

NUCLEAR WASTE TRANSPORTATION TERRORISM AND SABOTAGE: CRITICAL ISSUES

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ABSTRACT

State of Nevada Agency for Nuclear Projects (NANP) staff and contractors have been studying the potential risks of terrorism and sabotage against spent nuclear fuel and high-level radioactive waste shipments since the 1980s. NANP studies have been the basis for Nevada's petition for NRC rulemaking and for Nevada's review of the U.S. Department of Energy (DOE) Draft Environmental Impact Statement for Yucca Mountain. Based on review of the extensive literature on domestic and international terrorism, including recent DOE-sponsored studies and analyses, NANP staff and contractors have identified five critical issues for continued study:

1. Does a successful attack on a shipping cask utilizing a single high-energy explosive device constitute the maximum credible attack scenario for release of radioactive materials?
2. Can the health effects consequences of a successful attack on a shipping cask be accurately estimated without full-scale testing?
3. What methodology should be used for assessing the social and economic consequences of a successful attack resulting in release of radioactive materials?
4. Are potential adversaries likely to consider an attack resulting in massive economic impacts to have greater symbolic value than an attack resulting in many deaths?
5. Are potential adversaries likely to consider DOE shipments, or shipments to a DOE facility, to have greater symbolic value than past or current shipments?

The authors report preliminary findings and discuss research plans for these five topics.

INTRODUCTION

State of Nevada Agency for Nuclear Projects (NANP) staff and contractors have been studying the potential risks of terrorism and sabotage against spent nuclear fuel (SNF) and high-level radioactive waste (HLW) shipments since the 1980s. These studies have been focused primarily on potential risks associated with shipments to the proposed Yucca Mountain repository [1]. Based on two reports published in 1997,^a the State of

Nevada filed a petition for rulemaking with the U.S. Nuclear Regulatory Commission (NRC) in June, 1999, requesting that the NRC completely reexamine the issue of terrorism and sabotage relative to repository shipments of SNF and HLW. Nevada urged the NRC to conduct a comprehensive assessment of the consequences of 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. Nevada requested that NRC assess the full range of human health, environmental, and socioeconomic impacts of a terrorism or sabotage event resulting in a release of radioactive materials. Nevada emphasized the importance of addressing standard socioeconomic impacts, including cleanup and disposal costs and opportunity costs to affected individuals and business, as well as so-called special socioeconomic impacts, including individual and collective psychological trauma, and economic losses resulting from public perceptions of risk and stigma effects.^b

Soon after Nevada petitioned the NRC, the U.S. Department of Energy (DOE) released its Draft Environmental Impact Statement (DEIS) for Yucca Mountain in August 1999. The DEIS included an analysis of acts of sabotage, which acknowledged the vulnerability of shipping casks to attacks deploying high energy explosive devices. NANP staff and contractors prepared extensive comments on transportation terrorism and sabotage impacts as part of the State's review of the DEIS. NANP presented evidence that DOE failed to consider a credible worst-case scenario (complete perforation of the cask body by the reference weapon), underestimated by at least a factor of ten the human health impacts of the scenario evaluated (up to 150 latent cancer fatalities), and completely ignored the adverse economic impacts (\$3 billion - \$10 billion) of the expected release of radioactive materials in an urban area. These comments were formally submitted to DOE on February 28, 2000.^c

As of September 2001, neither the NRC nor the DOE have responded to Nevada's concerns. The NRC has not responded to Nevada's contentions that recent changes in the nature of the terrorist threat and the increased vulnerability of shipping casks to terrorist attacks involving high-energy explosive devices require amendment of current regulations and a thorough reexamination of sabotage consequences. The DOE has not responded to Nevada's specific comments that the sabotage scenario presented in the DEIS is unreasonably constrained, and the impacts of that scenario are insufficiently evaluated. Moreover, neither NRC nor DOE has responded to Nevada's contention that shipments to a geologic repository will be dramatically different from past shipments in the United States, and that these differences will create greater opportunities for terrorist attacks and sabotage.

CRITICAL ISSUES

NANP staff and contractors have reviewed the extensive literature on recent trends in domestic and international terrorism, including specific acts of terrorism and sabotage against energy facilities and transportation systems, and threatened terrorist use of radioactive materials and nuclear weapons. Based on review of this literature, including

recent DOE-sponsored studies and analyses, NANP staff and contractors have identified critical issues for continued study.

