Repository Perspective

Peter Swift
Sandia National Laboratories

DOE Fusion-Fission Hybrid Workshop
Gaithersburg, MD
October 1, 2009

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000. The content of this presentation reflects the views of the author and does not necessarily reflect the views or policies of the United States Department of Energy or Sandia National Laboratories

Background

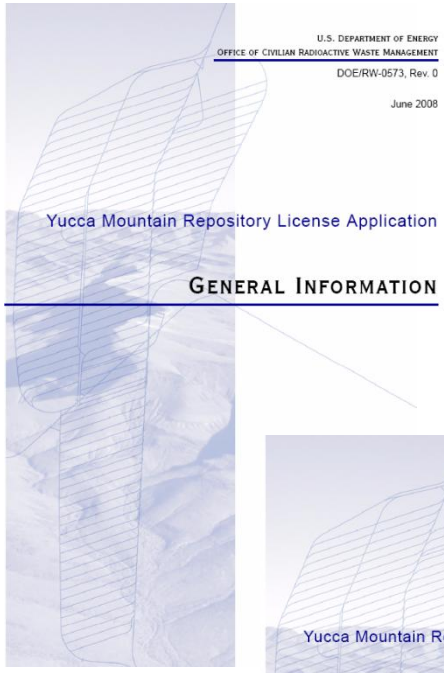
- All nuclear power options generate waste requiring long-term isolation from the biosphere
  - Interim storage followed by disposal in mined repositories is the option being pursued by most nations
  - Deep boreholes are a potential alternative disposal strategy
- World-wide, no repositories for used nuclear fuel or high-level radioactive waste are in operation
- Detailed safety assessments are available for at least three different disposal concepts
  - Granite (Sweden), clay (France), tuff (USA)
  - All show estimates of long-term performance well below regulatory limits (and far below natural background)
  - Performance estimates are available for both used fuel and vitrified high-level waste

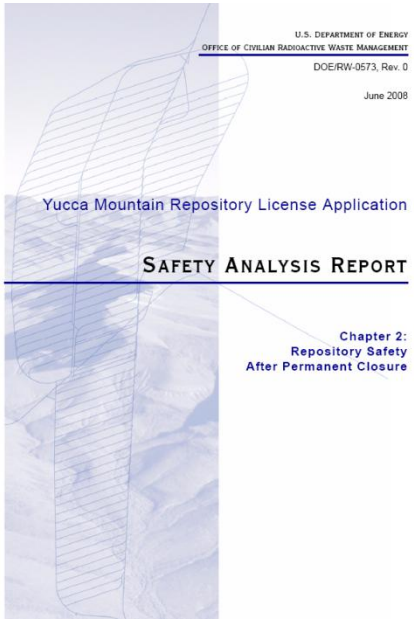
Yucca Mountain Repository License Application

DOE/RW-0573 Rev 0 June 3 2008
DOE/RW-0573 Rev 1 February 19 2009

- **General Information (GI)**
  - **General Description**
  - **Proposed Schedules for Construction, Receipt and Emplacement of Waste**
  - **Physical Protection Plan**
  - **Material Control and Accounting Program**
  - **Site Characterization**

- **Safety Analysis Report (SAR)**
  - **Repository Safety Before Permanent Closure**
  - **Repository Safety After Permanent Closure**
  - **Research and Development Program to Resolve Safety Questions**
  - **Performance Confirmation Program**
  - **Administrative and Programmatic Requirements**





Available from the NRC
http://www.nrc.gov/waste/hlw-disposal/yucca-lic-app.html#appdocuments

