RIC 2006

Session W4GH

Spent Fuel Management

State of Nevada Perspective on Transportation of SNF & HLW

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State of Nevada Perspective on Transportation of SNF & HLW

- SNF Transportation Hazards
- Nevada Safety & Security Recommendations
- Yucca Mountain Transportation Issues
- Baltimore Tunnel Fire
- Full-scale Cask Testing
- NAS Transportation Study

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

Spent Nuclear Fuel Transportation Hazards

- Direct SNF exposure deadly for 50+ years
- Each cask contains enormous amount of dangerous fission products (especially Cesium-137, half-life 30 years, 136,00 to 810,000 curies per cask)
- Shipping casks not tested full-scale
- 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
- Routine gamma radiation from casks hazardous to workers and to some members of public

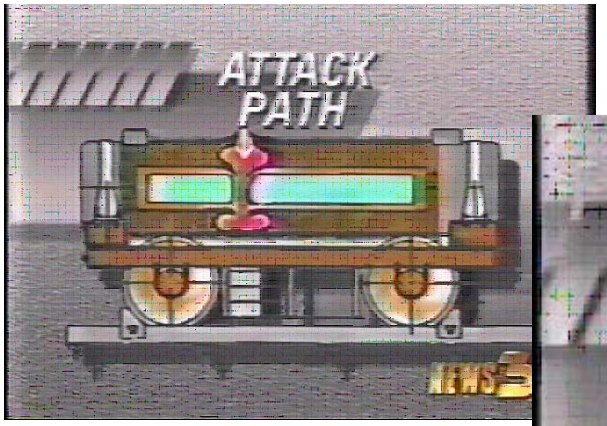
Radiological Characteristics of Spent Nuclear Fuel

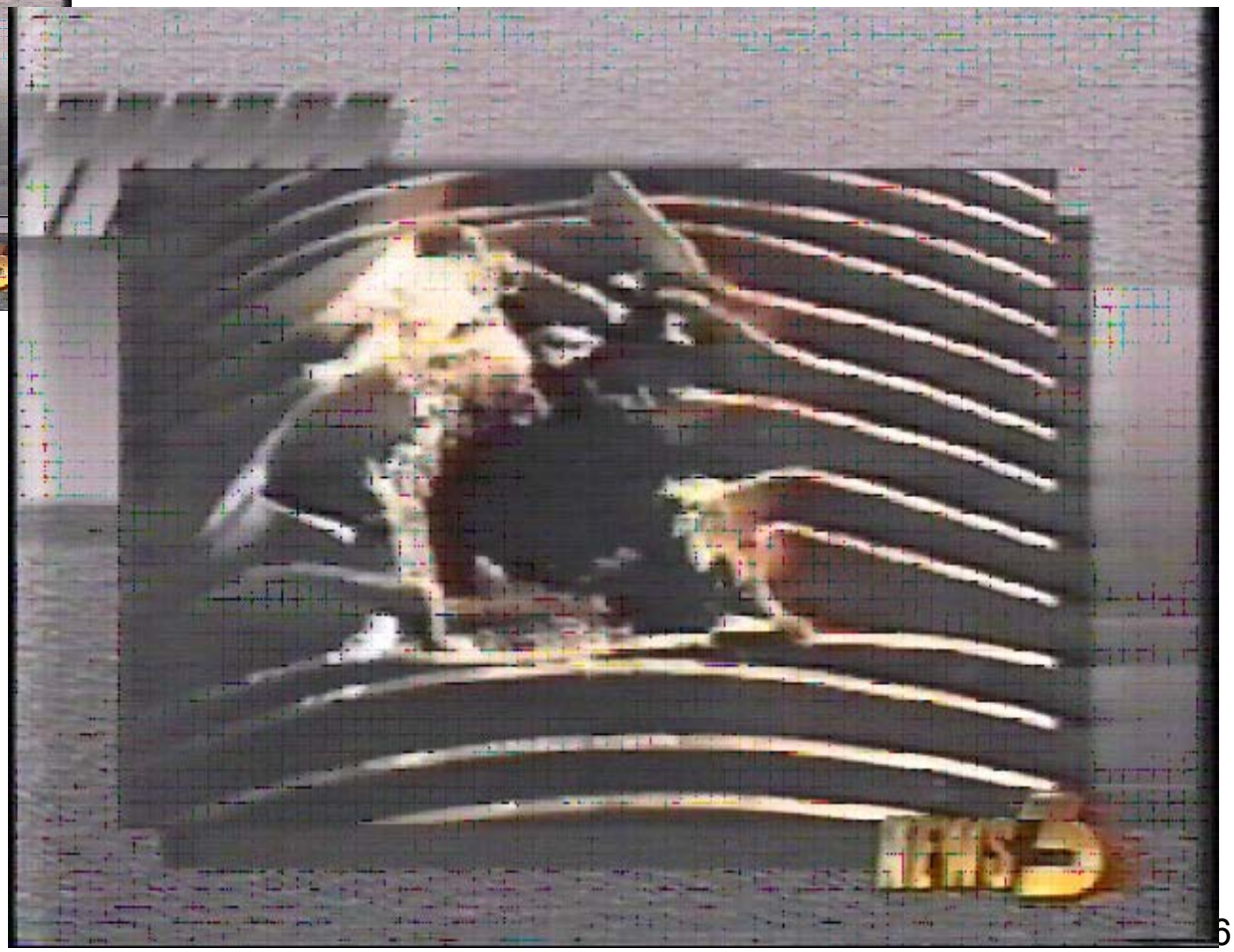
(DOE/NE-007, 1980)

