Spent Fuel Transportation Risk Assessment (SFTRA) Draft NUREG-2125

Overview for

National Transportation Stakeholders Forum

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SFTRA Overview Contents

- Project and review teams
- Purpose and goals
- Basic methodology
- Improvements relative to previous studies
- Draft NUREG structure and format
- Routine shipment analysis and results
- Accident condition analysis and results
- Findings and conclusions
- Schedule

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SFTRA Research and Review Teams

- Sandia National Laboratory Research Team [$1.8M; 9/06-9/12]
  - Doug Ammerman – principal investigator
  - Carlos Lopez – thermal
  - Ruth Weiner – RADTRAN
- NRC's SFTRA Technical Review Team
  - Gordon Bjorkman – structural
  - Chris Bajwa – thermal and overall content
  - Bob Einziger – fuels, source term
  - Anita Gray – health physics
- Oak Ridge National Laboratories External Peer Review Team [$125K; 9/10-3/12]
  - Matt Feldman
  - Cecil Parks

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SFTRA Purpose and Goals

- Continuing review
  - Final Environmental Statement (NUREG-0170, 1977)
  - "Modal Study" (NUREG/CR-4829, 1987)
  - Reexamination of Spent Shipment Risk Estimates (NUREG/CR-6672, 2000)
- NRC's safety mission
  - Considering public comment, provide updated basis for NRC's safety regulations applicable to spent fuel transportation
- Outreach responsibilities
  - Reassure public regarding spent fuel shipments
    - Basic message: Risks are low, so safety is high
    - Improve public understanding and acceptance of spent fuel shipments
- Update benchmark for environmental assessments
- Potential shipments
  - Significant issue when study began (2006) – much less so now (post Yucca Mtn curtailment)
  - Applicable to future shipments
- SFTRA is not
  - Driven by any external requirement or commitment
  - An EIS or major federal action
  - Required for any licensing action, nor does it contain any regulatory proposals
  - An analysis of transport security

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SFTRA Basic Methodology

- Radiological impacts of spent nuclear fuel (SNF) shipments
  - Routine conditions
    - Determine doses to various populations from cask during routine transport
  - Accident conditions
    - Perform finite element analysis of cask response to impact and thermal accident conditions
    - Use “event trees” developed by U.S. DOT to estimate probabilities of accident conditions
- Use RADTRAN to calculate routine doses and accident dose risks for representative truck and rail shipments
- Approach similar to that in NUREG-0170 and NUREG/CR-6672

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SFTRA Enhancements Over Previous NRC Spent Fuel Risk Studies

- New rail and truck event trees
- RADTRAN new Version 6:
  - Elevated (plume) releases
  - New loss of shielding analysis
- Updated population data (2000 Census; trying to revise to 2010 Census pending WebTRAGIS update)
- Updated traffic density and accident data for truck and rail
- High-fidelity cask finite element models of NRC-certified casks
  - NAC-STC (26 PWR, 130 ton rail-lead)
  - HI-STAR 100 (24 PWR,140 ton rail-steel)
- Direct loaded fuel and welded inner canister fuel
- More precise structural (e.g., bolt model) and thermal (e.g., 3-D) analyses
  - improved estimate of cask-to-environment release fractions

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SFTRA Report Structure and Format

- Audience
  - Public, media, industry, state and tribal governments, elected officials, and federal agencies
- Graded structure and content
- Executive Summary and Public Summary [All audiences]
- Main body text [informed public, science media]
- Appendices [industry, other federal agencies]
- Electronic and printed versions of SFTRA
  - NRC ADAMS Accession Number: **ML12125A218**
  - Printed Draft NUREG in black and white only (CD inside back cover will contain color version)
  - Printed Final NUREG in full color

