions. In Summer 2002, Margaret Chu from DOE stated that DOE's record of decision (ROD) formalizing its preference for rail would be issued sometime between December 2002 and March 2003. To date, the ROD has not been issued. To further compound this issue, at the end of March 2003, the press reported that, due to budgetary concerns, DOE was considering delaying or deferring the issue of planning rail access to Yucca Mountain.

Two short rail corridors run through Clark County, the Valley route and the Jean/Sloan route. There are two long routes, the Caliente route and the Carlin route, each of which would be over 300 miles. One version of the Caliente route would run through Chalk Mountain, which is the "back door" to the test site.

Problems have arisen with the development along the two shorter routes. Since the time that DOE first indicated an interest in the Valley route through northern Las Vegas, the Bureau of Land Management has transferred lands along the corridor. These lands have now been sold and are in the process of being developed commercially and residentially. This route is almost certainly no longer available to DOE.

A similar dilemma has occurred along a strip of Interstate I-15. The last 25 miles before entering California, it offers a couple of different options for rail access. Conflicts there include a new regional airport, casino and hotel development, and large-scale residential development. Although it is not impossible for DOE to use these routes, it no longer involves a simple transfer of Federally owned land. Conflicts will occur with privately owned lands. Based on this, the State believes that the two short routes to Yucca Mountain are no longer feasible.

That leaves the two long rail routes to Yucca Mountain, Caliente and Carlin. Several variations of the Caliente route exist. The rail route originally followed existing highways U.S. 93 and State Route 373, but was abandoned in 1990 because it traversed through high mountain passes like Hancock Summit. DOE is considering the Carlin route that runs primarily north to south and comes off of the Union Pacific main line near Beowawe, Nevada. This route is almost 100 miles long. The one advantage to this route, from a construction standpoint, is that the route runs north to south and parallel with the mountain valleys, and does not cross them. However, there are some difficult issues with the Carlin route involving the impact to private property, particularly mining plains that would have to be subdivided by the land acquisition for the railroad.

In addition, there are potential conflicts with Native American cultural sites and land claims. The State has concluded that DOE has not demonstrated that it can build a rail spur to Yucca Mountain, and at least two, and probably three, of the five potential corridors are clearly not feasible.

DOE has proposed an innovative alternative that involves putting heavy rail casks, of up to 160 tons, on large heavy-haul trucks (Figure D-2). Nevada permits a few of these types of rigs every year because the mining industry moves large pieces of equipment (e.g., autoclaves). The DOE heavy haul truck is about 70 meters long.

Figure D-2
Heavy Haul Truck

DOE has discussed moving these big rigs on the Beltline around Las Vegas from intermodal sites at Valley or Jean. DOE has also discussed the possibility of moving them along a route from Caliente, either around the test site or through the "back door" of the Nevada test site.

Another difficult aspect of rail access involves shipments through Las Vegas. There are eight ways to ship waste to Nevada by rail, and seven of them go through downtown Las Vegas. The percentage of shipments that could go through downtown Las Vegas are as high as 85 percent. Obviously, this is a concern to the people of Las Vegas. In summary, rail access to Yucca Mountain will be difficult.

The nuclear industry and DOE stated that many shipments have been made without problems, and the few accidents that have occurred have not resulted in releases. The State argues that future shipments will be very different. More spent fuel shipments will occur, and the shipment characteristics will be substantially different. Some of these differences have direct technical implications for risk assessment and risk management.

The urban areas most impacted by rail transportation will be Chicago, St. Louis, Salt Lake City, Los Angeles, San Bernardino, Atlanta, and Cleveland. Therefore, the issue of shipments through urban areas will likely have to be confronted, both in a technical risk assessment and in meetings with the affected communities.

Many jurisdictions and populations will be affected. Regardless of which approach is used (rail or road), up to 45 states, 700 counties, and 50 Indian reservations will be affected; 100 million to 120 million people will be living in impacted areas. Based on the State's latest geographic information systems analysis, approximately 11–15 million people live within 1/2 mile of a potential highway route.

The age or cooling time of spent fuel is a critical driver in the radiological risks of radioactive waste transportation. It is important to note that, even after 50 years, there is still a considerable total inventory (100,000 Curies) and a high surface dose rate (8640 rem/hour) in the average spent fuel assembly. As shown in Figure D-3, the most significant reduction in inventory and dose occurs in the first 10 years.

Radiological Characteristics of Spent Nuclear Fuel

(DOE/NE-007 1980)

SNF Age (Years)	Activity (Curies)	Surface Dose Rate (Rem/Hr)	Lethal Exposure (Time)
1	2,500,0000	234,000	10 sec.
5	600,000	46,800	1 min.
10	400,000	23,400	2 min.
50	100,000	8,640	4 min.

Figure D-3

DOE has assumed for planning purposes that the average age of transported spent fuel assemblies would be approximately 23 to 24 years. DOE's accident analysis uses hotter fuel which has been out of the reactor over approximately 14 to 15 years. NRC regulations allow 5-year-old fuel to be shipped in truck casks with dry interiors and 10-year-old fuel to be shipped in rail casks. The State is concerned that every one of the new high-capacity transportation casks represents an enormous radioactive inventory, including a large amount of cesium-137, which is a significant gamma radiation source.

The State is primarily concerned with radiation exposures to workers. There are some categories of workers who can potentially receive high enough doses to result in a considerable statistical impact on cancer possibilities. In particular, DOE has identified that, without administrative controls, safety inspectors could receive a radiation dose that could result in about a 10 percent increase in the possibility of lifetime cancer fatality and a 40 percent increase in the possibility of other types of health effects.

The State also questions the types of exposures not addressed significantly in the literature. These concerns involve unique local conditions where road transportation routes would funnel, creating situations in which large numbers of recurrent shipments would result in the possibility of an elevated radiation dose to individuals located on private property. For example, a potential highway route in the city of Ely includes the intersection of U.S. 93 and U.S. 6. Trucks may have to stop at a stoplight for between 30 and 90 seconds before making a left turn, thus, exposing nearby individuals to radiation.

Both DOE and Nevada have assessed the consequences of an accident involving a radiological release. The State has calculated the consequences of a successful terrorist attack and believes that they would be considerably higher than those analyzed in the Yucca Mountain FEIS. The FEIS represents DOE's first attempt to address in great detail the consequences of terrorism.

The State believes that probabilistic risk analysis (PRA) can appropriately be applied to the transportation issue. However, the State also believes that PRA has been repeatedly misused. The State prefers a comprehensive risk assessment based on a document that Golding and White from Clark University prepared for the State in 1990. Golding and White reviewed the NRC's reactor safety studies prepared in the 1980s following the Three Mile Island accident. The State has found guidance on the proper and improper applications for using probabilities, particularly in areas for which the user is uncertain about the soundness of the available data. The State believes that continuous risk analysis and risk communication should be used throughout the life of the project.

The State has also outlined its preferred transportation system designed to manage risks. This would involve using dual-purpose casks and shipping the oldest fuel first. Those are important program principles that currently have an unclear status at DOE. The original plan was to ship the oldest fuel first as the easiest method of managing radiological risk. The State also believes that rail shipments should be used to the maximum extent possible.

Accident prevention and emergency response are also extremely important. DOE and the affected states and tribes have been cooperating in this area. However, the State believes the way which DOE has proposed to privatize the transportation system is completely wrong. In particular, DOE's selection of managing contractors for transportation services should emphasize safety and public acceptance. Low-bid contractor selection is not the approach that should be used in this important area.

TWG Questions

Dr. Garrick questioned whether the State has made any attempt to put spent fuel transportation risks in the context of the risk of transporting other hazardous materials through Las Vegas, Nevada. Mr. Halstead responded affirmatively, however, the State has a difference of opinion between its studies and the studies of others which examine the consequences of accidents. The rule of thumb for a severe accident involving a gasoline tanker or a propane tanker in an urban area is 5 to 10 dead and $5 to $10 million in damages, assuming clean up begins the next day. The potential consequences from a credible, but not necessarily worst case, spent fuel accident are much more severe. From the standpoint of consequences, the State believes that spent fuel transportation risks require much stricter regulation. Both in statute and in regulation, the difference in the accident consequences between spent fuel and other types of hazardous materials is recognized.

In relating these probabilities, because of the frequency of certain shipments like gasoline, the per-person annualized risk will seem much greater for transporting some types of hazardous materials than for transporting spent fuel. If this analysis is performed on a strictly statistical basis, one would question why the transportation of spent fuel should be more strictly regulated than the transportation of other types of hazardous material. The State would argue that it is appropriate to more strictly regulate spent fuel transportation because of the greater consequences should an accident occur.

The State has also had problems with Federal preemption. In the 1970s, the State was concerned that mining companies shipped a large amount of dangerous explosives. The shipments involved leaving unguarded boxcars full of explosives in unsecured locations in urban areas. The State expended a great deal of effort to require security for boxcars of explosives parked in urban areas. After about 3 years, the State lost its case in a consistency determination by DOT.

At this point, the State is taking a very open-minded approach to comparative societal hazard assessments, such as the National Academies' study. In addition, the State understands the ACNW's position that the State should not base public policy on an unsubstantiated view of the different risks of shipping different materials.

Dr. Garrick noted that one lesson that has been learned from large-scope quantitative risk assessments is putting too much focus on consequence analysis. The discipline has matured enough to understand that the public can be easily led down the wrong path if too much attention is placed on consequence analysis. He cautioned Mr. Halstead in that regard. Dr. Garrick was pleased with the amount of emphasis the State is giving to incorporating the risk thought process in its work. Mr. Halstead stated that at some future time, the State would like to discuss these general issues and the application of NUREG/CR-6672. The State's concern about PRA is not an out-of-hand rejection; it is a rejection of the use of PRA to give oversimplified, unjustifiable answers.

Mr. Levenson noted that the State supported the use of dedicated trains for transporting spent fuel and added that the Navy came to the conclusion that there was no advantage to these trains. In fact, from a security and safety standpoint, the Navy believed they were a disadvantage. Mr. Levenson asked about the difference of opinion between the State and the Navy. Mr. Halstead responded that DOE is opposed to using dedicated trains, not the State. Almost all of the affected States want dedicated trains to be used. The industry has only used dedicated trains for the last few decades. The railroads are adamant that dedicated trains will be used for spent fuel shipments and the Nuclear Energy Institute has recently endorsed the use of dedicated trains to ship civilian spent fuel. It should be noted that Navy fuel is very different than commercial fuel. It is designed for use in battle conditions. The Navy ships spent fuel in very large, robust rail containers. Both the physical configuration of the fuel and the casks are less of a concern to the State from both the standpoint of accidental radioactive releases and terrorist attacks. In addition, it is Mr. Halstead's understanding that the Navy is adamant about using a 35 mile per hour speed limit for trains transporting spent fuel. This has always been the Navy's prevailing approach to safety as opposed to the use of dedicated trains. Rail industry representatives have told Mr. Halstead that, in a number of instances, they have accommodated the Navy by moving the casks in either dedicated trains or short trains because the weight of the large casks can adversely impact train dynamics. The State has not included data on Navy spent fuel shipments in its analysis because the statistical information is not readily available.

Mr. Levenson stated that the burn up of Navy spent fuel is much higher than that of commercial spent fuel, therefore, the source term is potentially much higher. Mr. Levenson noted that he was not sure that the rail casks used by the Navy were any more robust than those used to transport commercial spent fuel because he has not seen a comparative analysis. Mr. Halstead explained that he was comparing the current Navy rail cask with an IF-300 truck cask and noted that they are substantially different. The new multi-purpose canisters (MPC) that the Navy is proposing are more robust than any of the other cask designs. Mr. Halstead did agree that the State should review the Navy experience. However, the problem, until very recently, was that the Navy was unwilling to release its shipment miles data. Mr. Halstead had requested these data for the past 10 years.

Mr. Griffith, with the Naval Nuclear Propulsion Program, clarified that the 35 mile per hour speed limit mentioned by Mr. Halstead was invoked for transporting all of the Navy's large components across the country to protect them from damage. Specifically, only a small fleet of shipping containers exists. If a container were to be involved in an accident, the Navy would

not want it to be a very high impact collision that may remove the container from service. In the mid-1990s, the 35 mile per hour speed limit was removed by the Navy. Mr. Griffith noted that the Navy has completed 746 shipments. Those numbers are available to the public in documents on the Naval Nuclear Propulsion Program that are published annually.

Mr. Levenson added that, Navy fuel is certainly robust. However, most power reactors are designed for very substantial earthquakes. Commercial nuclear fuel is not fragile.

Yucca Mountain Transportation Safety Issues

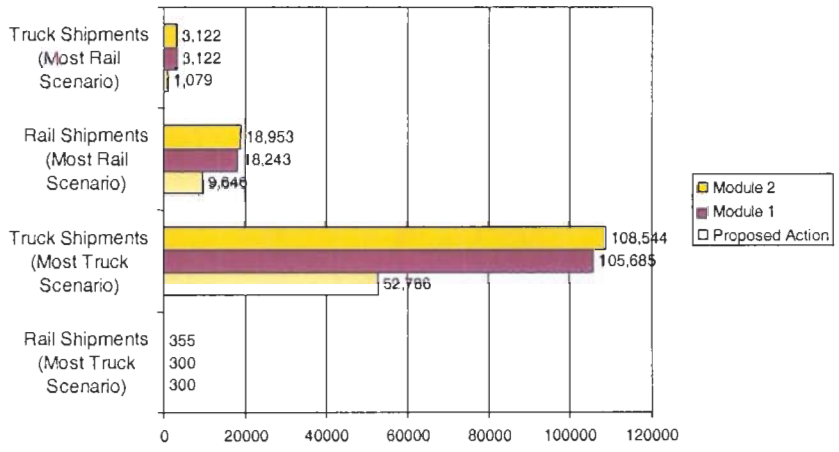
Bob Halstead
State of Nevada Agency for Nuclear Projects
Fred Dilger
Clark County Nevada Nuclear Waste Division
Presentation to
Advisory Committee on Nuclear Waste
U.S. Nuclear Regulatory Commission
Rockville, MD
April 22, 2003

Yucca Mountain Transportation Safety Issues

- Rail Access to Yucca Mountain
- Shipment Modes, Numbers, & Routes
- Radiological Risk Issues
- Risk Management Recommendations

Additional documentation available at
www.state.nv.us/nucwaste/trans.htm

Rail Access is Desirable



Consideration of Rail Access in Repository Site Evaluations

- 1980 GEIS assumed rail access
- 1984 Siting guidelines identified proximity to mainline railroads and ease of rail access favorable conditions
- 1986 DOE Env. Assessments evaluated rail access for 5 repository candidate sites
- Yucca Mt had the most difficult rail access

Yucca Mountain Transport Access Compared

Condition	Davis Canyon, Utah	Deaf Smith, Texas	Hanford, Washington	Richton, Mississippi	Yucca Mountain, Nevada
Nearest Mainline railroad (miles)	74	25	51	17	100
Nearest Alternative Rail line	Not identified	40	101	26	265
Rail Access new Construction (miles)	39	26	3	26	100
Rail Access cost (Million 1985 dollars)	142	21	6	16	151
Nearest Interstate Highway (miles)	89	14	28	26	100
Nearest Alternative Interstate (miles)	198	200	72	84	208

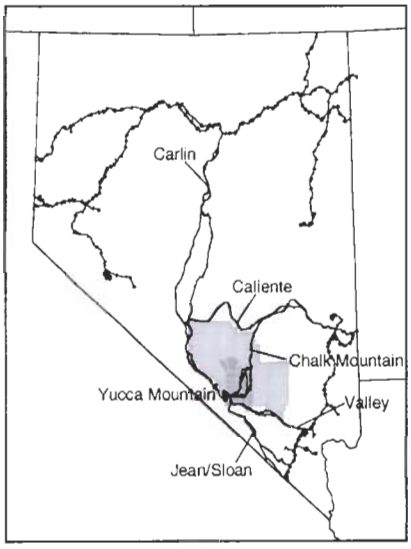
Current DOE Approach to Yucca Mountain Rail Access

- Final EIS: "DOE would prefer to use a branch rail line to ship spent nuclear fuel and high-level radioactive waste to Yucca Mountain."
- Final EIS identified five potential rail corridors: *Caliente, Carlin, Chalk Mt, Jean, Valley*
- DOE has not yet issued a Record of Decision (ROD) formally announcing a preference for rail or a preference between the rail corridors
- DOE is considering delay or deferral of rail spur construction plans (March 27, 2003)