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.

Cask Vulnerability in Accidents is Unclear: Baltimore 2001

Truck Cask Vulnerability in Attack Sandia Test, 1982





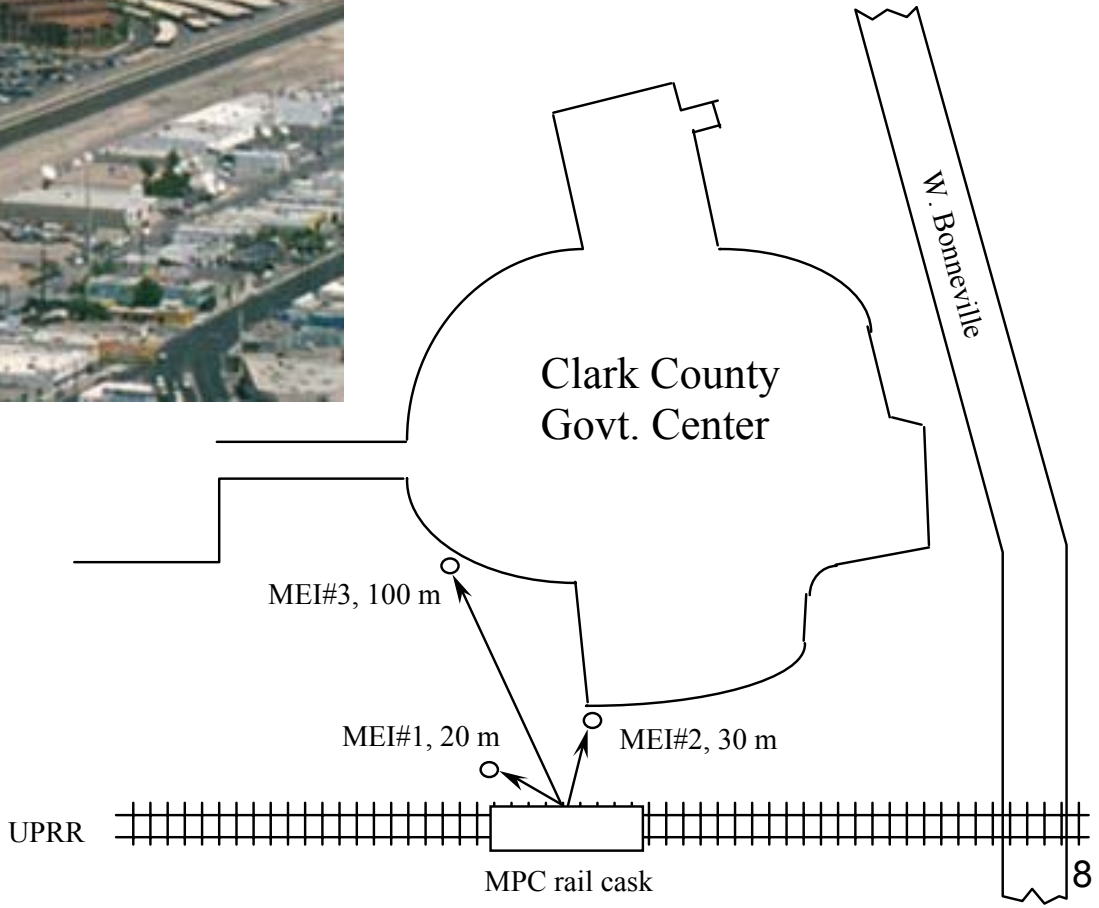
Rail Cask Vulnerability in Attack
IFC Test, 1998