Sample SFTRA Shipment Routes

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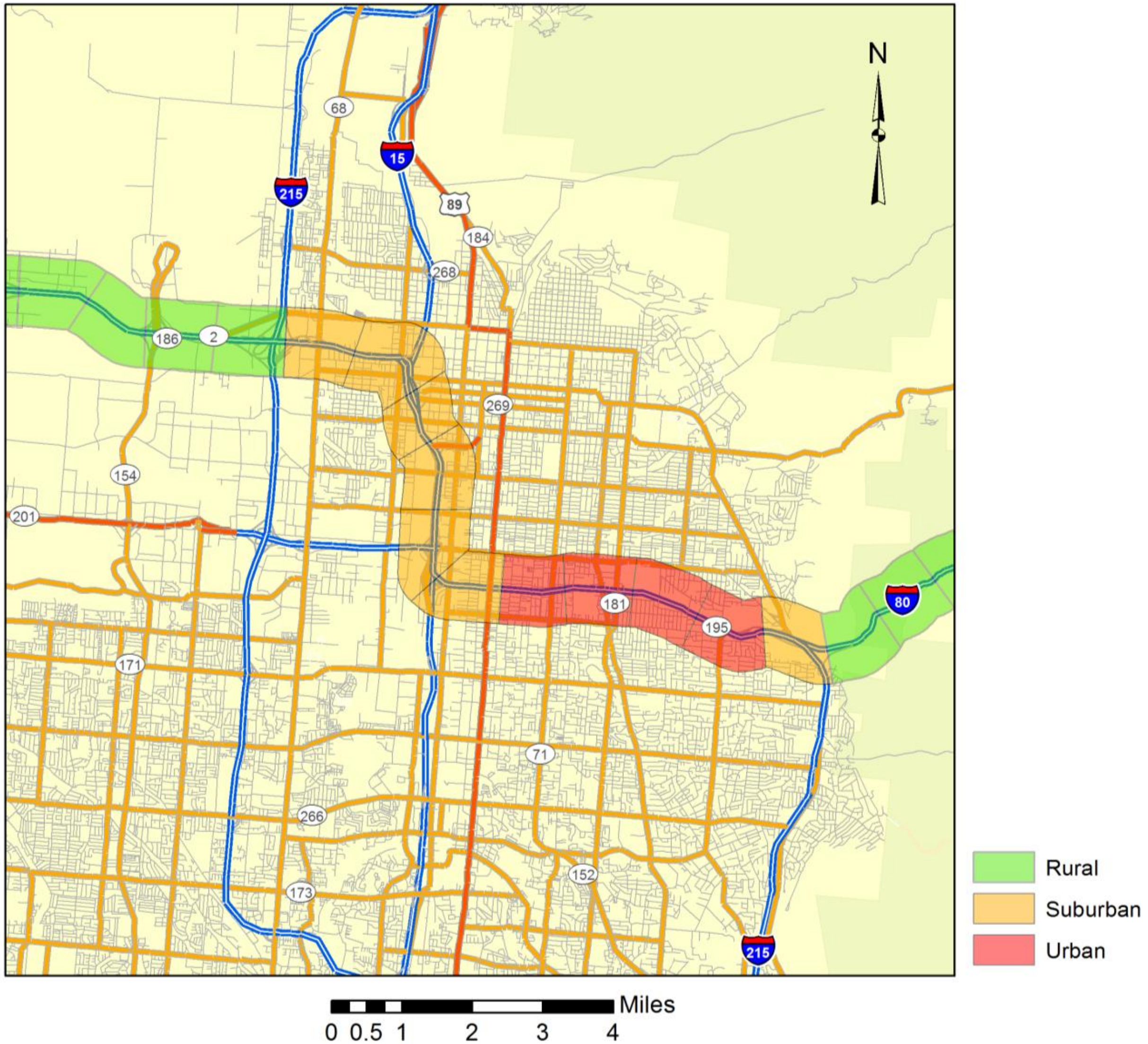
Routine Conditions: Illustration of Truck Route