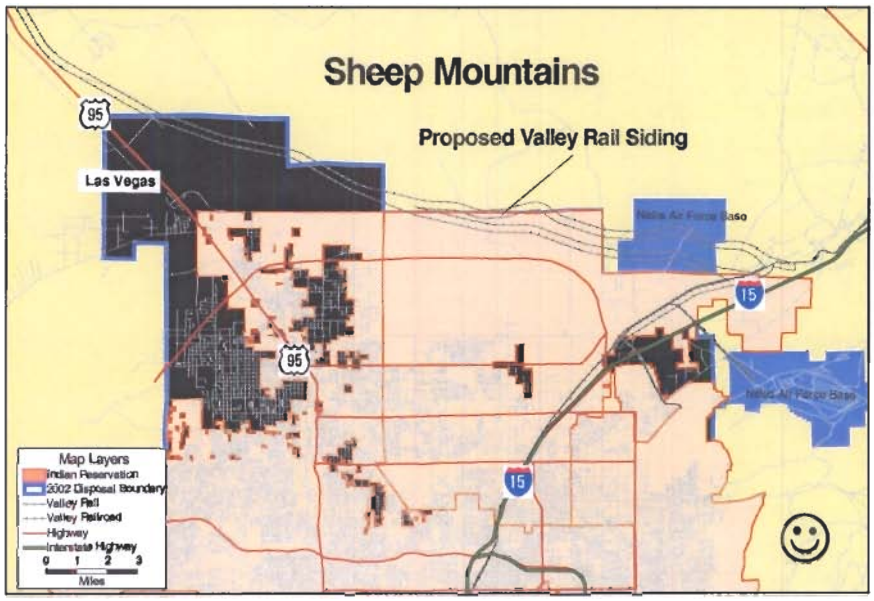
DOE FEIS Rail Corridors Compared

	Caliente	Carlin	Chalk Mountain	Jean	Valley
Cost (Millions of 2001 $)	$880	$821	$622	$462	$283
Length (miles)	319	323	214	114	98
One-way travel time (hrs)	10	9	8	4	3
Disturbed land area (sq mi)	18.3	19.3	12.6	9.2	5
Construction time	46	46	43	43	40
1990 Population	350	3200	589	492	219
Tribal Lands	None	None	None	None	None

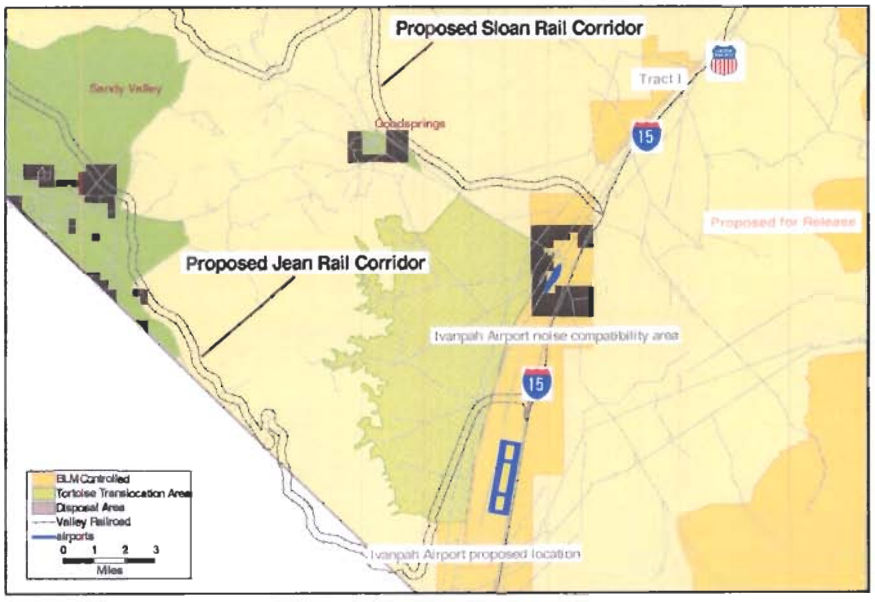
Potential Nevada Rail Routes to Yucca Mt



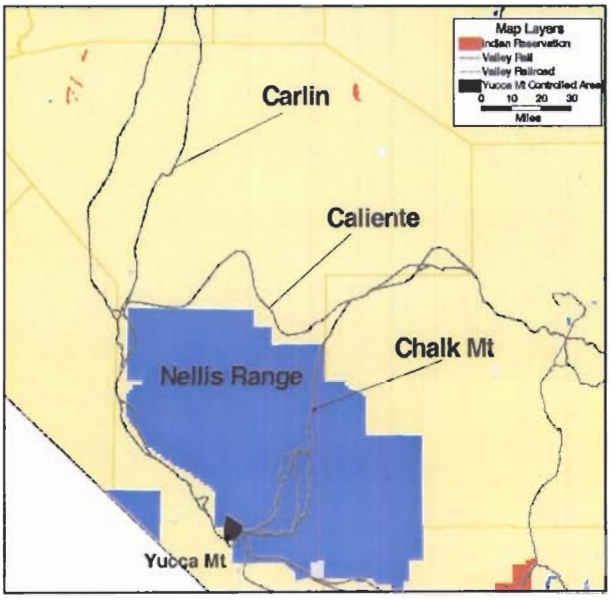
Valley Corridor Land Use Conflicts



Jean/Sloan Land Use Conflicts

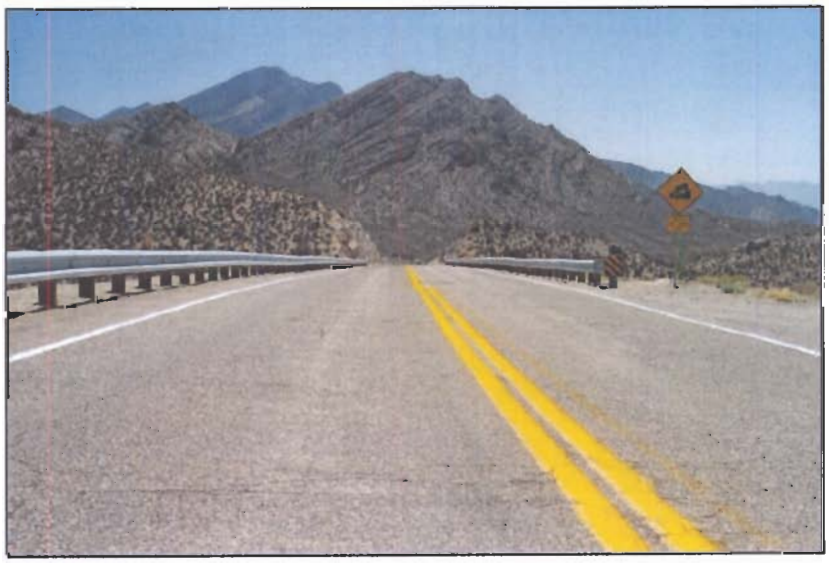


Caliente Chalk-Mountain Land Use Conflicts



Hancock Summit

(Original Caliente Rail Route, Current HHT Route)

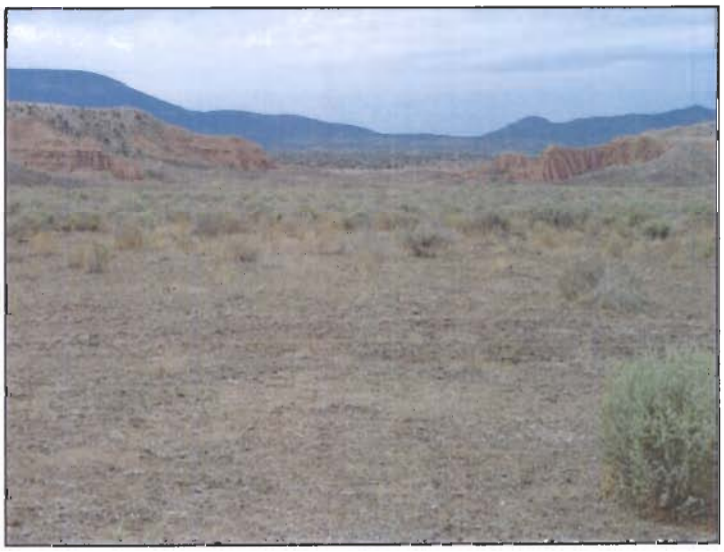


Crystal Springs

(Original Caliente Rail Route, Current HHT Route)

Bennett Pass

(Caliente Rail Route)



Timber Mountain Pass

(Caliente Rail Route)

Beowawe - Crescent Valley

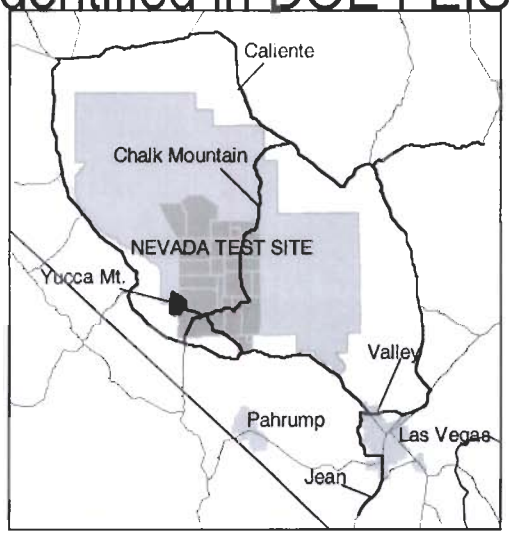
(Carlin Rail Route)

Southern Crescent Valley
(Carlin Rail Route)

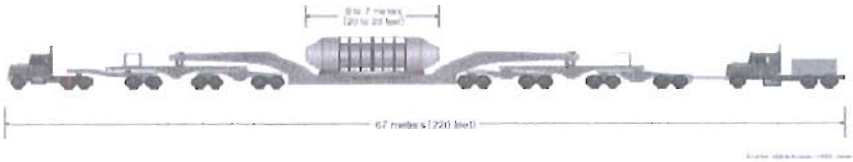
Rail Access Feasibility Issues

- Known land use conflicts: all 5 FEIS rail corridors
- U.S. Air Force opposition to Chalk Mountain
- Caliente or Carlin options would be longest new rail construction in US since 1930s
- Significant terrain and environmental challenges on Caliente and Carlin routes
- Potential Native American cultural resource issues
- Construction cost could exceed $1 Billion

Nevada Heavy Haul Truck Routes Identified in DOE FEIS



Heavy Haul Truck Rig for Use With Yucca Mountain Shipments



Nevada Heavy Haul Truck Feasibility Issues

- Permit requirements
- Travel restrictions
- Unprecedented HHT shipment frequency & distances
- Route options: Las Vegas versus mountain passes
- Safety issues (traffic flow impacts, safe passing distances)
- Routine radiation exposures (Goldfield, Beatty)
- Cost versus Rail & Legal-Weight Truck

Potential Rail Shipments Through Las Vegas

- 4 of 5 Rail access options identified by DOE would route Yucca Mountain shipments through downtown Las Vegas
- All 3 intermodal transfer options identified by DOE would route Yucca Mountain shipments through downtown Las Vegas
- Up to 85 percent of all rail shipments to Yucca Mountain would use the UP mainline through downtown Las Vegas

Union Pacific RR – Las Vegas

(Looking West from Stratosphere)

Union Pacific RR – Las Vegas

(Looking East from Stratosphere)

Las Vegas Population within ½ Mile of Union Pacific Railroad

Route Segment Data	Union Pacific Mainline through Las Vegas
Corridor Length (miles)	35.74
2000 Resident Population	39,291
Total Employment	83,976
Est. Avg. Daily Hotel/Casino Guests	18,032
Est. Avg. Daily Hotel/Casino Guests	18,032
School Population	597
Est. Avg. Daily Exposed Population	85,912

Rail Access Summary

- Direct rail access to national rail network is highly desirable for repository site
- Yucca Mountain site lacks rail access
- DOE has not demonstrated feasibility of any of the 5 rail access options identified in the FEIS
- Alternative to rail spur, HHT delivery from intermodal transfer station, probably not feasible
- Rail shipments through downtown Las Vegas will be a major issue in any future DOE transportation planning activities

U.S. Commercial SNF Shipment Experience (1964 –2001)

- Amount Shipped: 2,457 MTU (65 MTU per year)
- Truck Shipments: 2,396 (63 per year)
- Rail Shipments: 326 (9 per year)
- Rail Cask-Shipments: 479 (13 per year)
- Truck Share of Shipments: 88%
- Rail Share of MTU: 64%
- Average Truck Distance: 748 miles
- Average Rail Distance: 454 miles

Source: Halstead & Dilger, "How Many Did You Say? Historical and Projected Spent Nuclear Fuel Shipments in the United States, 1964-2048," Waste Management'03 Conference, February 25, 2003, Tucson, AZ

Potential Shipments- DOE Mostly Truck Scenario

109,000 Cask-Shipments over 38 Years (2010-2048)

- 108,544 Legal-Weight Truck (LWT) Shipments
- 355 Rail Shipments (Naval SNF)
- 2,866 Shipments per Year (7.9/day)
- 105,000 MTU Civilian SNF
- 15,000 MTU Equivalent Defense HLW, DOE SNF, Naval SNF, Civilian HLW

Source: DOE/EIS-0250, February, 2002, Table J-1

Factors Favoring LWT Transportation to Yucca Mountain

- All existing reactors and DOE sites can ship by legal-weight truck (LWT); 25-32 sites will have difficulty shipping by rail
- DOE repository thermal loading strategy may requirement LWT shipment of 5 year-cooled SNF
- Utilities may exercise contract options to ship 5 year-cooled SNF by LWT rather than older SNF by rail
- Current DOE privatization plan does not require transportation service providers to maximize use of rail
- LWT is cost-competitive with rail

Potential Shipments- DOE Mostly Rail Scenario

22,000 Cask-Shipments over 38 Years (2010-2048)

- 18,935 Rail Cask-Shipments
- 3,122 Legal-Weight Truck (LWT) Shipments
- 498 Rail Cask-Shipments per Year (1.4/day)
- 82 LWT shipments per Year (1.6/week)
- Requires an additional 3,004 Barge and 1,061 HHT Shipments from 24 reactors lacking rail access
- Could require an additional 18,935 HHT shipments in Nevada if no rail spur constructed

Source: DOE/EIS-0250, February, 2002, Table J-1

Potential Shipments- NV Current Capabilities Scenario

42,000 Cask-Shipments over 38 Years (2010-2048)

- 27,435 Legal-Weight Truck (LWT) Shipments from 25 reactor sites (35% of Civilian SNF total)
- 14,886 Rail Cask-Shipments from 52 reactor and DOE sites (65% of Civilian SNF total)
- 721 LWT shipments per Year (2.0/day)
- 392 Rail Cask-Shipments per Year (1.1/day)

Source: Halstead, May 22, 2002, based on DOE/EIS-0250, February, 2002, Tables J-1, J-2, J-4, & J-5

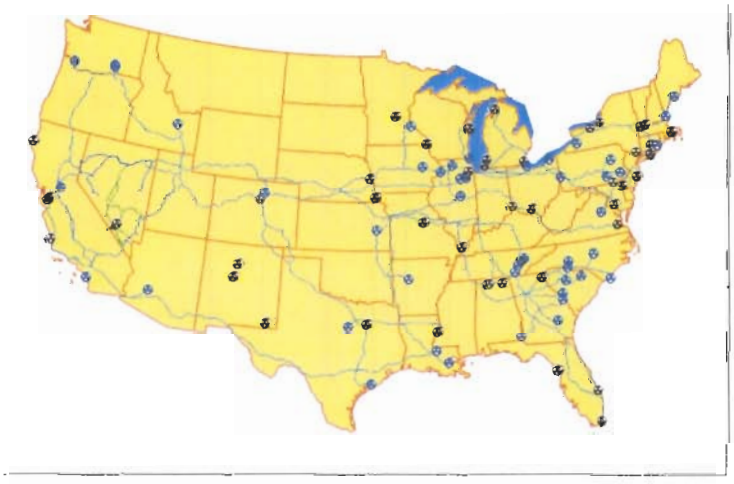
Yucca Mountain Shipments Compared to Past Shipments

- 43 Times More SNF Shipped Per Year
- 8 to 38 Times More Casks Shipped Per Year
- 5 to 40 Times More Shipments Per Year
- 443% Increase In Average Rail Shipment Distance
- 280% Increase In Average Truck Shipment Distance
- Western Route Characteristics and Operating Conditions
- Potential Unprecedented Reliance on Heavy Haul Truck and Barge Shipments

Source: Halstead & Dilger, "How Many Did You Say? Historical and Projected Spent Nuclear Fuel Shipments in the United States, 1964-2048," Waste Management'03 Conference, February 25, 2003, Tucson, AZ

Most Likely Highway Routes to Yucca Mountain

Most Likely Rail Routes to Yucca Mountain



Affected Jurisdictions & Populations Along Yucca Mountain Routes

- Truck and rail routes could traverse 45 states, 700 counties, and 50 Indian Reservations
- More than 120 million people live in counties traversed by truck routes
- More than 100 million people live in counties traversed by rail routes
- More than 11 million people live within one-half mile (800 meters) of a potential highway route

Source: Dilger & Halstead, Many Roads to Travel, WM'03, February 2003

Radiological Characteristics of Spent Nuclear Fuel

(DOE/NE-007, 1980)

SNF Age (Years)	Activity (Curies)	Surface Dose Rate (Rem/Hr)	Lethal Exposure (Time)
1	2,500,0000	234,000	10 sec.
5	600,000	46,800	1 min.
10	400,000	23,400	2 min.
50	100,000	8,640	4 min.