1. Does a successful attack on a shipping cask utilizing a single high-energy explosive device constitute the maximum credible attack scenario for release of radioactive materials?

The preliminary finding is that the maximum credible attack scenario could involve more than one high-energy explosive device applied directly to the cask, more than one missile or projectile fired against the cask, one or more explosive devices or missiles combined with an incendiary device, ignition of on-board fuel supplies in conjunction with a radioactive release, and an attack on a truck cask during fueling of the transport vehicle.

This preliminary finding is based upon NANP contractor reviews of the 1982 Sandia National Laboratories test program [2,3], the 1984 NRC proposed rulemaking [4], the current NRC design basis threat [10CFR73.1(a)(1)], and the Proposal for Development of Catalogue of Threat Scenarios for Generic Nuclear Facilities [5].

The NANP current plan of action is to issue a request for proposals (RFP) in October 2001. In addition to analysis of the four attack scenarios mentioned above, NANP will invite proposals to examine attack scenarios involving insider (employee) assistance, other varieties of sabotage, attacks on transportation infrastructure, and attacks intended to cause undetected release of radioactive materials during transit.

2. Can the health effects consequences of a successful attack on a shipping cask be accurately estimated without full-scale testing?

The preliminary finding is that full-scale testing of the actual cask to be used is necessary to determine the health effects consequences of an attack on a large rail cask. Full-scale testing may be necessary to determine the health effects consequences of an attack on shipping casks equipped with water-jacket neutron shields.

This preliminary finding is based upon NANP contractor reviews of the 1982 Sandia National Laboratories test program [2,3], the 1984 NRC proposed rulemaking [4], the 1999 DOE DEIS cask designs and SNF characteristics [6], the 1999 Sandia National Laboratories Study [7], and the current NRC design basis threat [10CFR73.1(a)(1)].

NANP plans to summarize the health effects consequences of an attack on a truck cask in the forthcoming State of Nevada Impact Report (December 2001). NANP staff and contractors will prepare a briefing paper on full-scale testing issues by December 2001.

3. What methodology should be used for assessing the social and economic consequences of a successful attack resulting in release of radioactive materials?

The preliminary finding is that there is currently no fully satisfactory methodology for assessing the full range of social and economic impacts of a successful act of sabotage. The economic model associated with RADTRAN5 provides a basis for estimating costs of compensation for damaged property and lost income, site characterization, cleanup and waste disposal. Additional research is necessary to develop reliable and valid

methodologies for assessing the social impacts of individual and collective psychological trauma, and the economic impacts of public perceptions of risk and stigma effects.

This preliminary finding is based upon NANP reviews of NRC contractor reports [8,9], and the 1988 State of Nevada Transportation Needs Assessment [10]. The evaluation of economic models is based on two reports prepared for NANP by Radioactive Waste Management Associates (RWMA) [11,12].

The NANP current plan of action is to issue a request for proposals (RFP) in October 2001. NANP is aware of related research already underway at universities and private research institutions in the United States, Austria, and Norway, and of plans for an international conference in 2002. NANP will also invite proposals from researchers who have previously studied stigma impacts on property values and business location decisions

4. Are potential adversaries likely to consider an attack resulting in massive economic impacts to have greater symbolic value than an attack resulting in many deaths?

NANP contractors are unable to make a preliminary finding based on literature reviews to date. The State of Nevada raised this issue in Docket PRM-73-10 regarding the current NRC definition of "radiological sabotage" (10 C.F.R. 73.2), which apparently excludes actions intended to cause economic damage rather than deaths or injuries. Nevada recommended that NRC amend the definition of "radiological sabotage" to explicitly include deliberate actions which cause, or are intended to cause economic damage or social disruption regardless of the extent to which public health and safety are actually endangered by exposure to radiation. Nevada contended that an incident involving an intentional release of radioactive materials, especially in a heavily populated area, could cause widespread social disruption and substantial economic losses even if there were no immediate human casualties and few projected latent cancer fatalities.

The NANP current plan is to delay action on this issue until NRC responds to the petition for rulemaking.

5. Are potential adversaries likely to consider DOE shipments, or shipments to a DOE facility, to have greater symbolic value than past or current shipments?