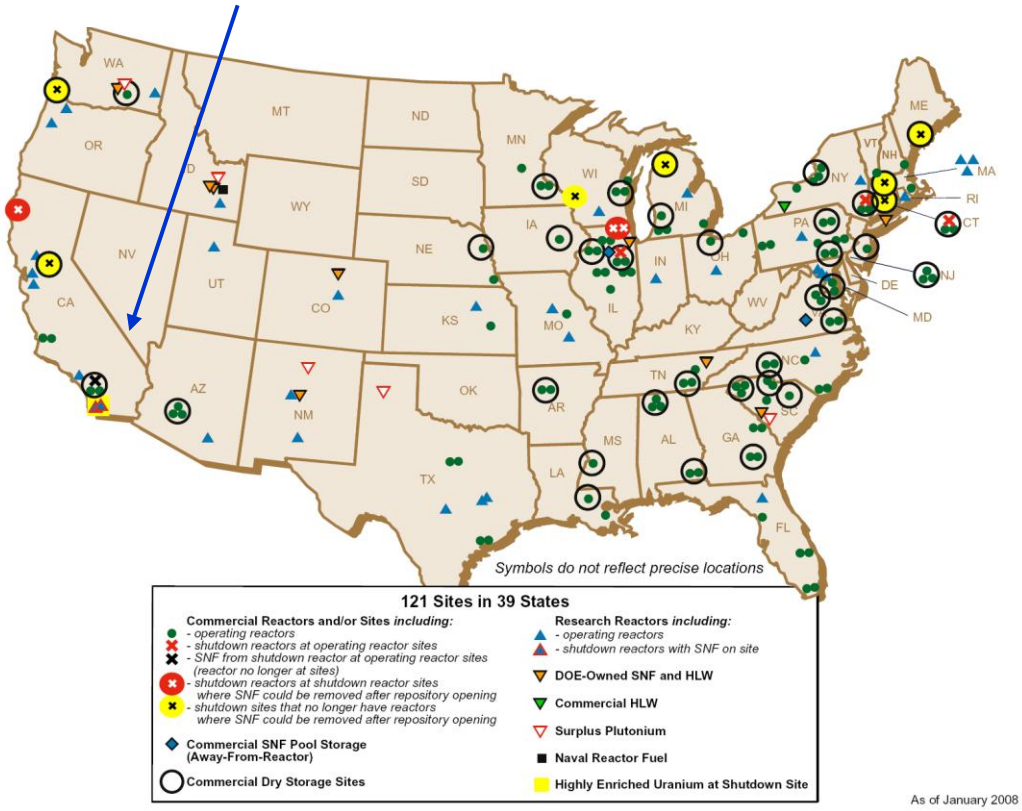
Spent Nuclear Fuel and High-Level Radioactive Waste in the United States

Current locations of spent nuclear fuel (SNF) and high-level radioactive waste (HLW) destined for geologic disposal:

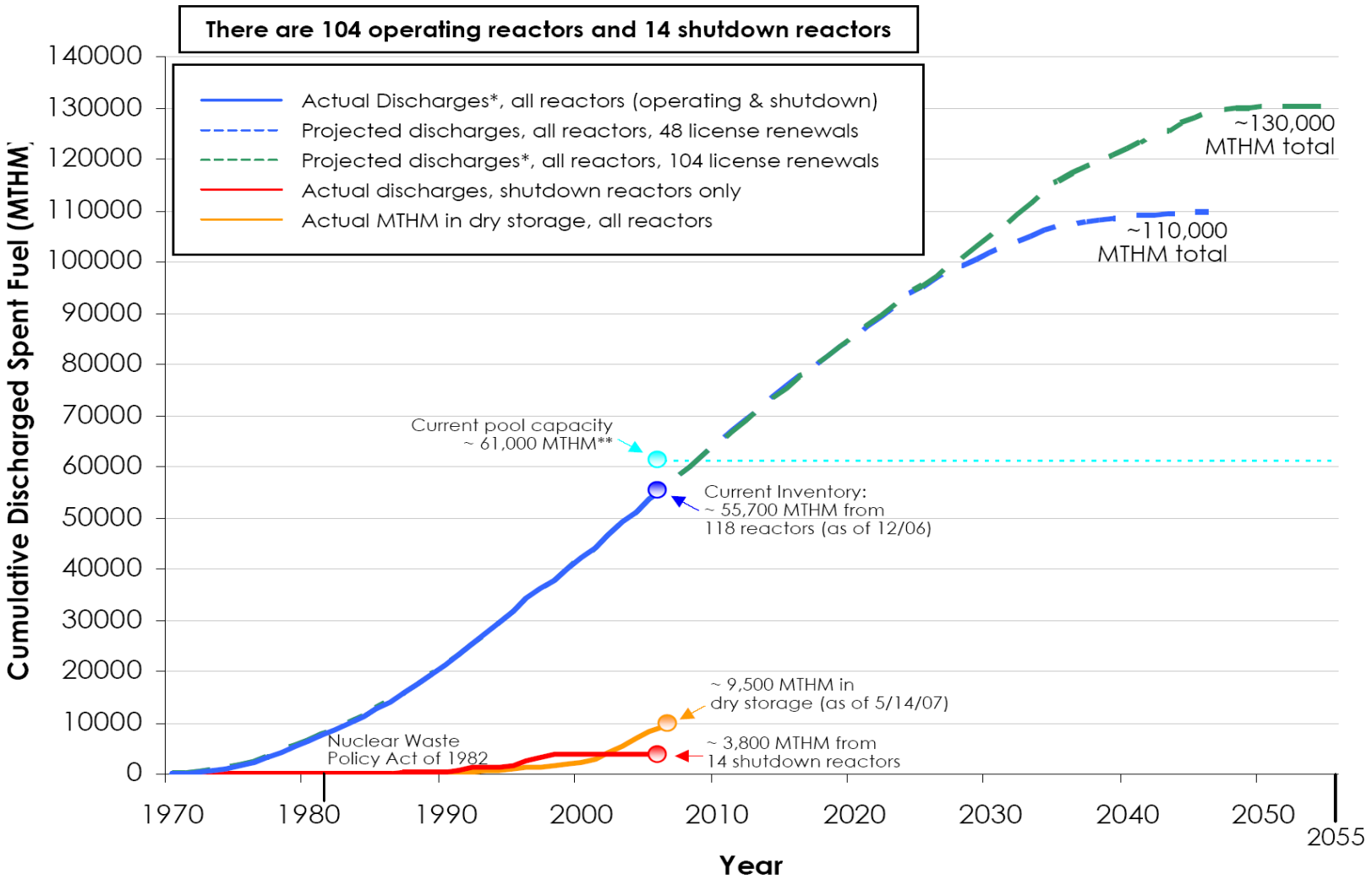
121 sites in 39 states

United States Department of Energy (DOE) Office of Civilian Radioactive Waste Management (OCRWM) Mission: to manage and dispose of high-level radioactive waste and spent nuclear fuel in a manner that protects health, safety, and the environment; enhances national and energy security; and merits public confidence.