Shipping Cask Inventories

- The representative truck cask (GA-4) loaded with 23-year cooled PWR SNF contains a radionuclide inventory of 355,000 curies total activity, including 136,000 curies of Cesium-137 (for 10-year cooled SNF, total inventory is 846,000 curies, including 177,000 curies of Cesium-137)
- The representative large (26 PWR) rail transport-only cask loaded with 23-year cooled PWR SNF contains a radionuclide inventory of 2,100,000 curies, including 816,000 curies of Cesium-137
- Casks loaded with HLW, DOE SNF, and Naval SNF also contain large radionuclide inventories dominated by Cesium-137 (27,000-450,000 curies)

Source: DOE FEIS, Table J-12

Routine Radiation Exposures

- Exposure rate 10 mrem/hour at 2 meters from cask
- Exposure to truck safety inspectors: 2,000-8,000 mrem/year (Potential for 200 rem over 24 years)
- Exposure to occupants of vehicle next to SNF truck cask in traffic gridlock (1 - 4 hours): 10 - 40 mrem per person per incident
- Exposure to service station attendant (maximally exposed member of public): 100-1,000 mrem/year
- Exposures at commercial and residential locations along potential routes in Nevada: 30 - 200 mrem/year

Source: Collins, Gathers, and Halstead, HPS 47th Mtg, July, 2002

Ely, NV – Potential Route

Goldfield, NV – Potential Route

Expected Transportation Accidents and Incidents

- DOE Mostly Truck National Scenario, 38 Years
  - 159 Truck Accidents
  - 2,391 Truck Regulatory Incidents
- DOE Mostly Rail National Scenario, 38 Years
  - 384 Rail/ 6 Truck Accidents
  - 767 Rail/ 91 Truck Regulatory Incidents
- Nevada Current Capabilities National Scenario, 38 Years
  - 291 Rail/ 46 Truck Accidents
  - 581 Rail/ 691 Truck Regulatory Incidents

Source: Halstead Testimony, 5/22/02

Consequences of Rail Accident – DOE Estimates

Maximum reasonably foreseeable rail accident in urban area

Draft EIS (July 1999), Table 6-12

- Probability 1.4 in 10 million)
- Population dose (person-rem): 61,000
- Latent cancer fatalities: 31

Final EIS (February 2002), Table 6-15

- Probability 2.8 in 10 million
- Population dose (person-rem): 9,900
- Latent cancer fatalities: 5

Consequences of Rail Accident-Nevada Estimate

Nevada-sponsored study of rail accident similar to July 2001 Baltimore Tunnel Fire (equal to engulfing fire, 800°C, 7-12 hours)

- Radioactive Release: 73,000 curies Cs-134 & Cs-137 (respirable aerosol)
- Contaminated Area: 32 square miles
- Latent cancer fatalities: 4,000-28,000 over 50 years (200-1,400 during first year)
- Cleanup cost (2001$): $13.7 Billion

Source: RWMA, 9/15/01

Consequences of Successful Terrorist Attack

Successful attack on truck cask in urban area using high-energy explosive device (90% penetration)

- DOE estimated impacts [FEIS, Pp. 6-50 to 6-52]
- Latent cancer fatalities: 48
- Nevada estimated impacts [RWMA, 4/15/02]
- Latent cancer fatalities: 300 – 1,800
- Economic cost (2000$): More than $10 Billion

Nevada Recommendations
Comprehensive Risk Management

- Comprehensive risk assessment (CRA) should cover all transportation system phases, events, and consequences (Golding and White, 1990)
- CRA calculates probabilities only where existing data, theories, and models are sufficient to support use of rigorous quantitative methods, and uses sensitivity analysis to illustrate impact of differing assumptions and variations in quality of data
- CRA should be used as working risk management tool throughout life of project, with ongoing public participation
- CRA should be basis of risk communication throughout life of the project

Nevada Recommendations
Preferred Transportation System

- Dual purpose casks for at-reactor storage and transport
- Ship oldest fuel first (at least 20 years at-reactor cooling)
- Maximum use of rail (mode of choice)
- Mandatory use of dedicated trains, special safety protocols, and special car designs as recommended by AAR
- Early DOE and carrier identification of preferred cross-country mainline routes in consultation with stakeholders
- Early involvement of corridor states and Indian Tribes, including financial assistance under Section 180(c)

Nevada Recommendations
Full-Scale Physical Testing of Casks

- Meaningful stakeholder role in development of testing protocols & selection of test facilities and personnel
- Full-scale physical testing (sequential drop, puncture, fire, and immersion) prior to NRC certification
- Additional testing (casks, components, models) and computer simulations to determine performance in extra-regulatory accidents and to determine failure thresholds
- Reevaluate Modal Study findings , and if appropriate, revise NRC cask performance standards
- Evaluate costs and benefits of destructive testing of a randomly-selected production model cask

Nevada Recommendations
Accident Prevention & Emergency Response

- Maximize use of regional organizations such as Western Governors Association (WGA) and Western Interstate Energy Board (WIEB) for planning, implementation, and program evaluation
- Coordinate with Indian Tribes and local governments
- Develop comprehensive safety program modeled after WGA-State-DOE WIPP Transportation Program
- Adopt WIEB Sept.,1994 proposal for evaluation and final designation of preferred shipping routes
- Implement Section 180(c) Financial Assistance to State, local, & tribal governments through rulemaking
- Revise DOE Plan for Privatization of Transportation Services to emphasize safety and public acceptance

D.5 Baltimore Tunnel Fire

Dr. Resnikoff stated that he had investigated the Baltimore Tunnel fire for the State of Nevada because the length and temperature of the fire appeared to exceed design requirements for shipping casks. The fire lasted for 5 days, and it reached flame temperatures of 1800 °F. In addition, a study by Southwest Research Institute found that the flame temperature could have been much higher than 1800 °F and quoted figure of up to 2600 °F.

Spent fuel from the Calvert Cliffs reactor would actually travel through the same tunnel where the Baltimore Tunnel fire occurred. The fire has important implications for accident probability and risk estimates used in the RADTRAN computer program. Therefore, the State wanted to understand the environmental and economic implications of this fire.

The fire occurred on July 18, 2001. At approximately 3:00 p.m., the 60-car train carrying mixed freight began to enter the Howard Street Tunnel traveling at 23 miles per hour. The details of the accident are somewhat unclear, and the NTSB will hopefully clarify them in the future. It appears that the 52nd car of a 60-car train derailed inside the tunnel. Emergency brakes were activated. One car, containing approximately 28,000 gallons of tripropylene, caught fire. Following the derailment, the train crew uncoupled the engines, drove out of the tunnel, and called the train dispatcher.

For some reason, the crew was unable to reach the train dispatcher until 3:25 p.m., 18 minutes after the accident. At 4:15 p.m. the fire department arrived but could not enter the tunnel due to the smoke and heat inside.

The tunnel is on a 0.8 percent grade, with the lower end (south portal) of the tunnel near Oriole Park at Camden Yards. This entrance was approximately 2400 feet from the derailment. The north portal, which is the higher end, had much more smoke coming out of it than the south portal of the tunnel. The north portal is about 5800 feet from the derailment.

Between 5:00 and 6:00 p.m., in the midst of rush hour, Howard Street (which runs under the tunnel) was closed. Three hours into the accident, a 40-inch water main located in the ceiling of the tunnel ruptured, pouring water into the tunnel. It is not clear why the water main broke—whether it was due to the heat of the fire or stresses caused by the softening of the metal. However, it is believed that the water main acted as a sprinkler system and put out the tripropylene fire, based on the difference in the type of smoke that came out of the tunnel following this event.

Seven hours after the accident, the firefighters were able to enter the south portal of the tunnel, but could not yet put out the fire. Cars that contained paper goods and other goods were still burning. Finally, the next day, workers began removing some of the burning cars.

The prime intention of the State's analysis was to identify the temperature of the fire and compare it to the cask design regulatory requirement of 1475 °F. The only information available to the State at the time was a fireman's eyewitness account that, seven hours after the initiation of the fire, he entered the tunnel and viewed metal glowing with a deep orange color. Therefore, the State surmised that the fire temperature at the height of the rail cars was somewhere between 1500 °F and 1650 °F. Southwest Research Institute has examined the components of the rail cars and identified that an alloy in the brake shoes had fused. For this to occur, Southwest Research Institute estimated that the temperature would need to be 2400 °F.

The National Institute of Standards and Technology (NIST) used a computer model, benchmarked with a tunnel fire in West Virginia, to simulate the Baltimore Tunnel fire. NIST estimated a peak flame temperature of 1800 °F, which lasted for the 3 hours before the water main broke. NIST took into account the availability of oxygen within the tunnel and found that some of the higher temperatures were located near the roof of the tunnel. The tunnel itself is lined with about 3 feet of brick which essentially acted as an oven or kiln. In other words, the fire heated up the brick. Therefore, it is not just a 3-hour fire that has to be considered; it is a 3-hour fire at a certain temperature and a continuing radiant heat from the brick itself. Any modeling of cask response to this accident has to take the radiant heat from the brick into account. The temperatures calculated by NIST do not differ much from the observations of the fireman who came into the tunnel.

The regulatory test for shipping casks consists of a drop, puncture, submersion, and fire tests. The State is interested in a test that involves a 30-minute fire at 1475 °F. The conditions in the Baltimore Tunnel greatly exceeded the cask design requirements, in that the fire reached temperatures of 1800 °F for 3 hours and not 1475 °F for 30 minutes, and the tunnel continued to stay hot for a long period of time.

The State is interested in what the consequences would be if a mixed freight train transporting spent fuel and other hazardous materials were to be involved in a fire similar to the Baltimore Tunnel fire. The State's analysis calculates an immediate dose of 5 rem in some areas as shown in Figure D-4. Some of the release paths include PCINet Stadium and Oriole Park at

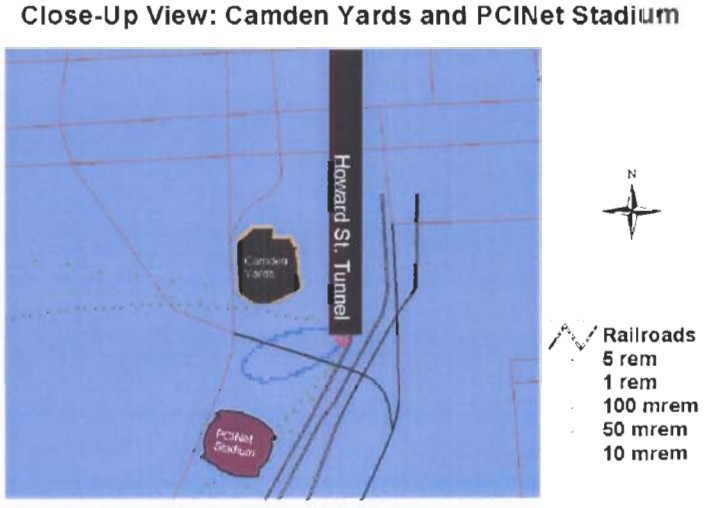


Figure D-4

Camden Yards. If the accident were to happen in between a day and night doubleheader at Camden Yards, people would have to be evacuated during rush hour. In addition, the accident would result in radioactive material adhering to the tunnel walls, creating a rather high gamma dose. The State's analysis did not estimate the dose from the tunnel walls.

TWG Questions

Dr. Hornberger questioned how the spent fuel cask inventory was mobilized. Dr. Resnikoff responded that the study assumed that the material released is cesium-137, not the spent fuel particulates, because cesium-137 is semi-volatile. The material could then adhere to cooler walls in the tunnel, resulting in a high gamma dose to emergency personnel. In addition, the HI-STAR cask safety analysis report (used in the NRC staff's analysis of the same tunnel fire; see Section 2.1.5 of this NUREG report) assumes that neutron shielding would boil off in accidents involving high temperatures. Neutron shielding is a resin with a low melting temperature. Without neutron shielding, the neutron dose would be much higher. Dr. Resnikoff pointed out that the State's study estimates a neutron dose on the order of 0.5 rem per hour which would be of concern to emergency personnel.

He went on to say that the State's study has some important implications for cask design. All casks are designed to withstand a 30-minute fire at 1475 °F which is far below the temperatures sustained in the Baltimore Tunnel fire. The NRC staff has argued that, even if the cask is only designed to withstand a 30-minute fire, it can still withstand a fire like the Baltimore Tunnel fire. The State disagrees with that. Dr. Resnikoff believes that it would be more factual to say that these casks are not designed to withstand all credible accidents that could happen.

The Baltimore Tunnel fire also has important lessons for emergency personnel. Mr. Resnikoff believes communications are poor between people in a tunnel and people in the outside environment. The train crew could not communicate until they got out of the tunnel. Radio communication was not possible, and cell phones could not be used. Emergency personnel should be trained and equipped to handle radiation accidents. For example, the responders need to have neutron- detecting meters, in addition to the gamma detectors they already have.

Stakeholder Comments

Ms. Gue, with Public Citizen, commented that the Working Group has returned several times to the issue of the probabilistic weighted relative risks of nuclear waste transportation compared to the transportation of other hazardous materials. It would be interesting for the TWG to examine the way in which these different risks interact and affect one another, particularly given that NRC does not have jurisdiction over the shipment of other hazardous materials. This type of analysis would be beneficial because NRC is contemplating licensing and regulatory decisions that could potentially give rise to an unprecedented level of spent fuel shipments.

Members of the public are keenly aware that accidents involving other hazardous materials do, in fact, happen. If high-level nuclear waste were on the roads and rails in the scale contemplated by the Yucca Mountain and PFS proposals, there would not only be a cumulative risk, but that there would also be interaction between the risks resulting from exposure to spent fuel and the risks resulting from exposure to other hazardous materials.

Ms. Gue further pointed out that NRC's regulatory standards for nuclear waste transportation casks do not appear to match the kinds of accident conditions that are attained in a fire involving other hazardous materials. For example, what temperatures do other hazardous materials, being shipped with spent fuel, and how does that compare to the regulatory standards for nuclear waste shipping casks?

Baltimore Tunnel Fire

Advisory Committee on Nuclear Waste

April 22, 2003

Presentation by

Marvin Resnikoff, Ph.D.

Radioactive Waste Management Associates

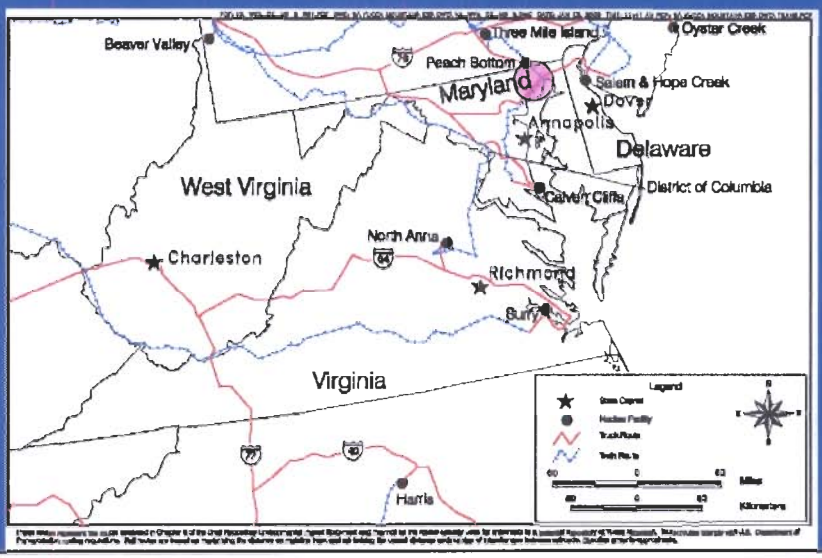
On behalf of the

State of Nevada

Why investigate the Baltimore Tunnel Rail Fire ?