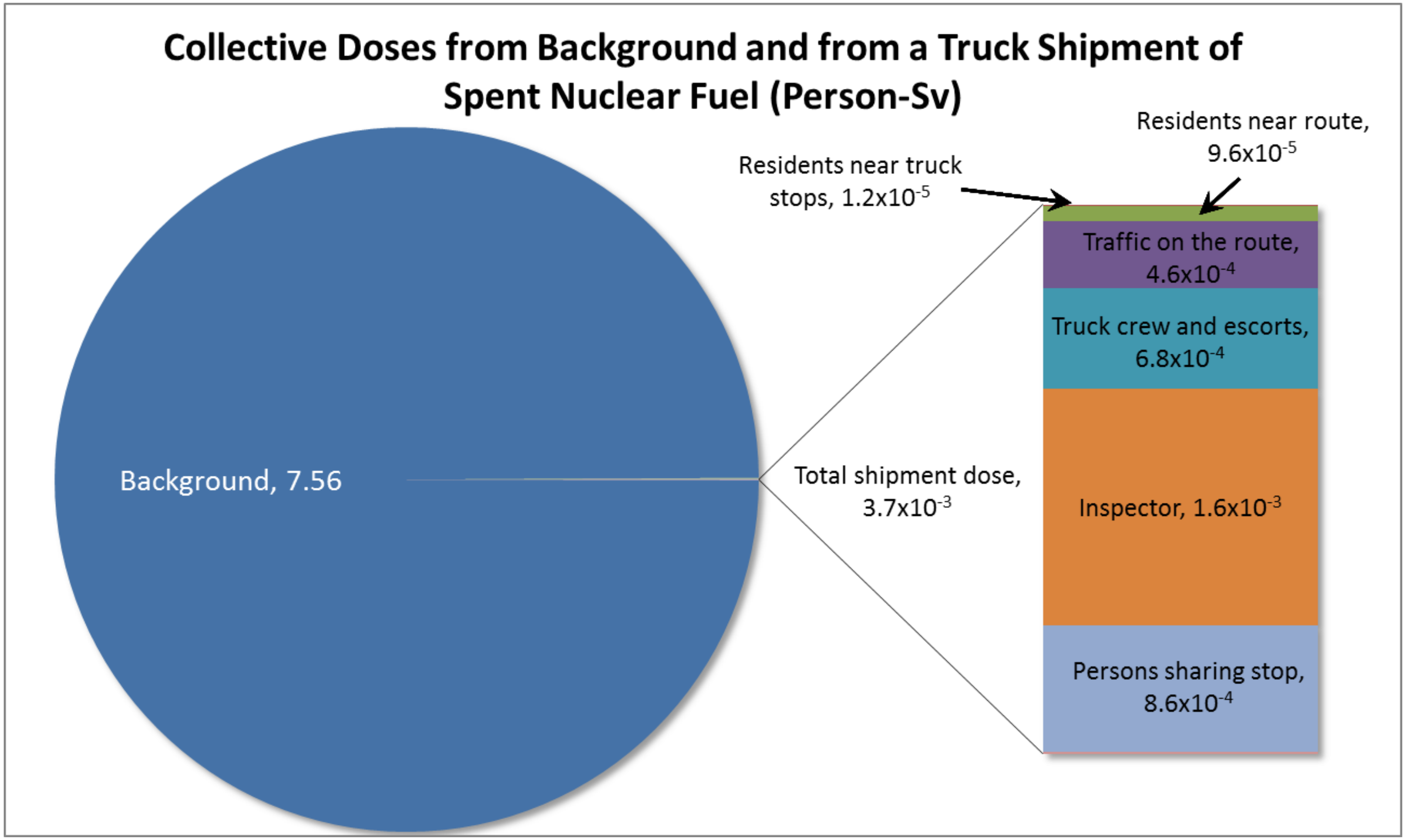
- Route segment lengths and population densities
- WebTRAGIS