Routine Radiation Exposures

Example: Clark County Government Center, Union Pacific Mainline, Las Vegas

Potential exposure per year
One cask, 48 hour stop
457 casks, one hour stop each

MEI#1 12-114 mrem/yr
MEI#2 5.2-49.4 mrem/yr
MEI#3 0.3-3.4 mrem/yr



State of Nevada Transport Safety & Security Recommendations to DOE

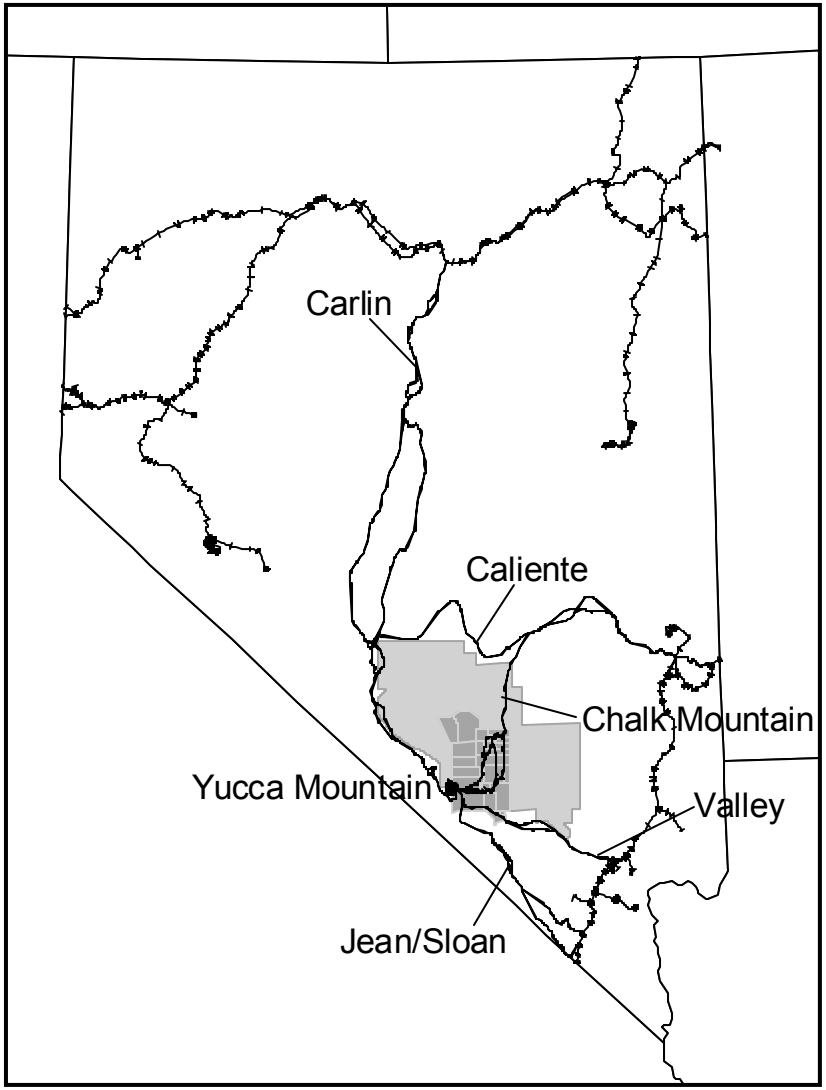
- Oldest Fuel First
- Mostly Rail (65-75%)
- Dual-Purpose Casks
- Dedicated Trains
- Full-scale Cask Testing (Regulatory & Extra-regulatory)
- NEPA Process for Selection of Rail Spur
- WIEB “Straw Man” Routing Process
- Sec 180(c) Program Rulemaking
- State Regulatory Enhancements (Safety & Perception)
- Terrorism and Sabotage Concerns