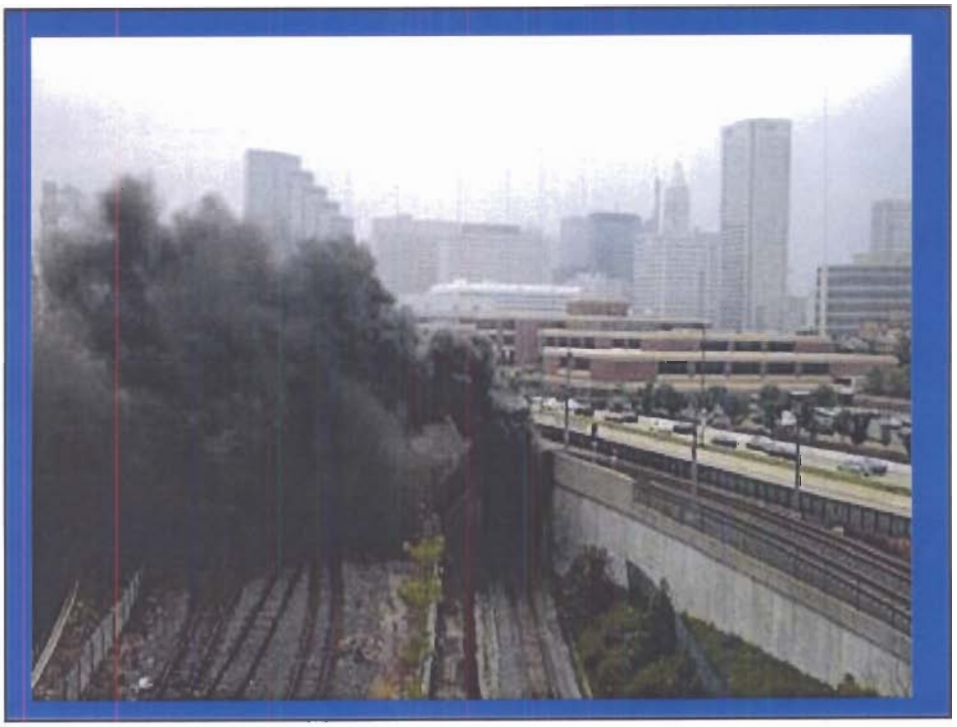
- Fire appeared to exceed cask design specs
- Calvert Cliffs reactor would use CSX tracks
- What are the implications for cask design, accident probability estimates, emergency preparedness and environmental impact?

DOE's Proposed Routes to Yucca Mountain



Chronology

- 7/18, 3:04 PM, train 100 yards south of tunnel entrance, traveling 23 mph
- 3:07 PM, emergency brakes activated, train in tunnel, 0.5 miles from northern end, black fumes fill tunnel
- 3:15 PM, train crew uncouples engines, drives out of north end, phones dispatcher
- 3:25 PM, black smoke pouring out of tunnel, crew reaches dispatcher
- 4:15 PM, fire department receives notification, cannot enter tunnel



- 5-6 PM, Coast Guard closes Inner Harbor, fans evacuated from Camden Yards ballpark, roads closed 1.3 miles within inner city, major highways closed, severe gridlock
- 6:15 PM, water main breaks, power failure
- 10 PM firefighters enter tunnel through south end
- 7/19, workers begin removing cars from tunnel, car containing tripropylene and burning cars remain
- 7/21, 4 PM, empty tripropylene tanker removed

Steel Temperatures

- 1000 °F, dark red color
- 1500 °F, newspaper report
- 1650 °F, orange
- 1825 °F, yellow
- 2200 °F, white

NIST Findings

- Peak calculated temperature 1800 °F within the flaming region for 1st 3 hours
- Wall surface temperature reached about 1500 °F
- Steel temperatures of rail cars expected to be similar to gas temperatures

Regulatory Tests

40 inch drop onto
6 inch steel spike

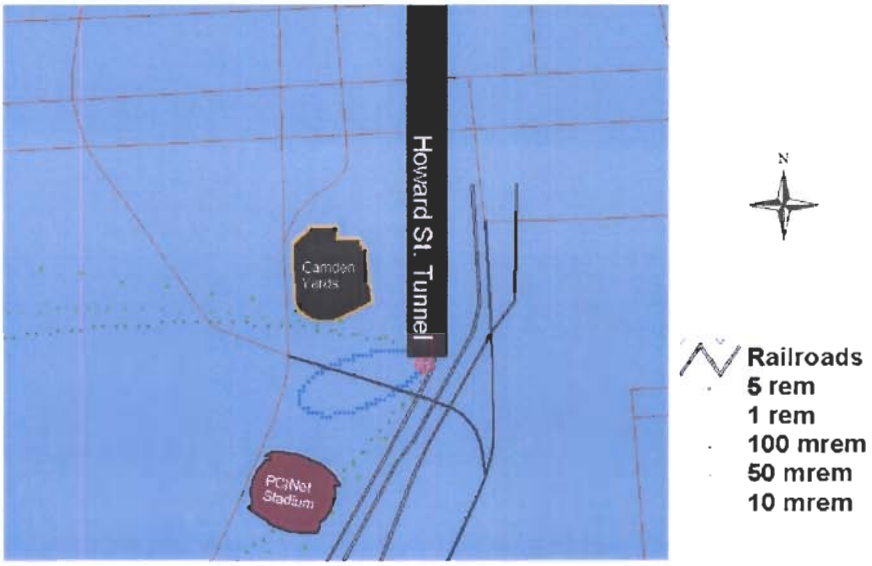
30 foot drop onto essentially unyielding surface

30-minute fire @ 1475°F

8-hour submersion of undamaged cask under 50 feet of water

Source: Sandia National Laboratories

Figure 7:
Close-Up View: Camden Yards and PCINet Stadium



Implications

- cask design (time, temperature of regulatory fire)
- accident probability estimates (is this a one in a million year accident?)
- emergency preparedness (how do local governments prepare for a severe accident?)
- environmental impact (dose to the public and emergency personnel)

D.6 Remarks by Jim Hall

Mr. Hall served as the Chairman of the NTSB for several years. Since leaving the NTSB in 2001, he has been involved with several important transportation safety and security issues.

As the Chairman of the NTSB, Mr. Hall repeatedly saw the results of planners failing to adequately address safety at the front end of a transportation project. Mr. Hall served 6 years as the Director of the State of Tennessee's State Planning Office, which was responsible for overseeing DOE's clean up of the Oak Ridge Nuclear Weapons Complex. In that position, he obtained a basic understanding of the complexity associated with the storage and transportation of spent nuclear fuel.

Mr. Hall is representing the State of Nevada to focus attention on one specific issue—the need for full-scale physical testing of the shipping cask. Full-scale testing is essential for both the protection of public health and safety and the promotion of public confidence.

Last summer, when Congress was debating the siting of Yucca Mountain as the Nation's nuclear repository, Mr. Hall was surprised when Secretary Abraham testified that DOE is just beginning to formulate its preliminary thoughts about a transportation plan. It has now been more than 14 months since the Secretary of Energy sent the Yucca site recommendation to President Bush, and DOE has yet to present a transportation plan.

Although a plan has not been presented, DOE has, in the FEIS, suggested several possible approaches to the transportation issues associated with the Yucca Mountain project. However, it is important to mention that, as this process continues to move forward, DOE has not yet formally declared its modal preference.

DOE stated in the FEIS that it would issue a ROD declaring its commitment to rail. At the current time, DOE does not even have a schedule of when it will make that most basic decision; therefore, it is not clear how DOE can state that there will not be 109,000 truck and 4,000 barge shipments. DOE put these scenarios and numbers forward, and DOE stated that, in its opinion, the risks and impacts of many thousands of truck and barge shipments would be legally and socially acceptable.

Finally, when Secretary Abraham and his representatives stated that only 175 shipments will occur per year, it is important to realize that by all accounts such a number is unrealistic. At the very least, there would be twice as many shipments per year, and, as has been pointed out, there could be as many as 2900 per year.

One assumption that can be made about DOE's transportation intentions is that the Department will likely assume title to commercial spent nuclear fuel at the power plants and will thus legally own the fuel and be the shipper of record. NRC has clearly concluded that this will be the case. Of course, DOE already owns the thousands of tons of high-level radioactive waste from defense activities and a large amount of spent fuel from civilian defense and naval reactor operations. This is significant because DOE ownership at the time of shipment limits the degree of NRC regulation.

In May 2002, Senator Durbin of Illinois wrote to NRC asking what role NRC would play in the transportation of spent fuel if Congress approves Yucca Mountain. Then-NRC Chairman Meserve responded by letter that if DOE took custody of the spent fuel at the licensee site, DOE regulations would control the actual spent fuel shipment. Under such circumstances, the

NRC's primary role in transportation of spent fuel to a repository would be the certification of the packages used for transport.

Senator Durbin then asked how NRC would be involved in selecting modes and routes for the relocation of nuclear waste if Congress approves Yucca Mountain. Meserve again stated that the only involvement NRC would have in the transport would be the certification of the transport cask.

The outgoing NRC Chairman clearly took the position that the only aspect of DOE's transportation of radioactive waste to Yucca Mountain that would be regulated by NRC would be cask certification. Over the course of the past 5 weeks, Commission staff have repeated this position at public meetings on the PPS in Rockville, Maryland; in Las Vegas, Nevada; and in Chicago, Illinois. This underscores the importance of the Commission's decision regarding full-scale cask testing, because cask certification is the only area in which the Commission will be directly involved in Yucca Mountain transportation safety planning.

Mr. Hall noted that other representatives of the State of Nevada were present to offer the specifics of the State's proposal for full-scale testing. They will also discuss reasons why the full-scale cask testing plan proposed by NRC staff and contractors is not only technically questionable and very costly, but is also unlikely to result in increased public confidence. It is not, of course, NRC's responsibility to promote public confidence in DOE's transportation activities. NRC should not approach the full-scale testing issue with public confidence as its objective. Instead, the protection of public and health safety and the environment should be the objective of NRC's approach. If the testing is done properly, public confidence will logically follow.

For the past 25 years, opponents of full-scale testing have focused on cost. Indeed, full-scale testing will be expensive. NRC staff has stated that a program to test one truck cask and one rail cask will cost more than $20 million. Nevada analysts believe that the NRC proposal could cost as much as $30 million. Nevada has proposed a plan to test all of the cask types that would be used for Yucca Mountain shipments if the repository goes forward. The plan includes testing one truck cask and four rail casks, plus additional testing and analysis, at a total estimated cost of $45 to $70 million.

To put these costs in perspective, the cost of Nevada's more effective full-scale testing program would be small compared to the overall cost of the Yucca Mountain transportation system. DOE estimates that transportation system would cost about $8.4 billion over 38 years. The State of Nevada has estimated approximately $9.2 billion for the same period. Nevada's testing program is less than one percent of the projected transportation expenditures.

Another way to put testing costs in perspective is to compare them to the cost of clean up after a worse-case transportation accident involving the release of radioactive materials. DOE acknowledges that clean up for one accident could cost up to $10 billion. State of Nevada analysts have run the same DOE computer models and concluded that the worse-case accident or successful terrorist attack could involve cleanup costs in excess of $10 billion. Again, whatever the figure, Nevada's comprehensive cask testing program would cost less than one percent of the projected cleanup cost of a worse-case accident or terrorist scenario

In conclusion, it will take cooperation at every level of this effort to make safety the primary concern. It is vital to remember that it is the decisionmaking and performance of individuals—sometimes acting alone, sometimes acting as members of a team or committee—that directly determine the safety of an organization or an operation.

TWG Questions

Dr. Garrick noted that Mr. Hall has a tremendous amount of experience dealing with transportation systems and accidents and investigations, whereas DOE does not have much experience in instituting a transportation system of this type. Dr. Garrick asked whether there was an example in the field of transportation and transportation safety that could serve as a source of lessons learned. Mr. Hall responded that in transporting hazardous materials in this country, there have been some tragic accidents on highways and in rail systems. There is also experience with pipeline systems and refineries trying to handle dangerous products. Mr. Hall suggested that the background and experience at nuclear facilities, as well as the existing experience in successfully transporting nuclear material, could also be drawn on. However, Mr. Hall re-emphasized the importance of casks, and stated that his experience at the NTSB taught him that any time several organizations are responsible for the same activity, it is a cause for concern. Dr. Garrick noted that the ACNW has expressed concern on several occasions to the NRC Chairman about which organization would be in charge if a transportation accident involving nuclear materials occurred. There are multiple agencies and multiple organizations. This question is relevant not only the Yucca Mountain project, but was also a major consideration in the Waste Isolation Pilot Plant project.

Mr. Levenson asked Mr. Hall whether any full-scale tests of rail cars were performed when new types of hazardous or toxic materials, such as fluorene or hydrogen, were to be shipped. Mr. Hall responded that there are testing and requirements for tank cars, and in the aviation area, but did not provide examples.

REMARKS OF JIM HALL
ON BEHALF OF THE STATE OF NEVADA
TO THE
U.S. NUCLEAR REGULATORY COMMISSION'S WASTE ADVISORY
COMMITTEE OF NUCLEAR WASTE

Good afternoon. My name is Jim Hall and for almost seven years, I served as Chairman of the National Transportation Safety Board (NTSB). The NTSB is the federal agency that is charged with the investigation of major transportation accidents, or as I liked to say, is the "eyes and ears" of the American people at transportation accidents across the country and around the world. In that role, I became all too familiar with the human and economic toll caused by these accidents. As a result, the Board and I did everything possible to find ways to prevent such tragedies from recurring.

Since leaving the NTSB in 2001, I have attempted to lend my voice to important transportation safety and security issues that I firmly believe in.

Prior to heading the NTSB, I served for six years as the Director of the State of Tennessee's State Planning Office which was charged with overseeing the Department of Energy's clean-up of the Oak Ridge nuclear weapons complex.

As Chairman of the NTSB, I repeatedly saw the results of the failure to adequately address safety at the front end of a transportation project. From my work in Tennessee, I have an understanding of the complexity associated with the storage and transportation of spent nuclear fuel. I am here today speaking on behalf of the State of Nevada to focus our collective attention on one specific issue associated with potential transportation tc Yucca Mountain – the need for full scale physical testing of the shipping casks. I believe that full-scale testing is essential for both the protection of public health and safety anc the promotion of public confidence.

Last summer, when Congress was debating the siting of Yucca Mountain as the nation's nuclear repository, I was asked to comment on the safety aspects of DOE's Yucca transportation plan. During that time, I was surprised when Secretary Abraham testified before the Congress and informed them, [DOE] "...is just beginning to formulate its preliminary thoughts about a transportation plan." It has now been more than 14 months since the Secretary of Energy sent the Yucca site recommendation to President Bush and the DOE has yet to present a transportation plan.

Although a plan has not been presented, DOE has suggested several possible approaches to the transportation issue in its Final Environmental Impact Statement (FEIS) for the Yucca Mountain project. And, you've already heard Nevada consultants discussing those possible scenarios earlier today. However, I feel it is important to mention again that, as this process continues to move forward, DOE has not yet even formally declared its stated modal preference.

DOE said in their FEIS that they would issue a record of their decision declaring their commitment to rail. At the current time, DOE does not even have a schedule of when they will make that most basic decision. So, when I hear DOE spokespeople saying that there won't be 109,000 truck and 4,000 barge shipments – I wonder what I am missing? Really, we need to remember, that it was DOE who put these scenarios and numbers forward and it was DOE that stated, in their opinion, the risks and impacts of many thousands of truck and barge shipments would be legally and socially acceptable.

Finally, when Secretary Abraham and his representatives say that there will only 175 shipments per year, it is important to mention that by all accounts such a number is unrealistic. At the very least, there would be twice as many shipments per year. Conceivably, there could be as many as 2,900 per year.