I-80 Corridor
Salt Lake City



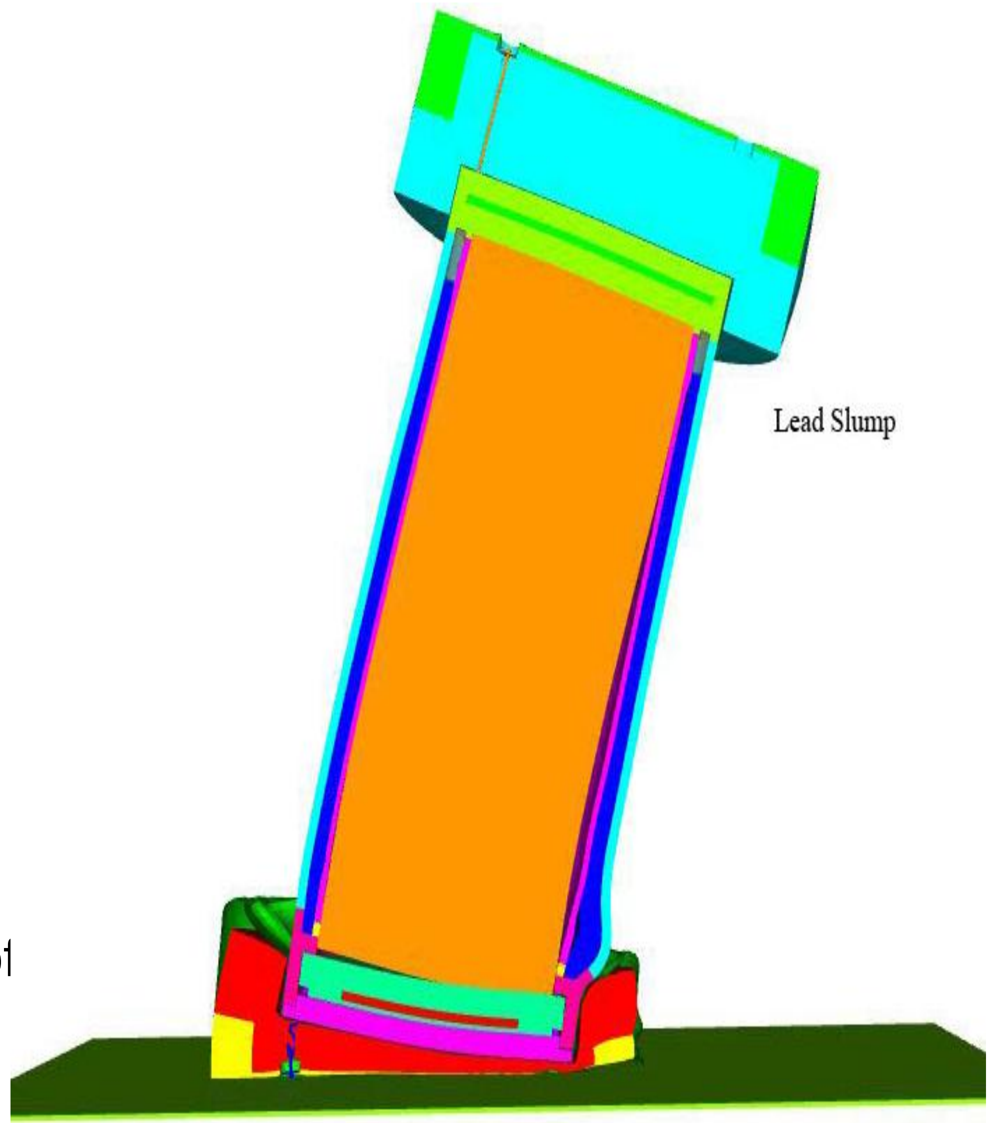
Routine Condition Results:

Illustration for Maine Yankee to ORNL truck shipment



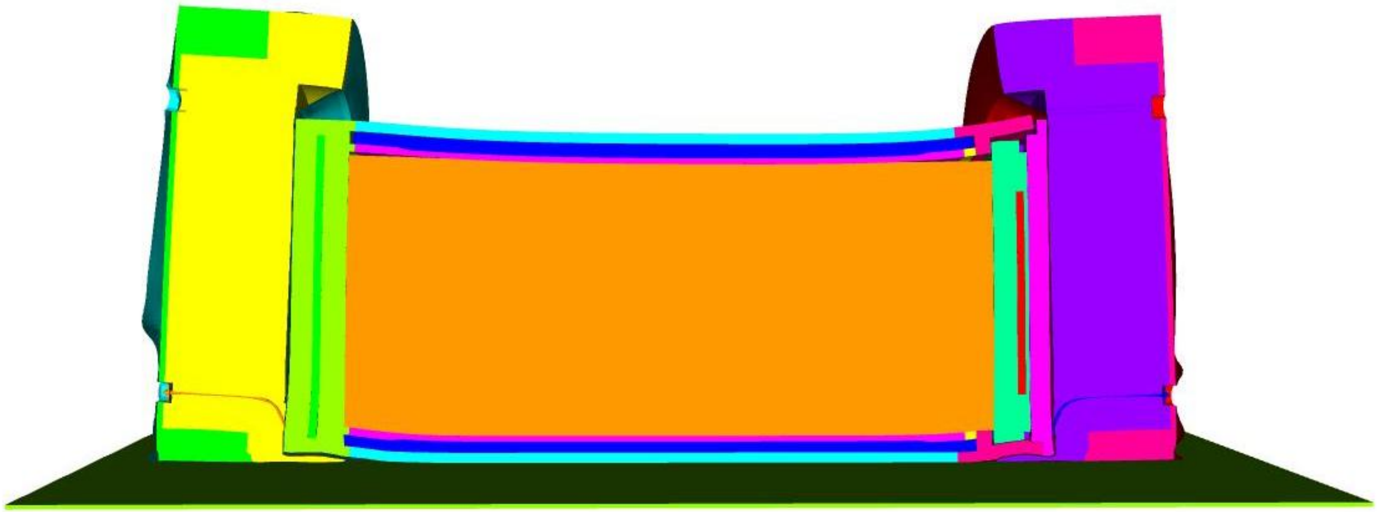
Rail-Lead Cask Impact Accident

- **Rail-Steel cask (welded inner fuel canister) does not form leakpath under any impact conditions analyzed**
- **Deformed shape of the Rail-Lead cask following the 193 kph (120 mph) impact onto an unyielding target in the corner orientation**
  - No leakpath is formed so there is no release of contents