Yucca Mountain Transportation Issues

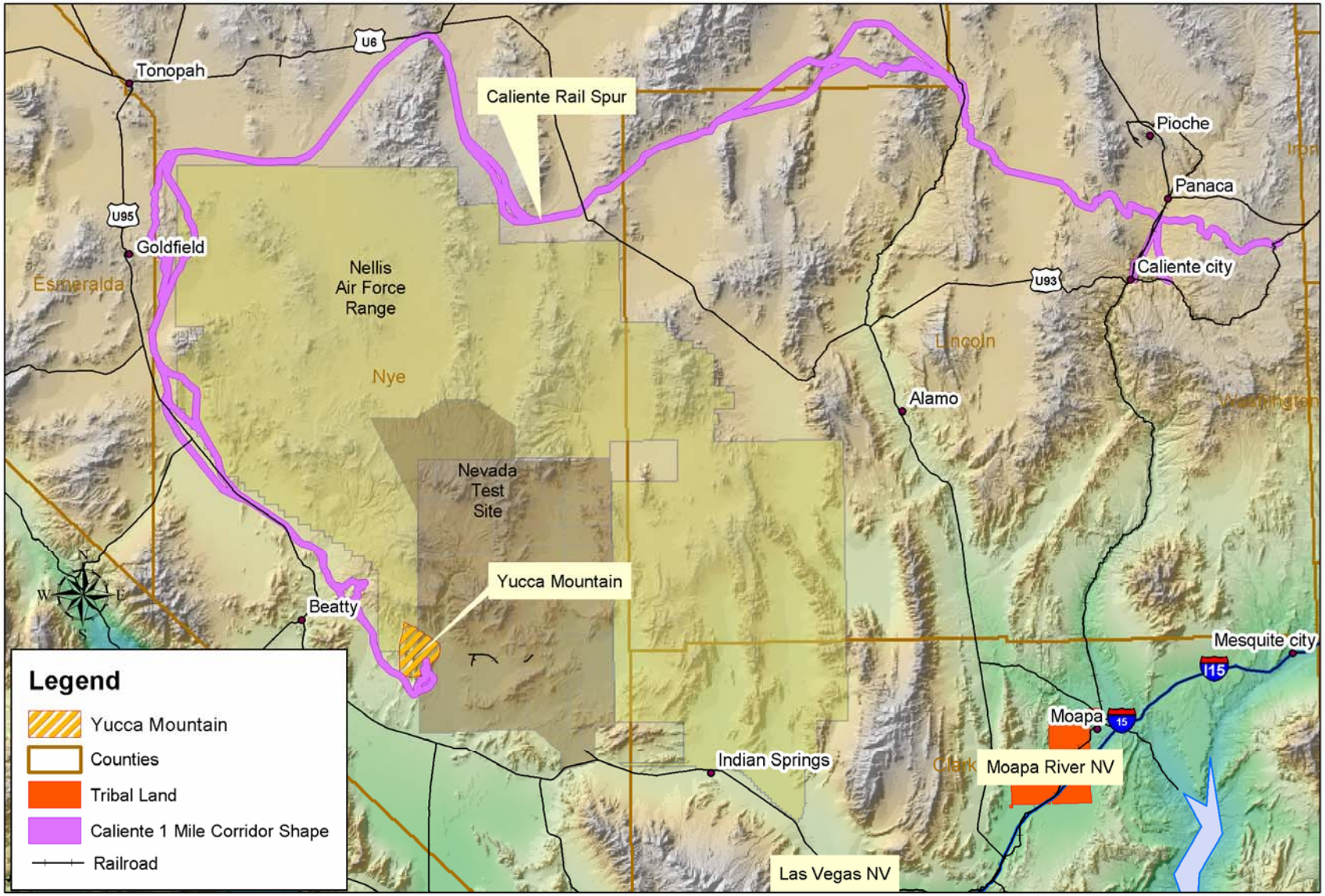
- No DOE national transportation plan
- Yucca Mountain site lacks rail access
- DOE FEIS (2002) evaluated mostly rail and mostly truck shipping scenarios for 24 & 38 years,& 5 potential rail access corridors
- DOE ROD (2004) selected mostly rail as preferred mode and Caliente Corridor as preferred rail access route
- Caliente would be longest (319 miles) new rail construction in US since 1930s (cost>$1 billion)
- Feasibility of rail transportation to Yucca Mountain has not been demonstrated

