Full-Scale Testing of Shipping Casks

Bob Halstead
Nevada Agency for Nuclear Projects
Fred Dilger
Black Mountain Research

Presentation to
WIEB High Level Waste Committee
Portland, OR
November 5, 2004

Background Issues

Transportation System Uncertainties

- Yucca Mountain site may not have rail access by 2010, by 2016, or ever; 24 existing reactor sites could have difficulty shipping by rail
- Under the DOE Mostly Rail Scenario there could be 10,725 Cask-Shipments over 24 years (about 8 rail casks per week, shipped in 2-8 trains, plus about 1 truck cask per week; additionally there would be 2,000 + barge and/or heavy haul truck shipments from 24 reactors to rail connections)
- Under the DOE Mostly Truck Scenario there could be 53,086 Cask-Shipments over 24 years (about 6 trucks per day, plus 300 rail casks of naval SNF shipped from Idaho in 100-300 trains)
- Even if rail access is constructed, DOE could ship for up to six years using only legal weight truck (LWT) casks, either by truck or by rail
- Utilities standard contract options could result in shipment of 5-year cooled spent fuel by truck and/or by rail

Background Issues

Transportation System Hazards

- Direct SNF exposure deadly for 50+ years
- Each cask contains enormous amount of dangerous radioactive materials (180,000 to 800,000 curies of radio-cesium)
- Routine radiation from casks hazardous to workers and to some members of public
- Cask breach in worst-case accident: 5-4,000+ latent cancer fatalities (LCFs) and $300,000-10 billion+ cleanup costs
- Cask breach in successful terrorist attack: 48-1,800+ LCFs and $10 billion+ cleanup costs

Cask Testing: Current Situation

- 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)

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

Estimated Cost of Nevada Proposal for Regulatory Testing (2003 Dollars)

- Legal-Weight Truck Cask: $7.8-8.4 Million
- First Rail Cask (130 ton): $19.1-22.0 Million
- Subsequent Rail Cask: $9.1-12.0 Million
- Assume one-time cost of $10 Million to upgrade test facility to lift and drop 130 ton cask

Overall Cost of Nevada Proposal (2003 Dollars)

- Estimated Cost of regulatory testing for 4 rail casks and 1 truck cask, plus testing to failure program that includes full-scale fire test of 1 truck cask: $50-70 Million
- Estimated Cost of Yucca Mountain transportation system (38 Years): $7.5-9.5 Billion

High-Priority Cask Testing Issues to be Addressed in NRC PPS

- Extent of stakeholder participation
- Selection of cask testing facilities
- Selection of casks to be tested
- Selection of test scenarios
- Availability of funding
- Commitment to testing program

Nevada Perspective on Controversy Over Baltimore Fire Studies

- Nevada publishes report on Baltimore Fire September 2001
- Nevada raises Baltimore Fire issues relative to NRC PPS full-scale testing proposal May 2002-Present
- NRC excludes Nevada consultants from technical meetings with NRC contractors (NIST) June-August, 2002
- NRC withholds draft reports and technical analyses requested by Nevada under FOIA August 2002-April 2003
- Baltimore Fire discussed at WM'03 Conference February 2003
- Baltimore Fire discussed at NRC PPS meetings March 2003
- NRC invites Nevada consultants to meet with NRC staff and contractors, provides requested data, and initiates open and ongoing dialogue April 2003-Present
- NRC Inspector General investigation May 2003-Present

Nevada Perspective on Baltimore Fire Study Issues to be Resolved

- NIST fire model & tunnel experiments
- Significance of water main break and oxygen supply
- Fire history reconstruction (duration, temperatures, cool down period)
- Hypothetical accident conditions (e.g., cask lid proximity to hottest region of fire)
- Selection of cask(s) to be evaluated and significance of welded internal canister
- Cask and fuel performance modeling
- Implications for extra-regulatory cask testing
- Need for independent peer review

Nevada Comments on NUREG-1768 NRC PPS Draft Test Protocols

- Good stakeholder participation process though March, 2003: public meetings, transcripts, website
- The draft testing protocols are wholly unacceptable
- NRC must reissue new draft for public comment
- NRC program costs >$20 million but would not determine if two casks tested meet NRC accident performance standards
- NRC program costs >$20 million but would not determine failure thresholds of the two casks tested
- NRC program results would not validate models

  - Impact test: expected cask deformations too small to be accurately measured

  - Fire test: unclear fire duration

Nevada Recommendations to NRC Extra-regulatory Full-Scale Tests

- Test Casks to be used for Yucca Mountain Shipments (Truck-GA/4; Rail-TBD)
- Load Casks with one PWR assembly, plus dummy or surrogate assemblies and heaters (simulate 5 YR SNF)
- Rail Impact Test: Tower drop; Lid end, Center of gravity over corner impact; No impact limiter; Speed TBD, based on modeling failure (probably >75 mph)
- Truck Impact Test: Tower drop; Lid end or backbreaker, TBD; No impact limiter; Speed TBD, based on modeling failure (probably >75 mph)
- Fire Test: Engulfing fire, Minimum 3 hours @ 1800˚F (1000˚C) or 6 hours @ 1475˚F (800˚C)

Nevada Critique of SECY-04-0135, July 2004
Test Purpose

- NRC program costs up to $40 million but would not determine if cask(s) tested meet NRC accident performance standards per 10CFR71
- NRC program costs up to $40 million but would not determine failure thresholds of the cask(s) tested
- NRC program costs up to $40 but may not provide any significant data for validation of existing computer models or scaling assumptions
- NRC objective appears to be primarily pubic relations

Nevada Critique of SECY-04-0135, July 2004

Test Details

- No plan to test a truck cask
- No current basis for selection of "representative" rail cask
- No provision for meaningful stakeholder input regarding test design, cask selection, & test facility selection
- No commitment to independent peer review

Nevada Critique of SECY-04-0135, July 2004

Stakeholder and Public Confidence

Nevada Critique of SECY-04-0135, July 2004

Stakeholder and Public Confidence

- NRC acknowledges lack of stakeholder confidence
- NRC staff and contractors initially propose “extreme” testing concepts and invite stakeholder comment
- Key stakeholders provide detailed recommendations and applaud NRC commitment to participation process
- NRC rejects major stakeholder recommendations, retreats from original NRC staff and contractor testing proposals, and limits future stakeholder involvement
- Likely result: Further erosion of stakeholder and public confidence in NRC