One assumption we can make about DOE's transportation intentions is that DOE will likely assume title to commercial spent nuclear fuel at the power plants and thus DOE will legally own the fuel and be the shipper of record. The NRC has clearly concluded that this will be the case. Of course, DOE already owns the thousands of tons of high-level radioactive waste from defense activities and a large amount of spent fuel from civilian defense and naval reactor operations. Now why is this significant? DOE ownership at the time of shipment is significant because it limits the degree of NRC regulation, and that is no small matter.

Last May, Senator Durbin of Illinois, wrote to the NRC asking, "What role would your Agency play in the transportation of spent fuel if Congress approves Yucca Mountain?" Then NRC Chairman Meserve responded, "If DOE takes custody of the spent fuel at the licensee's site, DOE regulations would control the actual spent fuel shipment. Under such circumstances, the NRC's primary role in transportation of spent fuel to a repository would be the certification of the packages used for transport." Senator Durbin asked a second question, "How would your agency be involved in selecting modes and routes for the relocation of nuclear waste if Congress approves Yucca Mountain?" Meserve again stated, "...the only involvement NRC will have in the transport will be the certification of the transport cask."

The outgoing Chairman of the Commission has clearly taken the position that cask certification is the only aspect of DOE's transportation to Yucca Mountain that would be regulated by the NRC. Over the course of the past five weeks, Commission staff have repeated this position at public meetings on the package performance study here in Rockville, in Las Vegas & Pahrump, Nevada and in Chicago. This underscores the importance of the Commission's decisions regarding full-scale cask testing, since cask certification is really the only area in which the Commission will be directly involved with Yucca Mountain safety planning.

Other representatives of the State of Nevada are here today to offer the specifics of the State's proposal for full-scale testing. They will also discuss reasons why the full-scale cask testing plan proposed by NRC staff and contractors is not only technically questionable and very costly, but is also unlikely to result in increased public confidence.

It is not the NRC's responsibility to promote public confidence in DOE's transportation activities. The NRC should not approach the full-scale testing issue with public confidence as its objective. It can and must approach this testing with protection of public health and safety and the environment as its objective. If the testing is done properly, public confidence will logically follow.

For the past twenty-five years, opponents of full-scale testing have focused upon costs. Indeed full-scale testing will be expensive. NRC staff has stated that their program to test one truck cask and one rail cask will cost more than $20 million. Nevada analysts believe the NRC proposal could cost as much as $30 million. Nevada has proposed a plan to test all of the cask types that would be used for Yucca Mountain shipments, if the repository goes forward. That means testing one truck cask and four rail casks, plus additional testing and analysis, at a total estimated cost of $45-70 million.

How can we put these costs in perspective? The cost of Nevada's more effective full-scale testing program would be small compared to the overall cost of the Yucca Mountain transportation system. DOE estimates the transportation system cost would be about $8.4 billion over 38 years. The State of Nevada has estimated approximately 9.2 billion for the same system over the same period. So Nevada's testing program is less than 1 percent of total projected transportation expenditures.

Another way to put testing costs in perspective is to compare them to the cost of cleaning up after a worst-case transportation accident involving the release of radioactive materials. DOE acknowledges that clean up could cost up to $10 billion, and that is for one accident. State of Nevada analysts have run the same DOE computer programs and conclude that a worst case accident or successful terrorist attack could involve clean-up costs in excess of $10 billion. Again, which ever figure we used, Nevada's comprehensive cask-testing program would cost less than 1 percent of the projected clean-up cost of a worst case accident or terrorist scenario.

In conclusion, let me thank you for this opportunity to share my views and experiences with you. It will take the cooperation of every level of this effort to make safety the primary concern. It is vital that we all remember that it is the decision making and performance of individuals, sometimes acting alone, sometimes acting as members of a team or committee that directly determine how safe an organization is.

D.7 Nevada Proposal for Full-Scale Regulatory Testing of Shipping Casks and Testing to Failure

Mr. Halstead stated that his presentation would outline the State of Nevada's current position on full-scale cask testing. In addition, the State is in the process of participating in the PPS meetings and in reviewing Draft NUREG-1768, "Package Performance Study Test Protocols," dated February 2003.

It is useful to review the current situation. Currently, NRC does not require full-scale physical testing of shipping casks. There are currently 16 spent fuel shipping casks certified by NRC for use in the United States. None of these have been tested at full scale to demonstrate compliance with 10 CFR Part 71 performance standards. Two truck cask designs have been subjected to a half-scale drop test. Three rail cask designs have been subjected to the drop test using 1/3- or 1/4-scale models, and more than half of the casks have been subjected to scale model impact limiter tests. That is the sum of the testing that has been performed. In summary, no full-scale testing has been performed, only limited scale model testing has been performed, and there has been substantial reliance on structural analysis.

For years, the State has argued the advantages of performing full-scale testing. These arguments have been organized in various ways. Sandia performed a study for DOE in 1993 that clearly stated the advantages of full-scale testing. The first, and most obvious, advantage is that it is a direct demonstration of compliance with the regulations. Secondly, while there are some issues that can be addressed through half-scale model testing, there is a clarity of characterization when a full-scale model is used. Further, in the PPS meetings, the cask manufacturers have suggested that there may not be much of a cost savings in using a half-scale model. By using the full-scale testing, the operation of the closure and the seal can be assessed as a total package.

It is also important to note that no purchase orders have yet been placed for casks intended for transportation to Yucca Mountain. Therefore, the industry does not have any fabrication experience with these new cask designs. Full-scale testing would offer the manufacturers some early lessons in preparing a prototype, while acknowledging that preparing a prototype is somewhat different than producing 50 units under a large contract. Other important advantages include eliminating the need for scaling and providing direct visual evidence.

The only disadvantage that has been discussed is the cost of fabrication and testing. However, from the standpoint of regulatory testing, there are clear advantages and no technical disadvantages to full-scale testing.

The State's approach to regulatory testing has five components. The first is strong stakeholder involvement. The second is an actual full-scale sequential test in accordance with NRC performance standards, preferably prior to NRC certification. However, because many of the casks have already been certified, performing the testing prior to DOE's procurement would serve the same purpose. The third component is additional testing to address the issues that the NRC staff is proposing in the PPS; however, full-scale testing may not be necessary for all of those tests. Full-scale testing is necessary for the fire test, but a combination of simulations, scale models, and full-scale component testing may be just as, or more, effective in determining failure thresholds. Finally, the last two points are things that might grow out of findings, and perhaps we should not speculate about what the findings would be.

The State contends the testing should be focused on the casks that will be used for shipments to Yucca Mountain. Currently, five of the certified casks have been identified by NRC as likely to be used either in shipments to Yucca Mountain or shipments to the PFS facility. A number of people have come to the PPS meetings and stated that the State's approach is deficient— not all of the casks should be full-scale tested. The State's argument is that its focus is on the casks that will be used in at least 95 percent of the spent fuel shipments that are likely to occur over the next four or five decades, including shipments to PFS. The State believes that it is important to focus on these new cask designs because the combination of new designs, new materials, and larger payloads raise questions that cannot be directly answered by looking at the performance of casks that have been used over the last 20 years. To a certain extent, code benchmarking can be accomplished through regulatory compliance tests, although the test objective should be reflected in the test design and may, in some ways, limit the applicability of the tests.

The State believes that the Nuclear Waste Fund could appropriately be used to support the full-scale tests, provided the casks tested would be the ones used to make spent fuel shipments to Yucca Mountain.

NRC and DOT could require, through regulation, the testing that the State would like to have performed could be required through regulation by NRC and DOT. The testing could also be performed through a unilateral DOE program decision, although some at DOE would argue that it would need Congressional approval. Certainly a Congressional mandate, either through statute or appropriations conditions, could be used to require such testing.

In the area of extra-regulatory testing, the State believes the focus should be on fire tests. The analyses conducted to date by DOE and Nevada generally conclude that accidents involving long-duration, high-temperature fires are likely to produce the worst consequences. Real-world fires are particularly a concern with the new generation of casks, which carry larger payloads and inventories of cesium-137.

As discussed at the November 2002 TWG meeting, the presenters agreed that very few physical data exist on actual cask performance in severe fires. Certainly, there have been other types of benchmarking exercises with large calorimeters, however, no fire testing with full-scale casks has been done since the 1970s. A key objective of these tests would be to determine both failure thresholds and benchmark codes.

Mr. Halstead identified five different approaches to the fire test that the State is considering, as shown in Figure D-5. There is considerable debate among the State's technical reviewers over not only what is desirable in a fire test, but also what is physically possible to perform. In particular, reviewers have raised questions about combining an impact test and a fire test, particularly because it would be preferable to have instrumentation installed at several points inside of the cask prior to the fire test. However, when the cask is subjected to an impact test, it is not clear whether it can be reasonably expected that instrumentation, such as thermocouples, will continue to operate properly.

Nevada Proposal for Regulatory Testing

- Meaningful stakeholder role in development of testing protocols & selection of test facilities and personnel
- Full-scale physical testing (sequential drop, puncture, fire, and immersion) prior to NRC certification or DOE procurement
- Additional testing (casks, components, models) and computer simulations to determine performance in extra-regulatory accidents and to determine failure thresholds
- Reevaluate Modal Study findings, and if appropriate, revise NRC cask performance standards
- Evaluate costs and benefits of destructive testing of a randomly-selected production model cask

Figure D-5

The State has estimated the costs associated with full-scale testing carefully and tried to err by overstating the costs. The State believes that the first effort to perform this testing program on a legal-weight cask is going to require a significant amount of stakeholder involvement, expensive modeling, and rigorous peer review. There are also some unknown costs associated with the instrumentation and how dummy or surrogate fuel will be designed and used inside of the cask. The State has considered scenarios in which a fresh fuel assembly has been used.

These costs represent the State's best estimate and may err on the high side. A cost of $27 to $30 million for the first two casks (one truck cask and one rail cask) is probably accurate, and the larger cask full-scale test program can be accomplished in the range of $45 to $70 million.

The State believes the following key issues still need to be resolved. The NRC should develop the test protocols for full-scale sequential tests, including a good, defensible definition of cask and fuel failure. The same attention must be focused on developing the test protocols for fires. The NRC needs to review the options for extra-regulatory impact tests. As previously stated, the State believes a full-scale test is necessary for the fire test, however, it is possible that some of the other extra-regulatory issues can be resolved with something less than full-scale

testing. The NRC should also assess the need for other extra-regulatory tests, particularly the puncture, deep immersion, and crush tests, which are not currently required by the regulations.

The State has assembled a review team to prepare comments on the PPS test protocols and plans to submit complete comments by December 2003.

TWG Questions

Dr. Hornberger noted that the State has done a good job of providing the TWG with details on what and how testing should be performed, but has not explained why the testing needs to be performed. Thinking in terms of cost/benefits, the State has not adequately stated the benefits. Mr. Halstead replied that although there are currently some elegant finite analysis codes, there is not a lot of benchmarking. Therefore, at the very least, Mr. Halstead believes that one full-scale rail and one-full scale truck cask must be tested for benchmarking purposes. It is Mr. Halstead's understanding that the Committee took a different position in its meeting in June 2002 and subsequent letter. Mr. Levenson pointed out that the Committee's letter was not against full-scale testing; it was against testing at extreme unrealistic conditions. Mr. Halstead continued that from a risk-informed basis, the Committee stated that it saw no clear need for testing to extreme conditions and was not sure that the benefits were commensurate with the expenditure of doing the test. Mr. Halstead agreed with the Committee that any extra-regulatory testing performed has to be well-justified, either by replication of a realistic worse-case accident or by the way in which the staff defines a failure threshold which can then be compared to the full body of knowledge about real-world accidents.

Mr. Halstead expressed his belief that there is an absolute need to perform one full-scale rail and one full-scale truck cask test for benchmarking purposes simply because it has not been done in this country since the 1970s. Secondly, he acknowledged that there is probably not a need to test more than one truck cask since because the physically similar GA-4 and the GA-9 will likely be used for transportation to Yucca Mountain. However, it is not as clear with the rail casks. There are some significant variations between the NAC and Holtec dual purpose casks, for example. There may be a representative new rail cask that can be used for benchmarking purposes, however, it appears that there is a good argument for at least two casks to be tested—one cask with a steel-lead-steel shell and one cask with a forged-steel shell.

Mr. Halstead also noted that the 1993 Sandia report presents a convincing argument to support full-scale testing. In addition, full-scale testing will provide strong evidence that a cask meets the requirements of 10 CFR Part 71.

Dr. Garrick asked about the basis for the State's proposed fire option tests. Mr. Halstead responded that the State was confident that the Baltimore Tunnel fire was a good analog for a very severe fire. However, this view is not shared by others. As the State reviewed the Southwest Regulatory Institute, Battelle, and NIST findings, it noted evidence that suggested the temperatures in the Baltimore fire might have reached 1600°F.

Dr. Birky added that a review of the past 35 years of fire experiments, testing, and accident investigation show a long litany of examples of accidents in which the resulting fires were more intense, or the damage was more extensive than one would have expected based on existing knowledge. The current NRC regulation for fire testing is set at a temperature too low for too short a time to be comparable to any accidental fire. A temperature of 850 °C is not very high for a fire. Experience has shown much higher temperatures in almost every accident involving hazardous materials in which a fire ensued.

Mr. Halstead noted that in the larger perspective, it is very difficult to consider the issue of cask performance without considering the issue of spent fuel performance when defining cask failure. At an NRC public meeting in Pahrump, Nevada, Mr. Halstead was concerned that some stakeholders believed that cask failure meant that a fuel assembly would pop out of a cask and lay on the road. To temper this view, the equivalence of a performance measure based on a consequence analysis should be defined to understand what test-to-failure means. Currently, a sufficient definition of cask failure does not exist.

Dr. Garrick stated that Sandia, which Mr. Halstead noted supported a full-scale test, also indicated in the same report that it believed that current regulations were acceptable and provided the necessary safety. It is very important to keep that in perspective. Mr. Halstead replied that the State has always believed that, although the regulations do not necessarily represent a worst-case accident, in general, they represent a good regulatory standard. The problem is that not one truck cask or one rail cask has been tested at full scale to benchmark the codes used to enforce the standard.

Mr. Levenson asked, with regard to the State's proposed fuel cladding testing, if the State wants to determine what happens to the fuel, why would it advocate spending tens of millions of dollars when that same information can be obtained in a furnace test for tens of thousands of dollars? Mr. Halstead responded that the State is also advocating that testing be performed for fuel performance purposes. In addition, the State believes all the information on fire testing using the CAFE code is based on the premise that fires are not scale models and that the basis for benchmarking the codes does not yet exist. Mr. Levenson noted that Mr. Halstead did not answer his question. Mr. Levenson's point was that scaling is not an issue in studying fuel failure, and the testing can be performed in a furnace. Mr. Halstead agreed that such testing could be performed in a furnace.