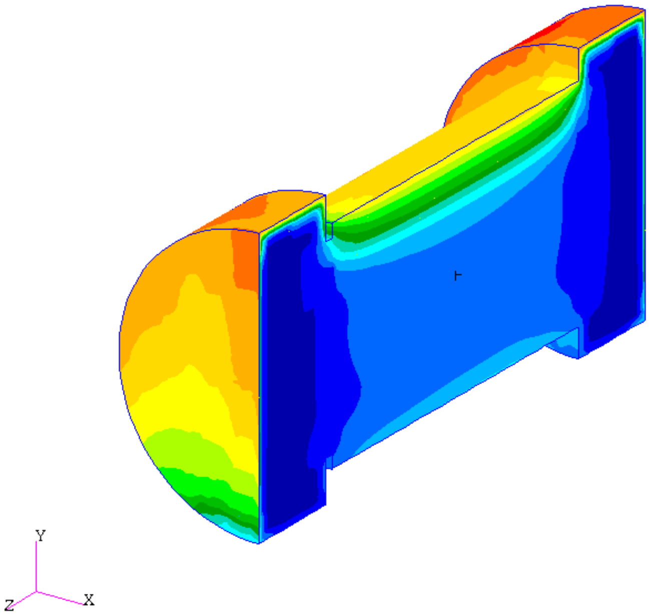
Rail-Lead Cask Impact Accident

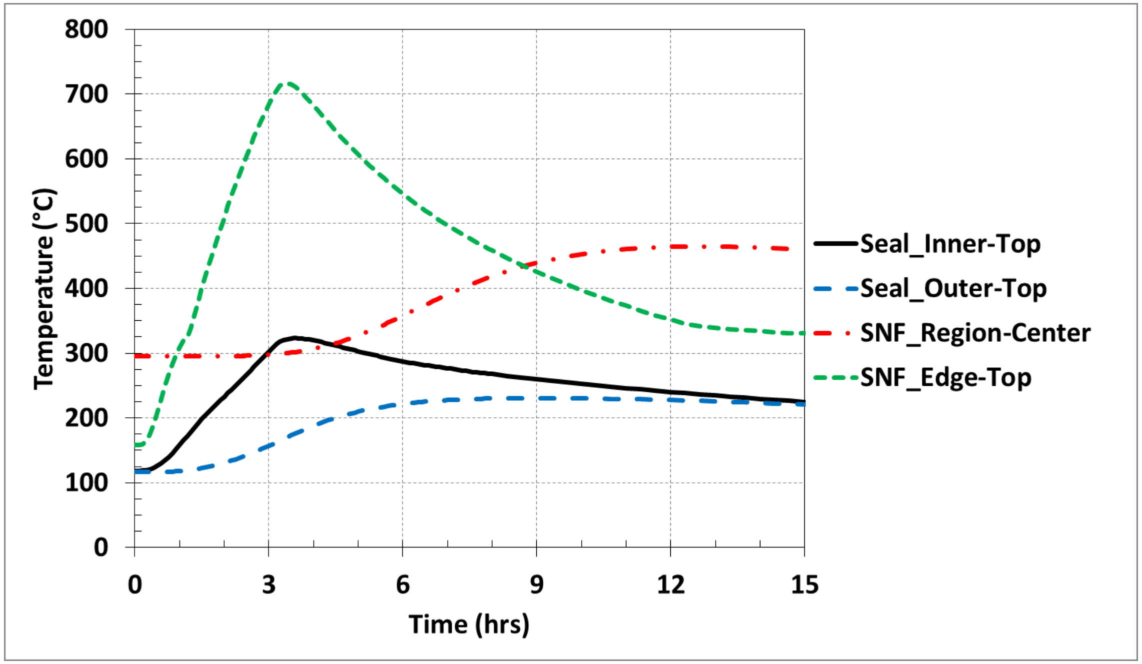
- **Deformed shape in <u>side orientation</u> following a 145 kph (<u>90 mph</u>) impact onto an <u>unyielding</u> target.**
  - Only cask and orientation resulting in a leakpath
  - 60 mph result shows no leakpath, but 60 mph impact into hard rock is assumed to result in a leakpath
  - 115 mph into non-hard rock would be required to result in a leakpath
    - No recorded accidents at this velocity



Rail-Lead Cask Fire Accident

After 3-hour concentric fire:

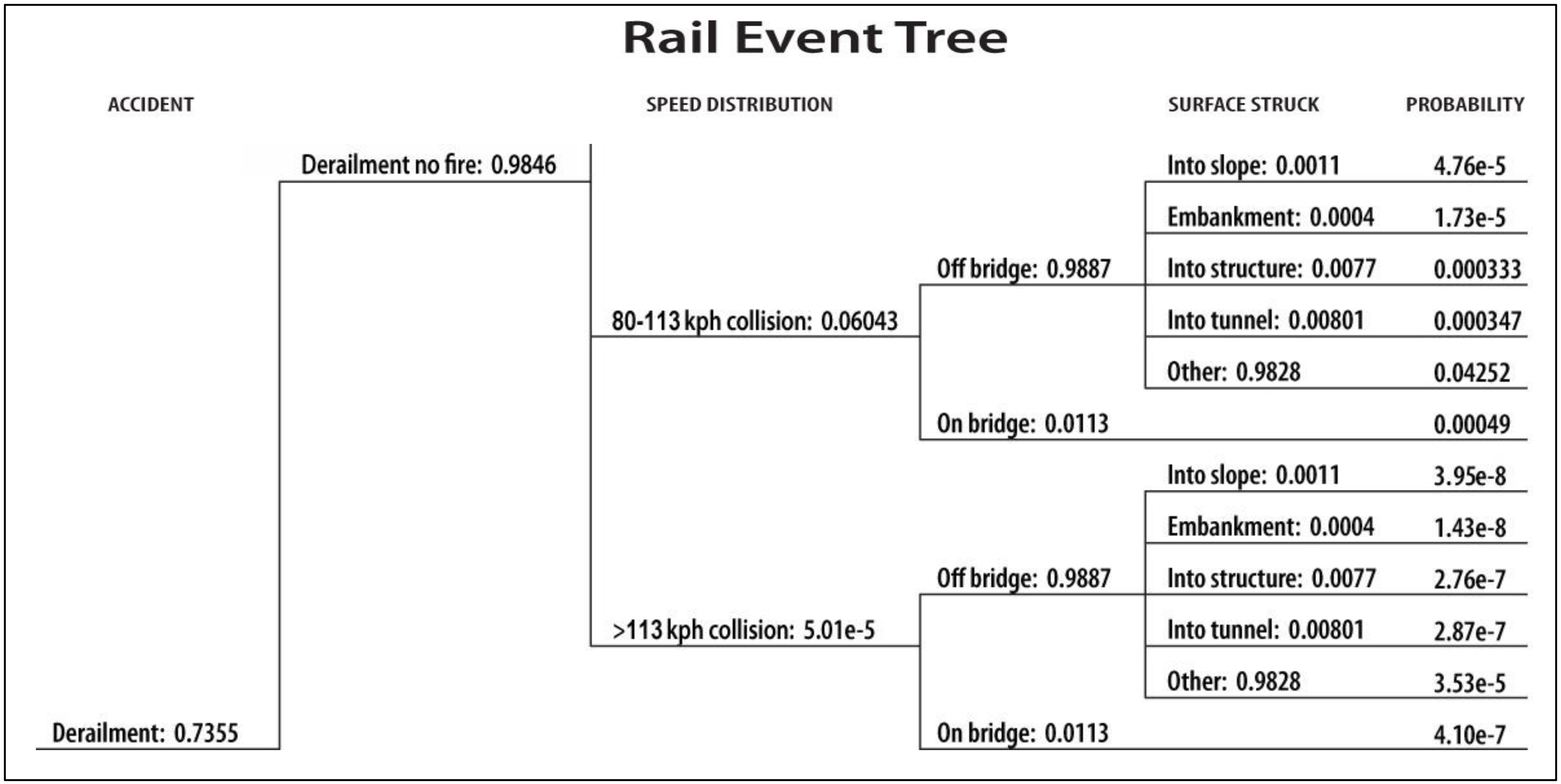




Rail-Lead Cask Fire Accident

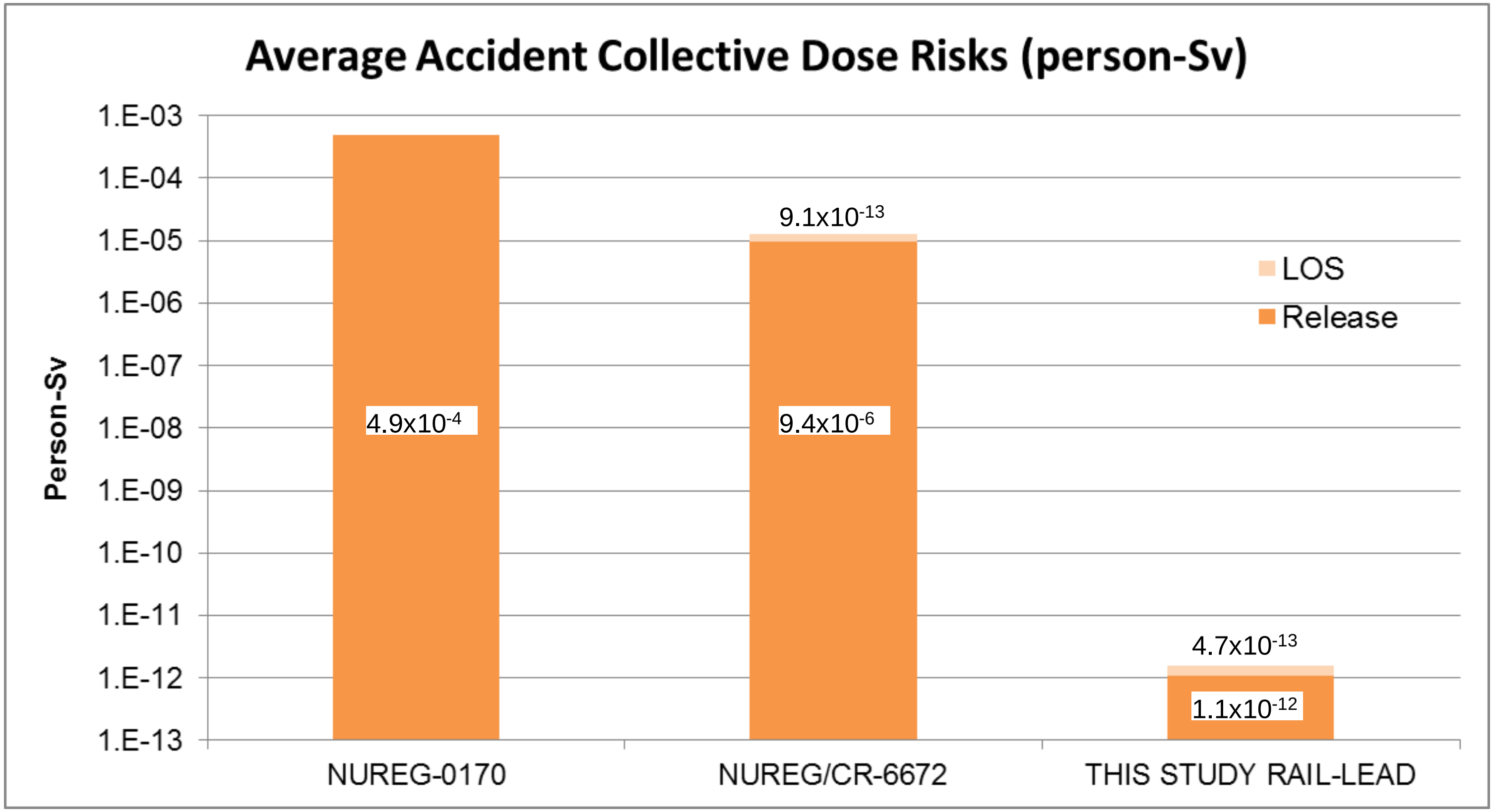
- **Rail-Lead cask is capable of protecting the fuel rods from burst rupture** and of maintaining containment when exposed to the severe fire environments analyzed.
- **Some reduction of gamma shielding is estimated to occur in two cases.** Partial loss of lead shielding is expected when the cask is exposed to
  - a concentric fire that burns longer than 65 minutes
  - a fire offset by 3 meters (10 feet) and that burns for longer than 2 hours and 15 minutes.
- **No release of radioactive material is expected if this cask was exposed to any of the severe fire environments analyzed** because the elastomeric seals did not reach their temperature limit, thus preventing any radioactive material release.