Proposed Yucca Mountain Repository

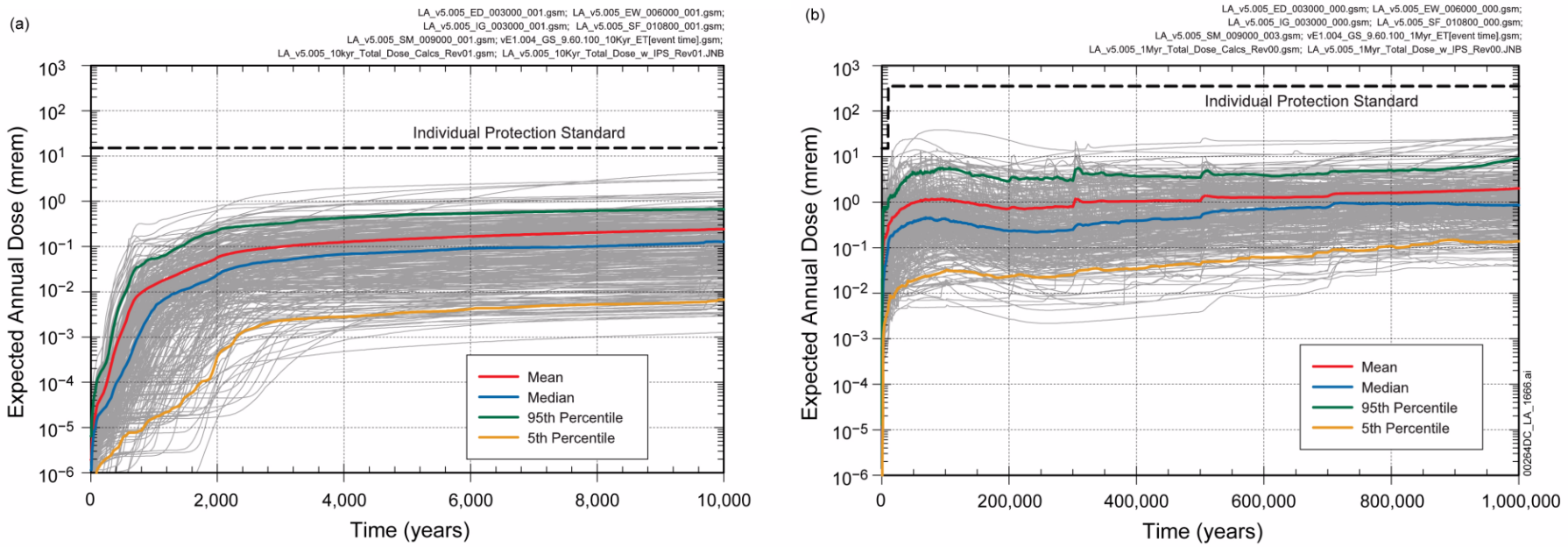


Historical and Projected Commercial Spent Nuclear Fuel Discharges (as of 05/21/07)



TSPA-LA Results

Total Mean Annual Dose



DOE/RW-0573 Rev 0 Figure 2.4-10

10,000 years

10,000-year Standard:
Mean annual dose no more than 0.15 mSv (15 mrem)

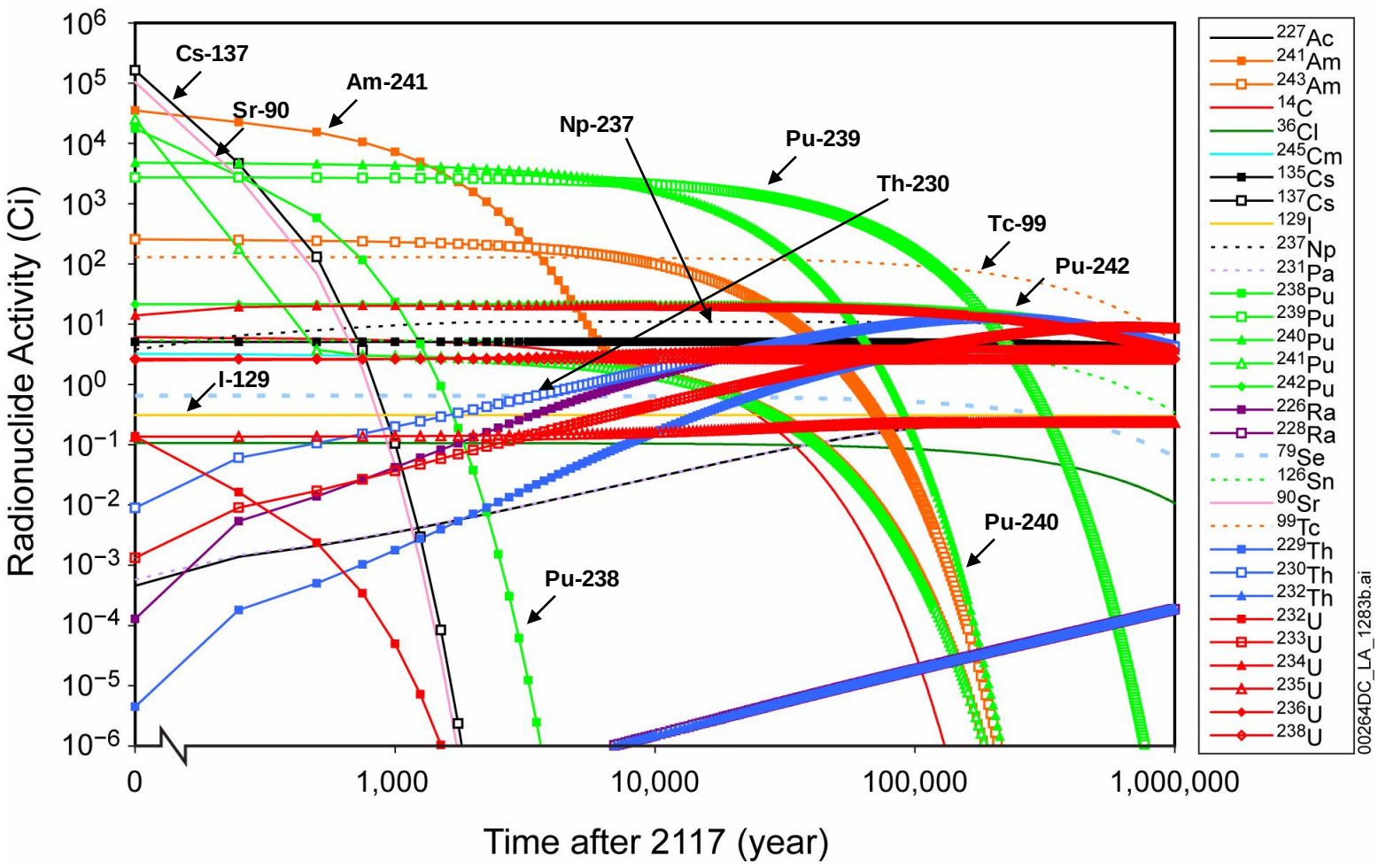
TSPA-LA estimated 10,000 yr maximum mean annual dose: 0.0024 mSv (0.24 mrem)