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Nevada Proposal for Full-Scale Regulatory Testing of Shipping Casks, & Testing to Failure

Robert J. Halstead
State of Nevada Agency for Nuclear Projects
Fred Dilger
Clark County Nuclear Waste Division
Presentation to
Advisory Committee on Nuclear Waste
U.S. Nuclear Regulatory Commission
Rockville, MD
April 22, 2003

Cask Testing Issues

- Absence of Cask Testing Requirements
- Advantages of Full-Scale Testing
- Nevada Proposal for Regulatory Testing
- Proposal for Extra-regulatory Testing
- Further Development of Proposal

Absence of Cask Testing Requirements

- NRC does not require physical testing
- 16 shipping cask designs currently certified
- No currently certified US cask has been tested full-scale to demonstrate compliance with 10CFR71(drop, puncture, fire, immersion)
- 2 truck cask designs drop-tested using half-scale models (TN-8 & GA-4)
- 3 rail cask designs drop-tested using 1/3- or 1/4-scale models (125-B, NAC-STC, TN-68)
- Scale-model impact limiter tests (9 casks)

Advantages of Full-Scale Testing – 1

(S.E.Gianoulakis, SNL, 1993)

- Single cask can be sequentially subjected to all normal and accident conditions defined by regulations; directly demonstrate compliance
- Clear characterization of package behavior and opportunities for design refinement (also achievable through half-scale model testing)
- Package closure and seal response can be directly measured; results represent actual package containment system response

Advantages of Full-Scale Testing – 2
(S.E.Gianoulakis, SNL, 1993)

- Allows early evaluation and monitoring of fabrication process
- Allows early operational testing
- Direct measurements (acceleration and surface deformation) eliminate need for scaling relationships
- Visual evidence (photos and videos) for system analyses and public demonstration
- Major disadvantage: Cost of fabrication and testing

Nevada Proposal for Regulatory Testing

- Meaningful stakeholder role in development of testing protocols & selection of test facilities and personnel
- Full-scale physical testing (sequential drop, puncture, fire, and immersion) prior to NRC certification or DOE procurement
- Additional testing (casks, components, models) and computer simulations to determine performance in extra-regulatory accidents and to determine failure thresholds
- Reevaluate Modal Study findings, and if appropriate, revise NRC cask performance standards
- Evaluate costs and benefits of destructive testing of a randomly-selected production model cask

Focus on Casks To Be Used for Yucca Mountain Shipments

- 5 currently-certified casks likely to be used
- These casks likely represent vast majority (perhaps 95% or more) of future SNF and HLW shipments, including PFS
- Directly address concerns regarding new (proposed) casks: new design configurations, new materials, larger payloads
- Demonstrate regulatory compliance & benchmark codes
- Appropriate use of Waste Fund
- Testing requirement could be implemented through NRC or DOT regulation, DOE program decision, or Congressional mandate

Extra-regulatory Tests Should Focus on Full-Scale Fire Tests

- Long-duration, high-temperature fires represent most severe accident environments evaluated by DOE and Nevada
- Real world fires could potentially result in significant release of radioactive materials (average SNF rail cask contains 816,000 curies Cs-137)
- There is little physical data on actual cask performance in severe fire environments
- Full-scale fire testing reduces uncertainties
- Determine failure thresholds and benchmark codes

Fire Test Options Under Consideration

- Undamaged cask in regulatory fire (800°C) for extended time period to replicate specific accident (e.g., 3-12 hours, per Howard Street Tunnel fire)
- Undamaged cask in regulatory fire (800°C) until fuel cladding temperature reaches containment limit (740°C)
- Undamaged cask in extra-regulatory fire (e.g., 1,000°C) for extended time period (e.g., 3 hours), or until fuel cladding temperature reaches containment limit (740°C)
- Damaged cask (9m drop) in regulatory fire (800°C) for extended time period based on predicted failure
- Damaged cask (per PPS) in regulatory fire (800°C) for extended time period based on predicted failure

Preliminary Cost Estimate for Nevada Cask Testing Proposal (2003 Dollars)

- Regulatory Testing of First Legal-Weight Truck Cask: $7.8-8.4 Million
- Regulatory Testing of First Rail Cask: $19.1-22.0 Million
- Assume one-time cost of $10 Million to upgrade test facility to drop 130 ton cask
- Regulatory testing of 5 casks, plus two extra-regulatory fire tests: $45-75 Million

Key Issues To Be Resolved

- Development of protocols for full-scale regulatory (sequential) tests
- Definition of cask (and SNF) failure
- Development of protocols for full-scale extra-regulatory fire tests
- Evaluation of options for extra-regulatory impact tests (full-scale, scale model, component)
- Evaluation of need for other extra-regulatory tests (puncture, deep immersion, crush)
- Validate cost and schedule estimates

Schedule for Nevada Proposal

- Nevada has assembled review team to prepare comments on PPS Draft Protocols
- Nevada comments on PPS Draft Protocols (Due 5/30/03) will provide additional details of Nevada testing proposal
- Nevada preparing work plan and budget for development of detailed proposal
- Draft proposal target date: December 2003

D.8 Safety Implications of the Baltimore Tunnel Fire

Dr. Resnikoff stated that his discussion would focus on the major and subtle differences of each cask and how the differences make it difficult to generalize and apply the results from the Baltimore Tunnel fire analysis to each cask. Specifically, the discussion will focus on the Holtec HI-STAR 100 cask, but will also include a discussion of the IF-300 cask.

The Holtec HI-STAR 100 consists of an overpack which contains a sealed (welded) MPC. The MPC contains the spent fuel. The overpack is constructed of concentric steel shells, approximately 9 inches thick for gamma attenuation and structural integrity. Some other transportation casks use lead or depleted uranium for gamma attenuation.

Outside the steel shells is a neutron-absorbing material called Holtite (proprietary to Holtec). Some casks, such as the IF-300, contain water rather than a resin or plastic for neutron absorbtion. Impact limiters, which are designed to crush on impact, are located on each end of the cask. For the Holtec cask, this impact limiter is made of aluminum in a honeycomb formation.

Inside the MPC, latticework holds either 24 pressurized-water reactor or 68 boiling-water reactor spent fuel assemblies. The MPC can either be shipped in the transportation overpack or stored in a concrete overpack. When closing the overpack, the annulas is filled with helium, which is a better heat conductor. Helium is also used in the MPC for heat transfer and to prevent oxidation of the uranium in the fuel and the cladding.

There are two plugs that cover valves used to evacuate the overpack of water and replace it with helium. The cover bolt structure is also important for confinement of the spent fuel and radionuclides.

In older casks, the outer neutron-absorber was a water jacket. In an accident, the water jacket could be pierced and the water lost. In addition, the neutron absorber in the outer portion of the cask provides insulation in a fire, however, that is not true for the HI-STAR cask.

To accommodate the resin insulator, the HI-STAR 100 cask is constructed with radial connectors which are 1/2-inch thick and designed to conduct heat out of the cask. The Holtite material is located within the channels. Unlike the IF-300, the HI-STAR 100 is not going to serve as an insulator in a fire, but will actually conduct the heat into the cask.

The Topical Safety Analysis Report (TSAR) for the HI-STAR 100 cask suggests that Holtec assumes that in a regulatory fire the Holtite neutron-absorbing material would evaporate. Without that neutron-absorbing material, the dose at the cask surface rises to 500 millirems (mrem) an hour.

Dr. Ryan stated that 500 mrem per hour seemed high and asked for the basis of that value. Dr. Resnikoff responded that his firm performed calculations assuming the removal of hydrogen and boron, which absorb the neutrons, to determine the neutron dose at the surface of the cask. These calculations looked at neutron attenuation. Dr. Ryan further questioned how 500 mrem was calculated, where the neutrons came from, and what was the burnup of the fuel. Dr. Resnikoff responded that the burnup of the fuel assumed in the HI-STAR cask is 40,000 megawatt days per metric ton that has been cooled for 10 years. Dr. Ryan noted that seemed very high to him by a factor of about 20. Dr. Resnikoff stated that the source of the neutrons

was curium-242 and curium-244. Dr. Resnikoff stated that he would provide the Committee with the calculations.

Figure D-6 is from the Hi-STAR TSAR and shows the temperatures of some of the components of the cask during a 1475 °F fire. Dr. Resnikoff projected some of these lines upward tc predict the temperature of the components during hotter fires. According to the calculations done by Holtec, the closure plate bolts will reach 512 °F in a regulatory fire. Holtec's calculations show that the accident limit is 600 °F. Dr. Resnikoff's projections of the plate bolts curve indicated that, in less than an hour of a closure, the plate bolts will exceed the design limit for a fire at 1475 °F and in less time for a fire at 1800 °F. Dr. Resnikoff added that he had not perfo·med this calculation, he had just projected a curve, although he thought it would be useful to see the calculation.

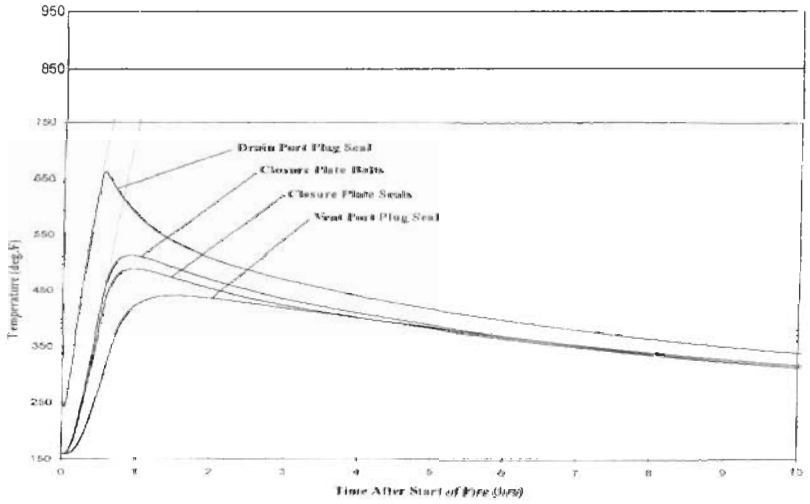

FIGURE 3.5.2: HI-STAR 100 PACKAGE CONTAINMENT BOUNDARY COMPONENTS FIRE ACCIDENT TRANSIENT TEMPERATURE RESPONSE

Figure D-6

Dr. Ryan questioned the basis for Dr. Resnikoff's projection. Dr. Resnikoff stated that he had taken the tangent of the curve. Mr. Halstead added that the assumption was that there are real-world fires that can produce these conditions and it addresses the question of what happens in both a regulatory and an extra-regulatory fire.

Mr. Halstead added that Dr. Resnikoff was trying to point out that these are the types of issues that the State believes have not been sufficiently addressed in the background analysis that supports the PPS approach to testing. The State would like to review the performance of specific certified casks under regulatory, slightly higher than regulatory, and considerably higher than regulatory conditions to make sure that it has the necessary information to make decisions on the testing protocols. Currently, the State cannot support the recommendations that are made for testing in NUREG-1768 even though it has supported testing for many years. For example, NUREG-1768 does not sufficiently assess the issue of bolts, seals, and fuel performance in certain temperature ranges.

Dr. Ryan expressed his appreciation for Mr. Halstead's views on the testing protocols, however, the basis for projecting the line in the graph was still not clear. Mr. Halstead acknowledged this point.

Dr. Resnikoff next pointed out that the closure bolts are under considerable stress. Once the closure bolts exceed the design limit, helium will be released from the overpack, which will also serve to insulate the MPC to some degree.

Dr. Resnikoff's final point was that not all casks have the same construction as the Holtec cask. Not all casks have radial conductors for heat. Some will have only an empty area or an area filled with water. All these variations in casks will need to be modeled. It is not a simple job to model these casks, which is one reason why the State is suggesting that several of these cask types be tested at full scale.

TWG Questions

Dr. Garrick asked if loss of shielding is the principal concern with the fire scenarios.
Dr. Resnikoff replied that he was concerned about loss of neutron shielding and, for the Holtec cask, that the destruction of the spent fuel cladding will be a problem for DOE when handling the spent fuel at Yucca Mountain. In addition, he was concerned about a leak from the MPC caused by a long-duration fire.

Dr. Garrick noted that he could understand the direct radiation issue associated with the loss of the neutron shield, but asked what would be the pathway for a leak. Dr. Resnikoff stated that a pathway could occur if the welds are loosened or the MPC itself might leak because it is only 1/2-inch thick.

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Safety Implications of the Baltimore Tunnel Fire

Advisory Committee on Nuclear Waste
April 22, 2003

Presentation by
Marvin Resnikoff, Ph.D.
Radioactive Waste Management Associates
On behalf of the
State of Nevada

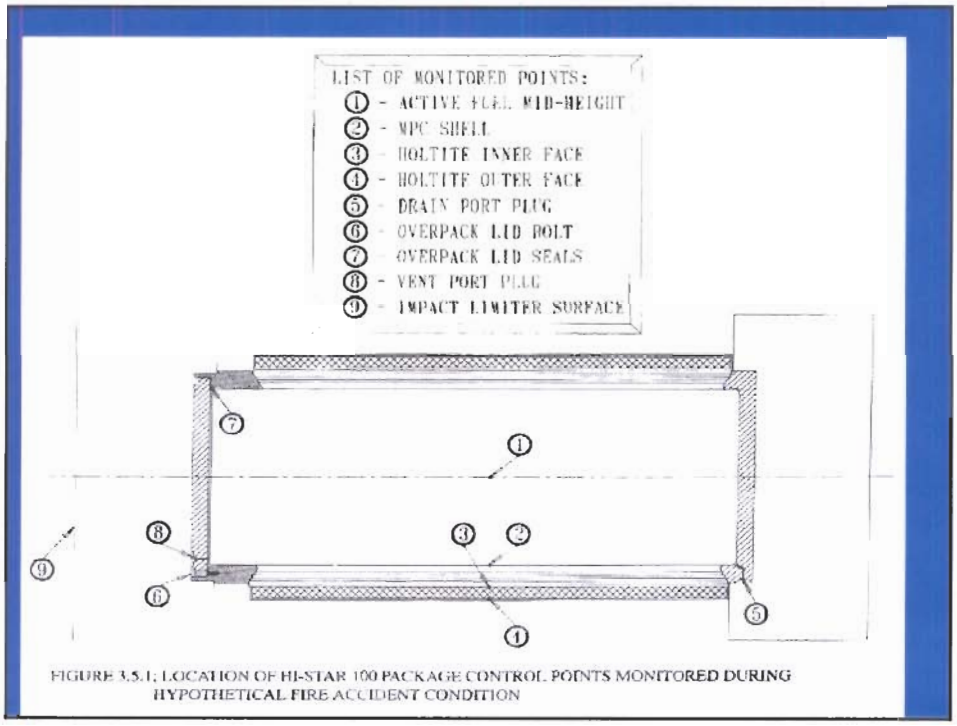
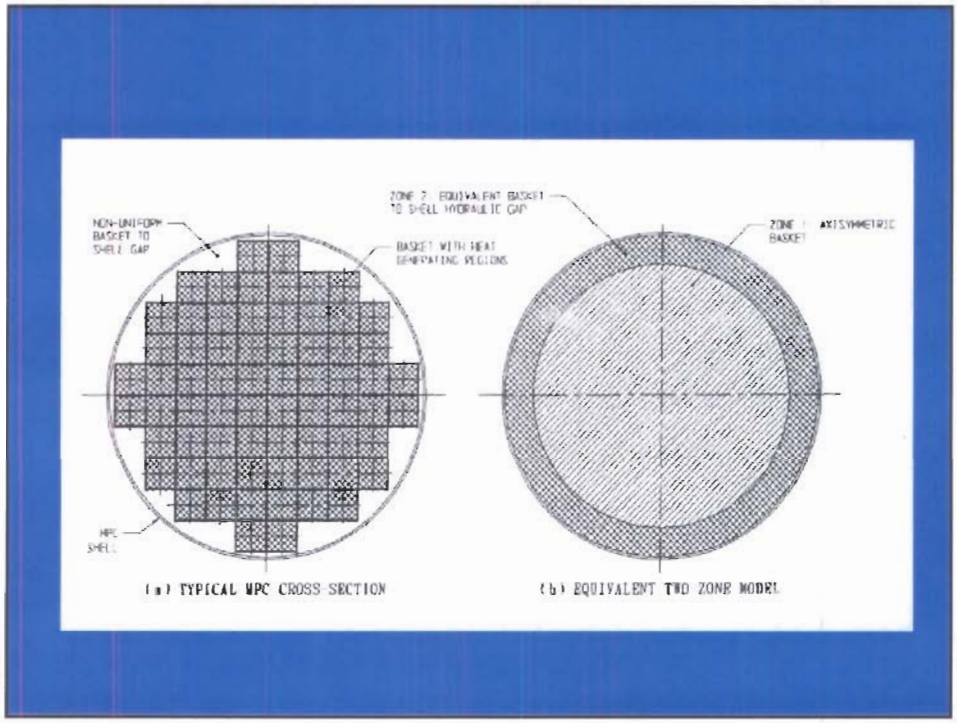