The preliminary finding is that a national disposal or storage facility may have greater symbolic value to terrorists than current at-reactor storage facilities, and that the enhanced symbolic value may extend to SNF shipments to such a facility. Further, a storage or disposal facility operated by DOE, the U.S. government agency responsible for producing nuclear weapons, may have greater symbolic value to terrorists as a target for attack than commercial storage facilities, and the enhanced symbolic value may extend to DOE shipments of SNF and HLW to such a facility.

This preliminary finding is based upon NANP reviews of DOE contractor reports [12,13], and a report by the U.S. Nuclear Waste Technical Review Board (NWTRB) [14].

The NANP current plan of action is to issue a request for proposals (RFP) in October 2001.

SUMMARY AND CONCLUSIONS

NANP is currently awaiting responses by NRC and DOE to previous studies regarding potential terrorism and sabotage against SNF and HLW shipments. NANP has identified five critical issues for further research. NANP will issue an RFP in October 2001 inviting researchers to prepare reports on four of these issues. NANP will summarize the findings of all previous terrorism and sabotage studies in the State of Nevada Impact Report to be Published in December 2001.

REFERENCES

- [1] Halstead, R.J., J.D. Ballard, and F. Dilger, "State of Nevada Studies of Potential Terrorism and Sabotage against Spent Fuel Shipments," WM '01 Conference, February 25-March 1, 2001, Tucson, AZ.
- [2] Sandoval, R.P., et al., An Assessment of the Safety of Spent Fuel Transportation in Urban Environs, SAND 82-2365, 1983.
- [3] Dietrich, A.M., and W.P. Walters, "Review of High Explosive Device Testing Against Spent Fuel Shipping Casks," Prepared for U.S. NRC by U.S. Army Ballistic Research Laboratory, Aberdeen Proving Ground, MD, October 13, 1983.
- [4] NRC, 10 CFR Part 73, Modification of Protection Requirements for Spent Fuel Shipments, Proposed Rule, Federal Register, Vol. 49, N. 112, June 8, 1984, 23867-23872.
- [5] Ballard, J.D., et al., Draft Proposal Prepared for Center for International Security and Cooperation, Stanford University, July 12, 2001.
- [6] U.S. DOE, Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada, DOE/EIS-0250, 1999.
- [7] Luna, R., et al., Projected Source Terms for Potential Sabotage Events Related to Spent Fuel Shipments, SAND99-0963, 1999.
- [8] Finley, N.C., et al., Transportation of Radionuclides in Urban Environs: Draft Environmental Assessment, NUREG/CR-0743, 1980.
- [9] Cluett, C., et al., Identification and Assessment of the Social Impacts of Transportation of Radioactive Materials in Urban Environs, NUREG/CR-0744, 1980.
- [10] RWMA, "Updated Truck Cask Sabotage Analysis," June 28, 2000.

[11] RWMA, "Worst Case Nuclear Waste Transportation Accident Analysis for Urban and Rural Nevada," Forthcoming, October 2001.

[12] Hoffman, B., Terrorism in the United States and the Potential Threat to Nuclear Facilities, Prepared for U.S. DOE, Rand Publication Series, R-3351-DOE, 1986.

[13] Hoffman, B., et al., A Reassessment of Potential Adversaries to U.S. Nuclear Programs, Prepared for U.S. DOE, Rand Publication Series, R-3363-DOE, 1986.

[14] NWTRB, Disposal and Storage of Spent Nuclear Fuel - Finding the Right Balance: A Report to Congress and the Secretary of Energy, March 1996.

ENDNOTES

^a The reports, J.D. Ballard, "A Preliminary Study of Sabotage and Terrorism as Transportation Risk Factors," (Sept. 1997), and R.J. Halstead and J.D. Ballard, "Nuclear Waste Transportation Security and Safety Issues: The Risk of Terrorism and Sabotage Against Repository Shipments," (Oct. 1997), can be accessed on the web at <http://www.state.nv/nucwaste/trans.htm>.

^b The text of the petition and comments submitted to the NRC are available on the web at http://3/26/01/ruleforum.llnl.gov/cgi-bin/rulemake?source=NV_PETITION.

^c NANP hearing statements and written comments on the DOE Yucca Mountain DEIS are available on the web at <http://www.state.nv.us/nucwaste/eis/yucca/index.htm>.