1,000,000 years

1,000,000-year Standard:
Mean annual dose no more than 1 mSv (100 mrem)

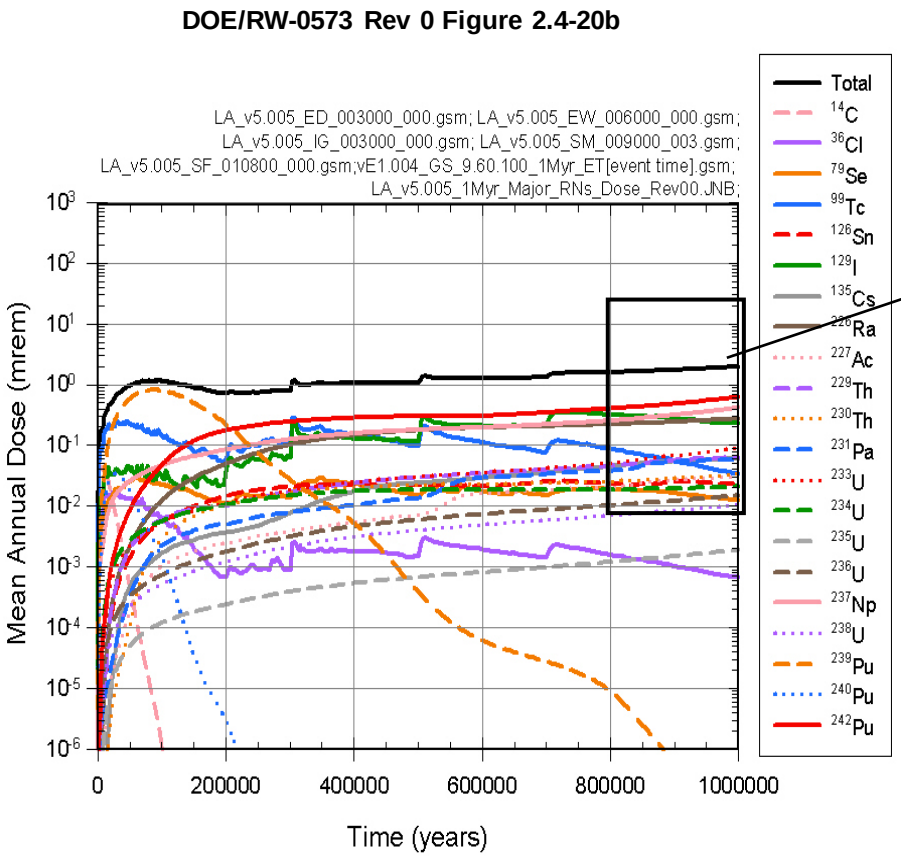
TSPA-LA estimated 1,000,000- yr maximum mean annual dose: 0.02 mSv (2.0 mrem)