FIGURE 3.5.1; LOCATION OF HI-STAR 100 PACKAGE CONTROL POINTS MONITORED DURING HYPOTHETICAL FIRE ACCIDENT CONDITION



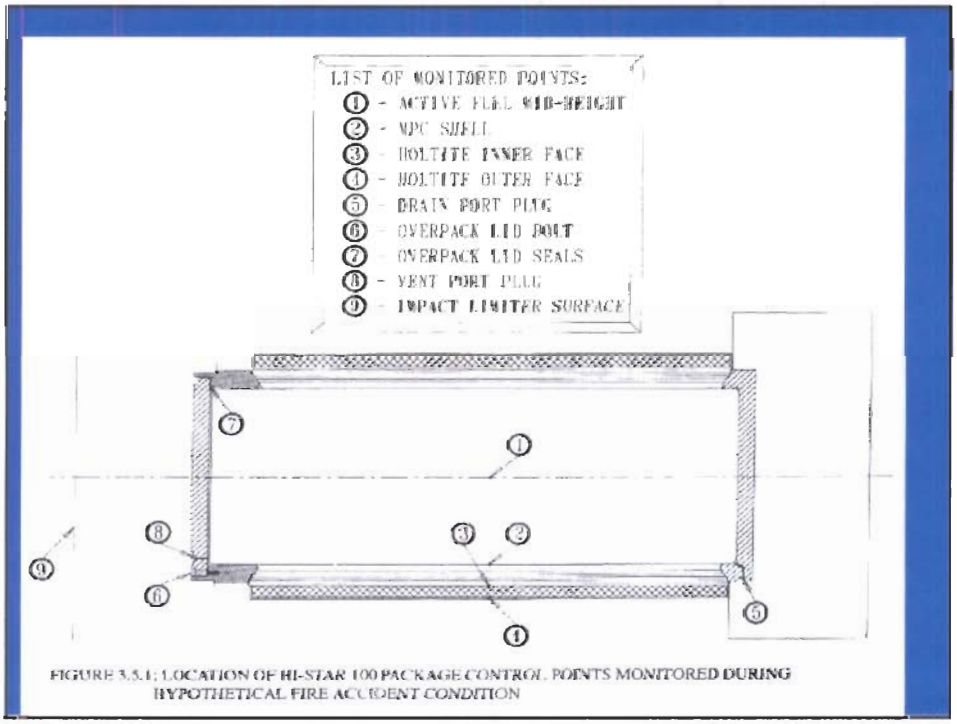
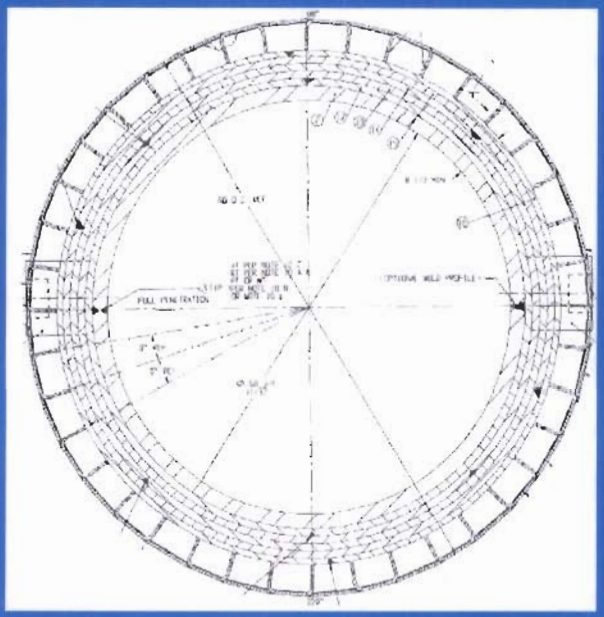
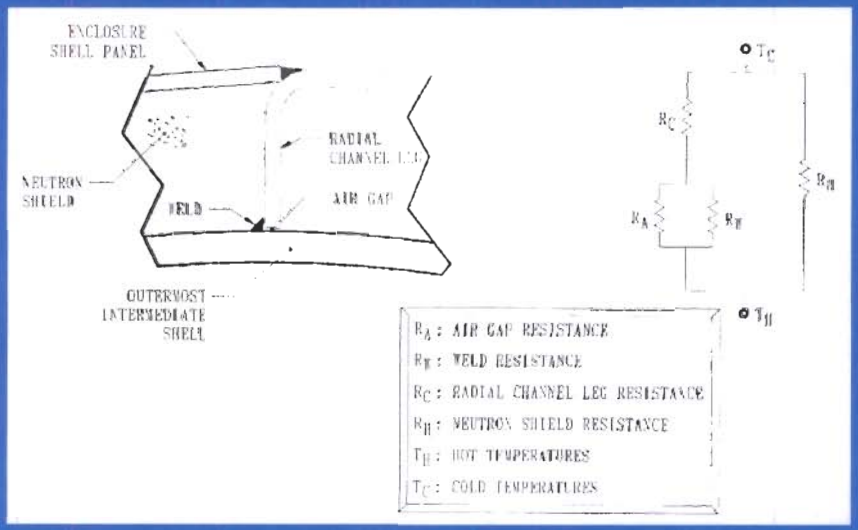
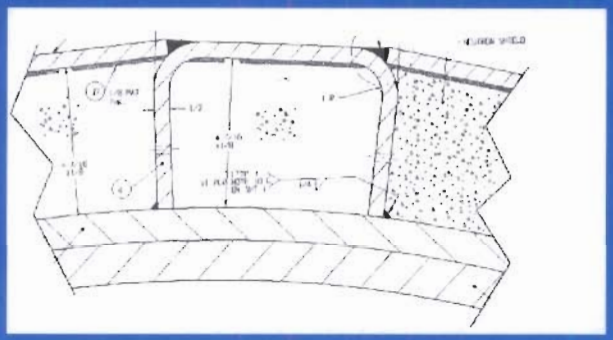


FIGURE 3.5.1: LOCATION OF HI-STAR 100 PACKAGE CONTROL POINTS MONITORED DURING HYPOTHETICAL FIRE ACCIDENT CONDITION




ENCLOSURE SHELL PANEL
NEUTRON SHIELD
RADIAL CHANNEL LEG
AIR GAP
WELD
OUTERMOST INTERMEDIATE SHELL
T_C
R_C
R_N
R_A
R_W
T_H
R_A : AIR GAP RESISTANCE
R_W : WELD RESISTANCE
R_C : RADIAL CHANNEL LEG RESISTANCE
R_N : NEUTRON SHIELD RESISTANCE
T_H : HOT TEMPERATURES
T_C : COLD TEMPERATURES



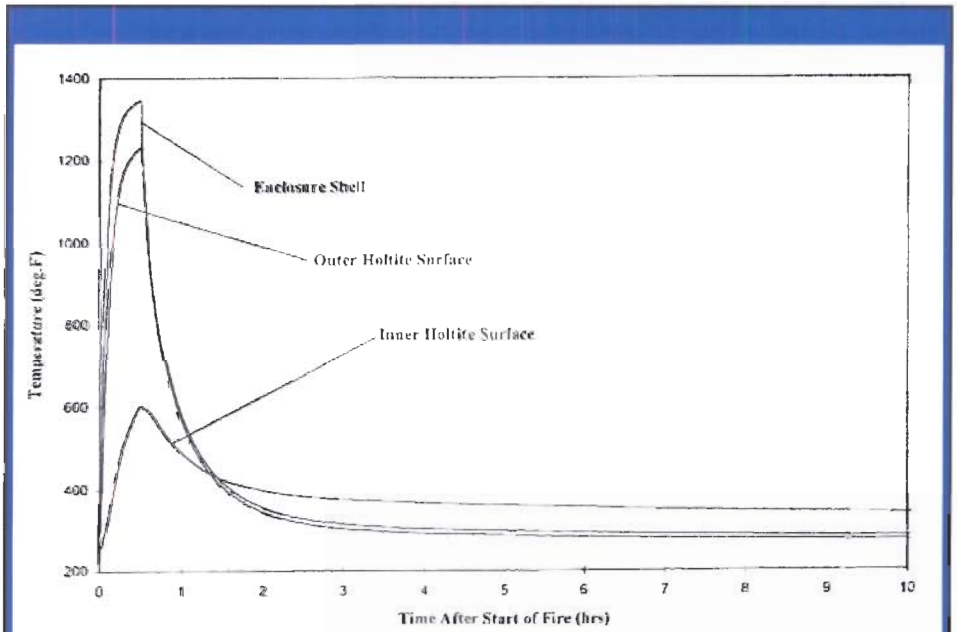


FIGURE 3.5.3; HI-STAR 100 PACKAGE NEUTRON SHIELDING REGION FIRE ACCIDENT TRANSIENT TEMPERATURE RESPONSE

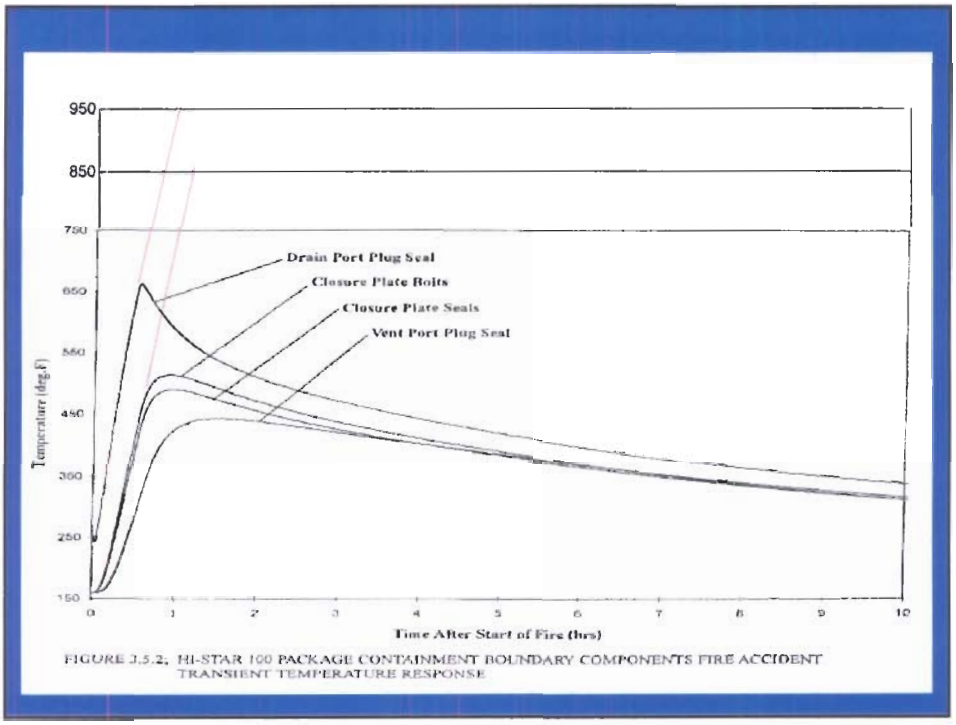


FIGURE 3.5.2; HI-STAR 100 PACKAGE CONTAINMENT BOUNDARY COMPONENTS FIRE ACCIDENT TRANSIENT TEMPERATURE RESPONSE

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D.9 Full-Scale Cask Testing: Past Experience, Lessons Learned, and Preliminary Assessment of NUREG-1768

Mr. Halstead stated that there are many testing programs that the State needs to review before it issues its draft document at the end of 2003. The State has reviewed in some detail the Sandia tests from the 1970s and the Central Electricity Generating Board tests on the Magnox cask conducted in the United Kingdom. These latter tests were known as "Operation Smash Hit."

The State was intrigued by innovative approaches to testing, as well as the approach taken to certify the Nupac 125B cask, used for shipping the Three Mile Island debris to Idaho. The State extensively studied the TRUPACT-II Test Program. It is very difficult to review all of these different types of tests, including testing performed in Europe and Japan, to identify the lessons learned. However, the State has identified some lessons learned that support its proposal for testing associated with NUREG-1768.

First, full-scale cask testing is expensive and often exceeds the budget. The United Kingdom tests on the Magnox Program cost $8 million in 1984; TRUPACT testing cost approximately $5 million in 1989.

An interesting aspect of the Nupac 125B testing is that the designers, who were pressured through financial rewards to obtain a quick licensing decision from NRC, not only decided to perform full-scale testing of the casks, but also decided to build full-scale canisters and test them. The designers noted that if the full-scale internal canister met the test requirements for the entire package, it could be assumed that the entire package would comply with the standard.

An important lesson learned is that before decisions are made as to what full-scale, scale-model, and component tests should be performed, more discussions should take place to ensure the tests provide meaningful results.

Most of these past tests were not designed for benchmarking. However, the Sandia tests were, and those tests were generally considered successful. The TRUPACT-II testing was, in part, required because the ability to model the heat transfer in that type of soft body/large package was not well known. If the objective is benchmarking, then the tests will be designed differently than tests performed to confirm regulatory compliance.

Regulatory compliance was not part of the Sandia tests, but it was a very significant part of the other tests which were also extremely successful. For example, the Nupac 125B probably could not have been licensed without performing the confirmatory tests.

Public acceptance of transportation cask testing is a difficult issue. First of all, public confidence is hard to measure. Secondly, an opinion survey or focus group research has not been performed to solicit public reaction to the cask testing.

The TRUPACT testing was a success because of the impact it had on the way State officials, emergency responders, and law enforcement officers are trained. The test program produced footage of drop and fire testing. The Idaho State Police produced a video called, "Safe Way Out," which Nevada has effectively used in its training programs. This video is effective partly because it provides good visual evidence, and partly because the package tested is the

package actually being used. Even the critics of radioactive waste transportation believe that the package was properly tested.

The British have had similar experience with the Operation Smash Hit testing, not only because it involved a locomotive impact on the cask, but also because part of the testing program involved a series of regulatory tests performed at Cheddar Gorge. The Sandia tests are an example of how not to perform tests to promote public confidence. Those tests did not involve casks that would be used for shipments to Yucca Mountain. In Mr. Halstead's experience, those tests are dismissed by the public as either irrelevant or a public relations exercise.

In summary, there are limits to what is applicable from the lessons learned from past radioactive waste transportation testing. However, the State believes it is important to use those lessons learned to the maximum extent possible.

With regard to spent fuel testing, NRC has not adequately explained to the State its test plans and how it plans to integrate cask testing with spent fuel testing. Another issue that has been debated between NRC and the State is the value that should be used for the gap inventory of cesium-137 when calculating the releases from serious fire and impact accidents. The values range from as low as 0.3 percent to over 20 percent. This is the single most important unresolved spent fuel issue because all of the models are driven by an assumed value for the gap inventory for cesium.

There is also the issue of determining temperature and impact limits for burst rupture of the spent fuel cladding. The State believes this should be done through laboratory testing of spent fuel. Similarly, the issue of the size distribution of released particles has been debated more contentiously when assessing the effects of a blast from a shaped charge, which could possibly release a considerable quantity of physical material from the cask. The size distribution of the particles becomes very important for the consequence assessment, but perhaps less important for accident consequence analysis.

Our knowledge about the behavior of cesium-137 in fire environments seems adequate, but not enough is known about the behavior of this radionuclide in impact environments. In addition, more needs to be learned about how strontium is affected by heat and under what circumstances. CRUD behavior is also an issue for which more data are needed.

The implications of higher burnup fuels must be better understood. Over the last 20 years, spent fuel burnup has increased approximately 50 percent.

With regard to the PPS, NRC has done a good job of providing the opportunity for stakeholder involvement. The State believes that, of the truck casks that are currently certified, the GA-4 is the logical choice for full-scale testing. However, the selection of the Holtec HI-STAR 100 for the rail cask to be full-scale tested may not be appropriate because it may not be the most representative rail cask to be used to ship spent fuel to Yucca Mountain.

The State has some concerns with Sandia both designing the test program and performing the tests. The State believes that it would be more appropriate for the PPS tests to be performed by a separate test facility to avoid a conflict of interest. This would also make the test facility accessible to stakeholders during testing.

The State believes that the cost of the testing will be between $25 and $30 million, and not the $20 million suggested by the NRC staff. The State also believes it is very important for NRC to commit to performing the full-scale tests.

TWG Questions

Dr. Ryan noted that he had read "Radiologic Impacts of Incident-Free Transportation to Yucca Mountain; Collective and Maximally Exposed Individuals," by H.E. Collins, G.R. Gathers, and R.J. Halstead. It appeared that the paper contained calculated dose to a maximally exposed individual and then applied cancer risk factors to that dose. Dr. Ryan stated that this did not appear to be a fair assessment because of the application of a risk estimator. For example, page 6 of the paper estimates the teratogenic risk of birth defects using a risk estimator. Dr. Ryan indicated that application of a risk estimator to an individual is not a correct use of such a risk estimator and is not epidemiologically correct. Dr. Ryan cautioned the State that maximal individual doses may in fact not be realistic. The State should review the probabilistic approaches to determining public or worker doses and then carefully apply cancer risk estimates only when appropriate. Such risk estimators, in an epidemiologic sense, do not apply to individuals and may not apply accurately to small groups. This type of analysis is not helpful in that it may mislead people that do not realize its limitations.

Mr. Halstead responded that he agreed with Dr. Ryan's statements about the ability to predict cancer risk in a specific individual. This also relates to the issue of using latent cancer fatality as the measure of radiological health risks. The process of critiquing them was not made clear in the paper. It is important to note that the key issue for worker doses is that potential issues exists, depending on certain policy decisions that allow routine doses to be delivered to workers

Dr. Ryan added that a very large body of worker dose evidence exists that the State can use to review actual worker doses for units in transport. Mr. Halstead agreed, but noted that the data were absent in DOE's FEIS analysis, which was the focus of the paper.