Railroad Roots: City of Caliente and Lincoln County Lobbied DOE for Rail Spur

DOE FEIS Potential Nevada Rail Routes



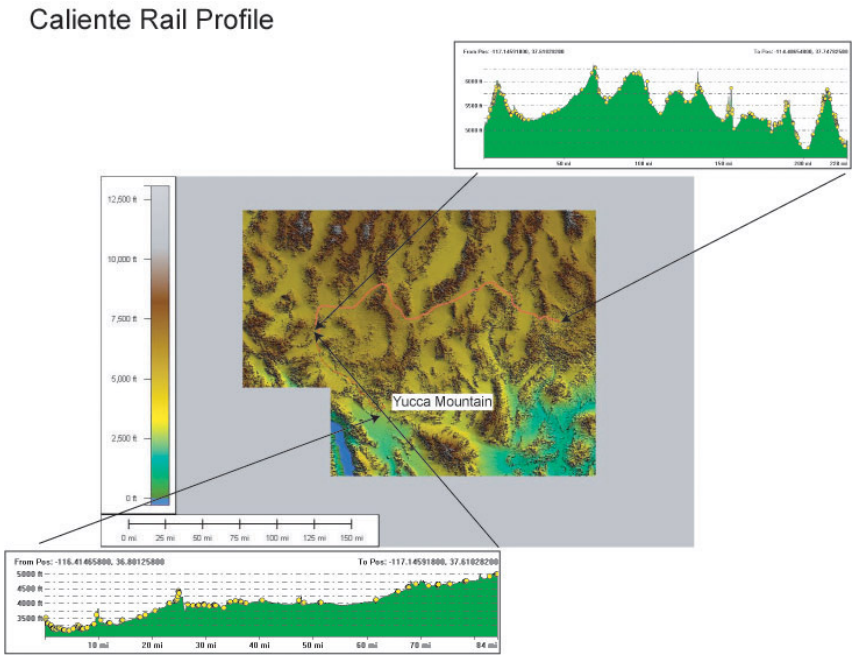
Proposed Caliente Rail Spur to Yucca Mt.