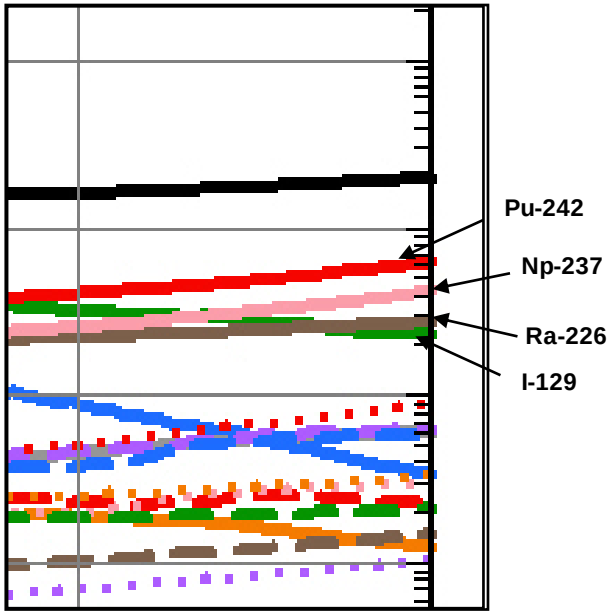
Commercial Used Nuclear Fuel Decay History



DOE/RW-0573 Rev 0, Figure 2.3.7-11, inventory shown for an single representative Yucca Mountain used fuel waste package

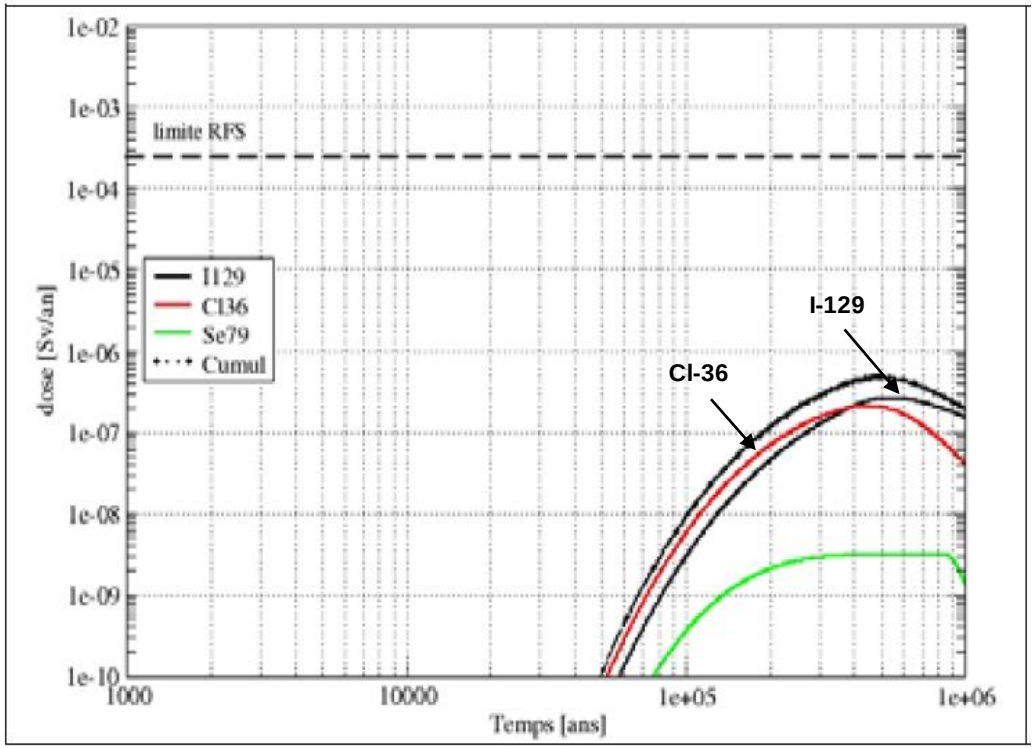
Contributors to total dose: Yucca Mountain