Accident Conditions: U.S. DOT Rail Accident Event Tree Segment



Accident Condition Results:

Accident collective dose risks from release and loss of gamma shielding (LOS) accidents. The LOS bars are not to scale.



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SFTRA Findings

- The collective dose risks from routine transportation are vanishingly small. **Theses doses are about four to five orders of magnitude less than collective background radiation dose over the same time period and exposed population as the shipment.**
- The routes selected for this study adequately represent the routes for spent nuclear fuel transport, and there was relatively little variation in the risks per kilometer over these routes.
- **Radioactive material would not be released in an accident if the fuel is contained in an inner welded canister inside the cask.**
- Only rail casks without inner welded canisters would release radioactive material, and only then in exceptionally severe accidents.
- If there were an accident during a spent fuel shipment with a cask that does not include an inner welded canister, there is only about one in a billion chance the accident would result in a release of radioactive material.
- **If there were a release of radioactive material in a spent fuel shipment accident, the dose to the maximum exposed individual would be non-fatal.**

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SFTRA Conclusion **(pending resolution of public comments)**

- Based on these findings, **this study reconfirms that estimated radiological impacts from spent fuel transportation *conducted in compliance* with NRC regulations are low**, in fact generally less than previous, already low, estimates.

  Accordingly, with respect to spent fuel transportation, the previous NRC conclusion that the **regulations for transportation of radioactive material are adequate to protect the public against unreasonable risk is also reconfirmed by this study**.

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SFTRA Current Schedule

Milestone	Date
1. Publish Notice for comment in Federal Register	5/14/2012 (completed)
2. Public comments due	7/13/2012
3. Response to public comments (SFTRA Rev 3.0)	8/15/2012
4. Final Draft (SFTRA Rev. 4.0)	9/30/2012
5. NRC publishes Final SFTRA	by 12/31/2012

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Comments on Draft Report

- ADAMS Accession Number for Draft NUREG-2125 : **ML12125A218**

- Federal Register Notice**: 77 FR 28406**, May 14, 2012

- You may submit comments by the following methods:
  - **Federal Rulemaking Web site:** Go to *http://www.regulations.gov* and search for Docket ID **NRC-2012-0108**.
  - **Mail comments to:** Cindy Bladey, Chief, Rules, Announcements, and Directives Branch (RADB), Office of Administration, Mail Stop: TWB-05-B01M, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.
  - **Fax comments to:** RADB at 301-492-3446.