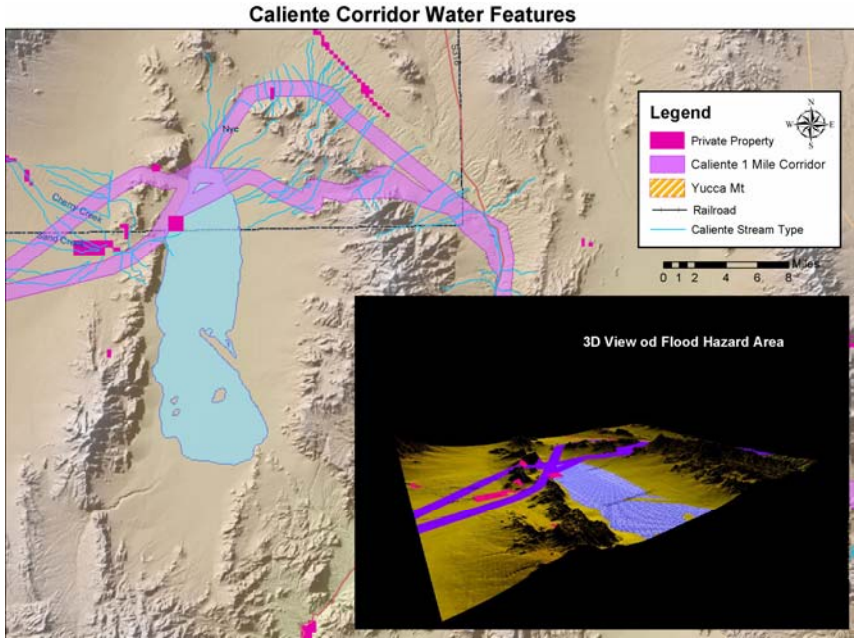


Prepared by Black Mountain Research 4/15/2005

0 15 30 60 Miles

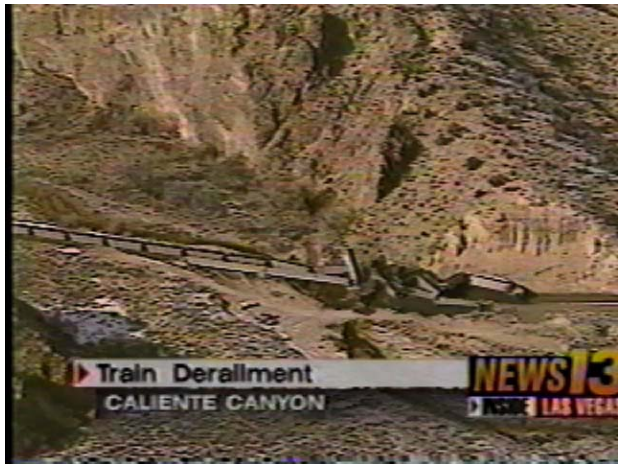
DOE Underestimated Terrain Challenges Along Caliente Corridor





DOE Failed to Evaluate Specific Land Use Conflicts Along Corridor

DOE Failed to Evaluate Safety and Reliability of UP Route to Caliente



Baltimore Tunnel Fire
Fire History and Safety Implications

- After 4 ½ years, & studies by NTSB, FEMA Fire Division, NRC, and NANP, many facts are still a matter of dispute,
- Hottest region of BTF apparently burned 2-3 hours at 1500-2000˚F or 800-1,000˚C, burned another 3-4 hours at lower temperatures, and cooled down over several days.
- BTF was NOT worst case rail fire - duration and temperature limited by water main break, oxygen supply, & other factors; tank car contained enough fuel for a 6-7 hour fire.
- BTF was a much more severe fire than the hypothetical accident fire assumed in NRC regulations – engulfing fire at 1475˚F or 800˚C for 30 minutes; hottest region of BTF burned 4-6 times longer, 25% hotter.
- BTF is relevant to Yucca Mountain – 14 tunnels within 50 miles of Caliente on the UP mainline, each rail shipment to Yucca Mountain would pass through at least 6 tunnels within Nevada alone; Potential shipments in rail casks without welded canisters, in LWT truck casks on railcars, and in general freight service.

Baltimore Tunnel Fire Concerns about NUREG/CR-6886

- NUREG/CR-6886 significantly underestimated BTF potential radiological consequences; assumed casks located at least 20 meters from the hottest region of the fire.
- Even at 20 meters distance, NUREG/CR-6886 significantly underestimated consequences for NAC LWT by assuming enclosure in ISO shipping container.
- Even at 20 meters distance, NUREG/CR-6886 may have significantly underestimated BTF potential radiological consequences for all three casks because of uncertainties in NIST FDS model, assumptions about SNF cladding performance, assumptions about release pathways from casks, and other factors; also failed to assess impacts of loss of shielding.
- If subjected to the hottest region of the BTF for its full duration, most, if not all, NRC certified shipping casks could experience failure of lid seals, neutron and gamma shielding, and fuel cladding failure, resulting in a potentially significant release and dispersion of fission products. One possible exception – the Holtec Hi Star 100 with welded canister – requires more analysis.