Dr. Garrick stated that he believed that one of the most important issues for sensible test protocols is that the tests be associated with a realistic and technical basis. Much has been said about the various risk assessments that have been performed for spent fuel transportation. While certain elements of the work have been good, Dr. Garrick admitted that the transportation risk assessment is many years behind the quality of risk assessments that were done in the nuclear power plants even 10–15 years ago, particularly with respect to identifying specific contributors to risk and in terms of defining rational and convincing risk metrics, or risk measures. The transportation risk studies are behind both in terms of the comprehensiveness of the uncertainty analysis and in terms of the scope. Dr. Garrick would like to see more evidence that the test protocols are anchored to a technical basis or analysis. Dr. Hornberger agreed.

Dr. Bahadur questioned whether Dr. Resnikoff's Baltimore Tunnel fire study had received a peer review. Dr. Resnikoff responded that it had been reviewed by his peers in the State of Nevada and that they had provided comments that improved the paper. Mr. Halstead added that at some future date, the State plans to update the paper with information obtained from NRC and other sources and submit the analysis for the Packaging and Transportation of Radioactive Material Conference or possibly a technical journal where it would undergo the peer review.

Mr. Kobetz noted that Mr. Birky expressed a concern that NRC regulations may not be conservative enough with regard to the fire test and questioned whether the State has a current safety issue that suggests that the regulations are not adequate. Mr. Halstead responded that if the State had the technical information to argue that the current standard was inadequate, it would file a petition for rulemaking. However, at the current time, he does not believe there is sufficient information to justify the State challenging the existing regulations.

Stakeholder Comments

Ms. Gue noted that Public Citizen, a public interest organization, has a long-standing commitment to issues of transportation safety, as well as nuclear waste management. Therefore, the question of nuclear waste transportation is an interesting nexus for the organization. The Committee and the various agencies involved should have no doubt that spent fuel transportation is a significant public concern that cannot be addressed simply through a public relations campaign. Specific concerns relate to the question of credibility of the various regulatory agencies charged with protecting public health and safety. Unfortunately, Ms. Gue believes that the history with respect to both NRC and DOE does not particularly inspire public confidence.

The Committee should play a vital role in addressing this credibility problem. After the first round of these meetings, the public was very concerned because the Committee heard exclusively from an industry panel. In fact, Public Citizen sent a letter to the Committee expressing its concerns. Public Citizen hopes that future meetings of the Committee will have more balance built into the presentations made, and the Committee will take more of the lead in addressing some of the questions that do remain about these issues. It is vitally important that the ACNW act as an independent advisory committee, demonstrating its commitment to fully explore dissenting views, as well as the well-known positions of the nuclear industry.

Full-Scale Cask Testing:
Past Experience, Lessons Learned, & Preliminary Assessment of NUREG-1768

Robert J. Halstead
State of Nevada Agency for Nuclear Projects
Presentation to
Advisory Committee on Nuclear Waste
U.S. Nuclear Regulatory Commission
Rockville, MD
April 22, 2003

Past Experience with Full-Scale Cask Testing

- SNF Shipping Cask Crash and Fire Test Program, Sandia National Laboratories, 1977-1978
- Magnox Cask Regulatory and Demonstration Test Program, CEGB, United Kingdom, 1983-1984
- Nupac 125B Quarter-scale Cask and Full-scale Canister Test Program, 1984-1985
- TRUPACT-II Test Program, Sandia National Laboratories, 1988-1989

Lessons Learned

- Costs
- Benchmarking of Codes
- Regulatory Compliance
- Licensing Time
- Public Acceptance
- Safety Enhancements

Spent Fuel Testing Issues

- PPS failure to integrate cask and fuel testing plans (plans not included in NUREG-1768)
- Gap inventory of Cs-137
- Rod & pellet temperature and impact limits (burst rupture)
- Size distribution of released particles
- Behavior of Cs-137, Sr-90, & CRUD in severe impacts and fires
- Implications of higher burn up

General Concerns Regarding PPS & NUREG-1768

- Extent of future stakeholder participation
- Selection of casks to be tested
- Selection of test scenarios
- Selection of cask testing facilities
- Program cost & availability of funding
- Commitment to carry out testing program

Selected Preliminary Concerns with NUREG-1768

- Absence of modeling to predict failure thresholds (performance envelope analysis)
- Prioritization of impact testing versus fire, and absence of specific fire test durations
- Use of impact limiters
- Test instrumentation
- Probabilistic Metric (Pp. A-2 to A-3)

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ATTENDEES
APRIL 22–23, 2003

ATTENDEES FROM THE NUCLEAR REGULATORY COMMISSION

APRIL 22, 2003

Larry Camper	NMSS
Andrew Murphy	RES
Debbie Lipkey	OIG
Elaine Brummett	NMSS
Sue Gagner	OPA
Chet Poslusny	NMSS
Stephanie Bush-Goddard	NMSS
Dan Dorman	RES
Jocelyn Mitchell	RES
Philip Justus	NMSS
Jake Philip	RES
Banad Jagannath	NMSS
Tim McCartin	NMSS
Dennis Galvin	NMSS
Omid Tabatabai	NMSS
Bill Reamer	NMSS
Yong Kim	NMSS
Heather Astwood	OCM/EXM
Anne Passarelli	NMSS
Kathryn Winsberg	OCM/EXM
Mike Layton	OCM/GJD
Lawrence Kokajko	NMSS
Janet Kotra	NMSS
Dave Esh	NMSS
Chris Grossman	NMSS
Kim Hardin	NMSS
Chris Bajwa	NMSS
Robert Lewis	NMSS
Jorge Solis	
Amy Snyder	NMSS
Ron Parkhill	NMSS
Ken Erwin	
Jack Guttmann	NMSS
Bernard White	NMSS
Antonio Dias	NMSS
Mitzi Young	OGC
Allen Gross	Cradal
James Johns	Cradal
Steven Baggett	NMSS
Dave McIntyre	OPA

ATTENDEES FROM THE NUCLEAR REGULATORY COMMISSION (CONT'D)

APRIL 23, 2003

Aladar Csontos	NMSS
Tamara Bloomer	NMSS
Robert Lewis	NMSS
Jeffrey Pohle	NMSS
Tim McCartin	NMSS
Tae Ahn	NMSS
Omid Tabatabai	NMSS
Debbie Lipkey	OIG
Bret Leslie	NMSS
Anne Passarelli	NMSS
Lawrence Kokajko	NMSS
Janet Kotra	NMSS
Chris Grossman	NMSS
Dave Esh	NMSS
Andy Campbell	NMSS

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APRIL 22, 2003

Norman Henderson	Bechtel SAIC Company
Michael O'Mealia	Nevada
E. von Tiesenhausen	Clark County
B. Pastin	National Academy of Sciences
Tom Isaacs	Lawrence Livermore Lab.
Bob Budnitz	Lawrence Livermore Lab.
Bob Bernero	National Academy of Sciences
Thomas Caton	JKRA
John Austin	Link Technologies
Jeff Williams	DOE
John Vincent	Nuclear Energy Institute
John Russell	Center for Nuclear Waste Regulatory Analyses
Carol Hanlon	DOE
David Safford	BNA
Jim Shaffner	PARALLOX BAH
Jim Hall	Hall Associates/State of Nevada
Hank Collins	Collins Group
Robert Loux	State of Nevada
Dan Fehringer	Nuclear Waste Technical Review Board
David Safford	BNA
Thomas Griffith	Naval Reactors
William Lake	ASE, Inc.
Ben Grove	Las Vegas Sun
Joseph Morris	National Academy of Sciences
Bob Hastead	State of Nevada
Robert Fronczak	American Association of Railroads
Karyn Severson	Nuclear Waste Technical Review Board
Ellen Ott	DOE
Elaine Hiruo	Platts
Michael Conroy	DOE
Marvin Resnikoff	Radioactive Waste Management/State of Nevada
Merritt Birky	Self
Eileen Supko	ERI
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Andrea Jennette	Fuel Cycle Week
Paul Genoa	Nuclear Energy Institute
Lisa Gue	Public Citizen
Mitch Singer	Nuclear Energy Institute
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ATTENDEES FROM OTHER AGENCIES AND GENERAL PUBLIC (CONT'D)

APRIL 23, 2003

Norman Henderson	Bechtel SAIC Company
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Steven Kraft	Nuclear Energy Institute
John Austin	Link Technologies
Jim Shaffner	PARALLOX BAH
John Russell	Center for Nuclear Waste Regulatory Analyses
Michael O'Mealia	Egan & Associates
Earl Eust??	

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON NUCLEAR WASTE
WASHINGTON, D.C. 20555-0001

June 4, 2003

The Honorable Nils J. Diaz
Chairman
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: TRANSPORTATION WORKING GROUP MEETING, APRIL 2003

Dear Chairman Diaz:

During its 141st Meeting on April 22-23, 2003, the Advisory Committee on Nuclear Waste (ACNW or the Committee) conducted a follow-on to the November 2002 Transportation Working Group Meeting that was held in Rockville, Maryland. The Committee heard a briefing from representatives of the National Academies on their proposed Transportation Study and from representatives of the State of Nevada (the State) and its contractors on their concerns about the transportation of spent fuel and high-level waste. The Committee expects to receive a briefing on the Academies' report again when the report is completed.

Representatives of the State presented information and recommendations on a number of transportation issues. Many of the State's current issues, such as route selection, relate to matters that are the responsibility of the Department of Energy, Department of Transportation, or the State. It was pointed out that the Nuclear Regulatory Commission (NRC) and the ACNW have neither responsibility for nor authority for disposition of such issues. The State representatives indicated that they believe the NRC should be given greater authority in the area of transportation.

In discussing issues that are regulated by the NRC, primarily cask certification, the State representatives provided summaries of their conclusions and recommendations but did not present the supporting technical bases. In addition, they qualified the statements by noting that the information and conclusions were tentative and subject to change based on their continuing review of the issues. For example, they recommended several full-scale cask fire tests with surrogate spent fuel to test the fuel's behavior beyond regulatory fire requirements. The State representative was asked why this type of test required a full-scale cask, why not simply heat a fuel assembly in a furnace? The State representative responded that they had not considered anything other than full-scale cask testing and acknowledged that simpler alternatives might be appropriate.

The State is currently sponsoring several studies on the risk associated with spent fuel transportation. To date, these studies have not identified a safety concern that would indicate that current NRC regulations are not adequate. Nevertheless, the State believes that full-scale testing of the casks should be performed to confirm their safety and that the testing should go beyond regulatory requirements. The State representatives agreed with the Committee that testing performed to benchmark codes is quite different from testing performed to demonstrate regulatory compliance. Attempting to accomplish both objectives with a single test is probably

not possible. The Committee maintains that full-scale testing beyond regulatory requirements would not provide any meaningful information, and agrees that if full-scale testing is performed, it should not have multiple objectives.

The State is concerned that the regulatory requirements for transportation package fire testing may not be sufficient with regard to the maximum temperature and duration of the fire. The NRC staff is aware of these concerns and has initiated discussions with the State and its consultants to resolve these issues.

The Committee reviewed a report that references NUREG/CR-6672[1] as the basis for release fractions resulting from a rail accident. The report was prepared by a State contractor[2]. The Committee notes that the release fractions calculated in NUREG/CR-6672 are very high and extremely conservative. The aggregate effect of the five conservatisms identified in the NUREG/CR is to overestimate radiological releases by several orders of magnitude. Despite the conservatisms, NUREG/CR-6672 concludes that spent fuel transportation regulations adequately protect public health and safety. The Committee believes that it is unfortunate that such overestimates of consequence are published by NRC in NUREG reports, because they get separated from the caveats and are used as though they were valid best estimates.

The Committee would like to restate its position that testing or analysis of conditions beyond reality is neither appropriate nor prudent. To date, the State agrees that it has not identified any technical issue indicating that current NRC regulations are not adequate.

Sincerely,

George M. Hornberger
Chairman

[1]U. S. Nuclear Regulatory Commission, NUREG/CR-6672, "Reexamination of Spent Fuel Shipment Risk Estimates," dated March 2002.

[2]"M. Lamb and M. Resnikoff, Radioactive Waste Management Associates, "Radiological Consequences of Severe Rail Accidents Involving Spent Nuclear Fuel Shipments to Yucca Mountain: Hypothetical Baltimore Rail Tunnel Fire Involving SNF," dated September 2001.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

July 16, 2003

George M. Hornberger, Chairman
Advisory Committee on Nuclear Waste
Mail Stop T-2-E-26
Washington, DC 20555-0001

SUBJECT: TRANSPORTATION WORKING GROUP MEETING, APRIL 2003

Dear Chairman Hornberger:

I am responding to your letter of June 4, 2003, to Chairman Diaz. I would like to express the U.S. Nuclear Regulatory Commission (NRC) staff's appreciation for the Advisory Committee on Nuclear Waste's (ACNW's) efforts to foster discussions on spent fuel transportation issues, including the November 2002 and April 2003 workshops. We stand ready to continue to support ACNW in these efforts.

The NRC staff attended the April 2003 workshop and agree with your assessment that there was no information presented that indicates NRC transportation regulations are inadequate. The State of Nevada's (hereafter, State's) consultants' concerns with fire temperatures revolved around evaluating cask performance in severe fires (e.g., the differences in NRC's and the State's Baltimore Tunnel Fire studies) rather than questioning the regulatory requirements. The staff met with the State's consultants on May 8, 2003. A meeting summary is available through NRC's Public Electronic Reading Room, on the Internet, at http://www.nrc.gov/reading-rm/adams/web-based.html (ADAMS Accession No. ML031400892). There are currently no planned additional interactions, but we are in the process of performing additional analyses and are open to discuss our final analyses with the State.

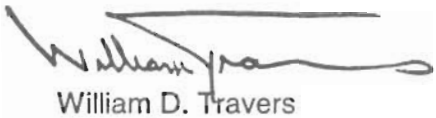
The NRC staff understands ACNW's views on the Package Performance Study (PPS) and its full-scale cask testing objectives. We are currently evaluating the public comments received and plan to keep ACNW updated on our comment resolution progress and resultant recommendations.

Regarding ACNW's comments on (NUREG/CR-6672), "The Reexamination of Spent Fuel Shipment Risk Estimates," the staff also believes that NUREG/CR-6672 is conservative, but the staff does not believe the conservatisms over-estimate releases by several orders of magnitude. However, NUREG/CR-6672 significantly reduced the level of conservatism, compared with previous transportation studies and reaffirmed the conclusions of earlier environmental risk assessments; namely, that the transportation regulations were adequately protective, with modern input assumptions. The calculated values of risk are extremely low. Further, since the study needed broad applicability for the wide range of shipping options possible, some variables and assumptions were necessarily conservatively selected. Although the conservatism in the report could be beneficial in licensing proceedings, the conservatisms and the basis for the conservatisms could be confusing for public communications efforts. The staff recognizes the importance of considering the context of the modeling, analysis and

assumptions in the report when referencing it. Note that the PPS fuel experiments, which are now on hold, were designed to address the degree of conservatism in the NUREG/CR-6672 release modeling.

If you have any questions, please feel free to contact me at 301-415-8580 or Bill Brach and his staff in the Spent Fuel Project Office.

Sincerely,



William D. Travers
Executive Director
for Operations

cc: Chairman Diaz
Commissioner McGaffigan
Commissioner Merrifield
SECY

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U.S. NUCLEAR REGULATORY COMMISSION

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11. ABSTRACT *(200 words or less)*

This report contains the information presented at the Advisory Committee on Nuclear Waste Transportation Working Group (TWG) Meeting held at the U.S. Nuclear Regulatory Commission (NRC) headquarters in Rockville, Maryland, on November 19-20, 2002. Summaries of participant discussions and the presentation material provided during the meeting are included. In addition, Appendix D to this report contains information presented at the TWG Follow-On Meeting conducted on April 22, 2003.

The objective of these two meetings was to examine the technical aspects of spent fuel transportation package design, analysis, and testing to determine whether sufficient evidence exists or additional evidence needs to be obtained to substantiate that spent fuel can be transported safely. In addition, spent fuel and high-level waste (HLW) transportation experience was reviewed to determine whether the transportation packages used have performed as designed. Various national laboratories, cask vendors, industry groups, and NRC staff who have been directly involved in the transportation of spent fuel and HLW over the past 30 years made presentations at the meetings. Past and future transportation safety studies were also discussed at the meetings. Special emphasis was placed on the transportation package because, if no significant package failure occurs, there can be no significant radiation consequences.

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