I-129 contribution at 1 Myr ~ 1/10th of total

Contributors to total dose: Meuse / Haute Marne Site



I-129 is the dominant contributor at peak dose (example shown for glass waste only)

ANDRA 2005, *Dossier 2005: Argile. Tome: Evaluation of the Feasibility of a Geological Repository in an Argillaceous Formation*, Figure 5.5-22, SEN million year model, C1+C2 vitrified waste

Contributors to total dose: Forsmark site

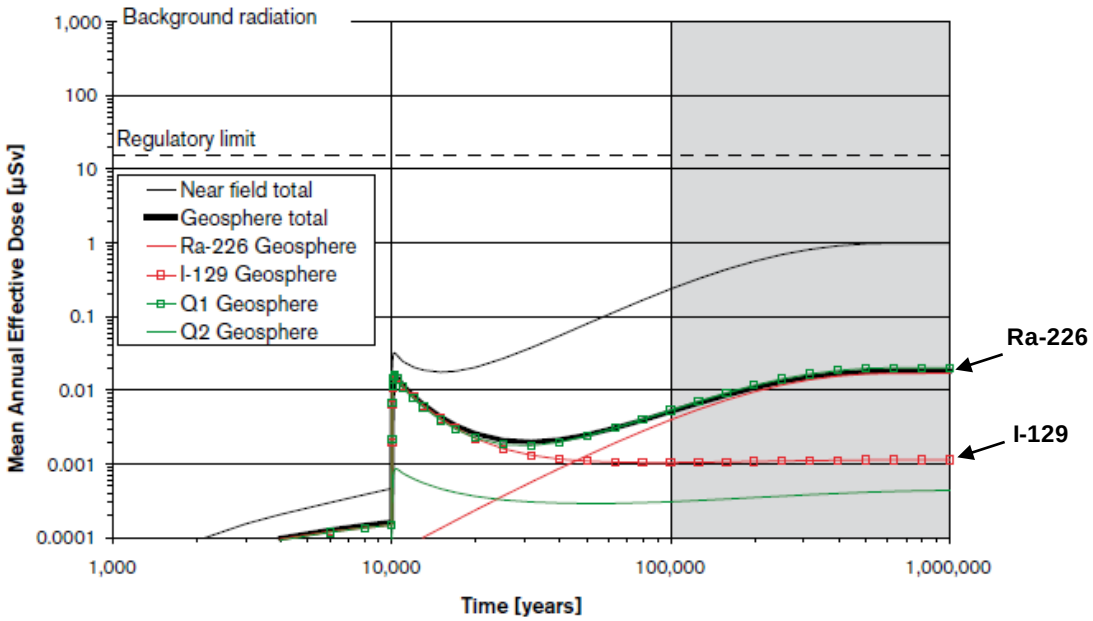


Figure 10-18. The Forsmark pinhole failure base case (geosphere total, i.e. LDF values applied to releases from the far-field model) decomposed with respect to dominant nuclides (Ra-226 and I-129) and release paths (Q1 and Q2). The effect of discarding geosphere retention is also shown (near field total, i.e. LDF applied to releases from the near field model). 10,000 realisations analytic model.

Early peak from rapid release of I-129 when package fails (assumed at 10,000 yr for this case)

Long-term peak from Ra-226 controlled by fuel dissolution and diffusion through buffer

SKB 2006, *Long-term Safety for KBS-3 Repositories at Forsmark and Laxemar—a First Evaluation*, TR-06-09, Figure 10-18

Conclusions

- Used nuclear fuel and high-level radioactive waste will continue to be safely managed in the United States with interim storage for several decades
- Geologic disposal is a robust concept, and assurance of long-term performance should not require separation and transmutation of radionuclides or development of specialized waste forms
- Repository efficiency (e.g., waste loading, cost of engineered barriers) may be enhanced by separation and transmutation of radionuclides and development of specialized waste forms