Baltimore Tunnel Fire Regulatory & Policy Implications

- Regulatory implications for NRC and DOT – dedicated trains should be required for ALL SNF shipments by rail, ISO containers should be required for all shipments of NAC LWT casks by rail, and additional administrative controls may be needed for rail shipments through tunnels
- Policy implications for NRC – PPS should give priority to full-scale, extra-regulatory fire testing of truck and rail casks, under most severe BTF conditions
- Policy implications for DOE – all rail shipments by dedicated train, no LWT cask on rail shipments to Yucca Mountain, evaluate use of welded canisters for all rail shipments, identify tunnels and other hazards along routes and develop risk management measures

Full-Scale Cask Testing Revised Recommendations

- Meaningful stakeholder role in development of testing protocols & selection of test facilities and personnel
- Full-scale regulatory testing (sequential drop, puncture, fire, and immersion), of each cask design to be used for repository shipments, required either for NRC certification, or for DOE procurement (Estimated cost $50-70 million total for 5-7 casks)
- Extra-regulatory fire test of LWT or Rail cask - engulfing fire, 3 hours @ 1475˚F-1800˚F (800˚C-1000˚C), followed by cool-down (Estimated cost $4-7 million)
- Determine cask and fuel failure thresholds by computer simulations and component testing (not full-scale casks)
- No need at this time to evaluate costs and benefits of destructive testing of a randomly-selected production model cask (originally recommended by NV)

Full-Scale Cask Testing Concerns about NRC PPS Test Plan

- SECY-05-0051 (SRM, 6/9/05) ignores major stakeholder concerns, even after revisions by Commissioners
- Primary focus on rail cask (no commitment to LWT cask)
- No meaningful basis for selecting currently certified rail cask “that DOE is likely to use” for Yucca Mountain
- Inadequate impact scenario (train traveling 60 mph impacts upright cask on railcar at 90-degree angle) compared to real world rail accidents, previous demonstration tests (“Operation Smash Hit”), and regulatory drop test requirements
- Post-collision fire test (30-min engulfing, optically dense, hydrocarbon) of questionable technical value & feasibility
- Cost estimate of $11.2 million (impact test only)
- Proposed test plan “is not the final word on this issue”

NAS Transportation Study Areas of General Agreement

- Most of the report's findings agree with findings previously reported by the State of Nevada, and with one notable exception, most of the report's recommendations agree with recommendations previously made by the state of Nevada.
- Nevada agrees with the report's most important overall finding, that the challenges of the repository transportation program should not be underestimated, and agrees with its most important overall recommendation, that serious consideration be given to taking the transportation program out of the DOE repository program, and perhaps out of DOE altogether
- Nevada agrees with the report's finding that special efforts will be needed to protect shipments from terrorism, sabotage, and theft, and the recommendation that wherever possible, objective information about security risks and countermeasures should be shared with elected officials and the public.

NAS Transportation Study Agreement on Risks & Impacts

- Nevada agrees that transportation risks can be reduced by shipping the oldest fuel first, maximizing use of rail transportation, requiring use of dedicated trains for rail shipments, and minimizing truck shipments
- Nevada agrees that the most significant transportation accident risks would likely involve exposure of shipping casks to long-duration, fully-engulfing fires, and that additional steps must be taken to reduce the likelihood of such accidents.
- Nevada agrees that the potential adverse social and economic impacts of repository shipments are important, and that for many members of the public, social and economic impacts (often referred to as perceived risk impacts) are as important as health and safety impacts, and that special government efforts will be needed to manage social and economic impacts.
- Nevada generally agrees with the report's recommendations, as we understand them, regarding full-scale testing of the shipping casks that would actually be used for repository shipments. However, Nevada believes that more a comprehensive testing program will be needed.

NAS Transportation Study Primary Area of Disagreement

- Nevada strongly disagrees with the report's recommendation that DOE proceed with rail access construction.
- The report apparently supports DOE's selection of the Caliente rail corridor, despite overwhelming evidence of questionable engineering feasibility, adverse safety conditions, unacceptable environmental impacts, and high construction costs. (DOE has increased its estimate of Caliente construction costs from $800 million in 2002, to $2 billion in 2005.)
- The report ignores evidence presented directly to the committee by affected Nevadans that the proposed railroad would irreparably harm ranchers, miners, and other land users.
- The report ignores evidence presented directly to the committee that selection of Caliente would likely route significant numbers of rail shipments through downtown Las Vegas, less than one-mile from the Las Vegas Strip, resulting in uniquely adverse social and economic impacts, and requiring extraordinary planning and training for emergency response.