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The Geopolitics of U.S. Nuclear Waste Repositories

Nuclear Waste: The Challenge of Interim Storage and Long Term Disposal 2010
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Agenda

- Yucca Mountain: future implications
- Understanding the Blue Ribbon Commission
- Technical and Socio-Political Issues of Siting a New Geologic Repository
- Reprocessing and Repositories
- Concluding Remarks

Yucca Mountain
Light at the End of the Tunnel?

- February 2009: The Obama administration (sworn in January 2009) eliminated all funding in the fiscal year 2010 budget except that needed to answer inquiries from the Nuclear Regulatory Commission, "while the Administration devises a new strategy toward nuclear waste disposal."
- "The Administration has determined that developing a repository at Yucca Mountain, Nevada, is not a workable option and has decided to terminate the Office of Civilian Radioactive Waste Management. The Nation needs a different solution for nuclear waste disposal. As a result, in 2010, the Department will discontinue its application to the U.S. Nuclear Regulatory Commission for a license to construct a high-level waste geologic repository at Yucca Mountain and establish a Blue Ribbon Commission to inform the Administration as it develops a new strategy for nuclear waste management and disposal. All funding for development of the Yucca Mountain facility and the Office of Civilian Radioactive Waste Management will be eliminated by the end of FY10. The Administration remains committed to fulfilling its obligations under the Nuclear Waste Policy Act. Ongoing responsibilities under the Act, including administration of the Nuclear Waste Fund and the Standard Contract, will continue under the Office of Nuclear Energy, which will lead future waste management activities."
  - From Dept. of Energy, FY-2011 Congressional Budget Request
- March 2009: What's wrong with Yucca Mountain, Mr. Chu," McCain asked at an Energy and Natural Resources Committee hearing on support for scientific research.
  - "I think we can do a better job," replied the Nobel Prize-wining physicist.

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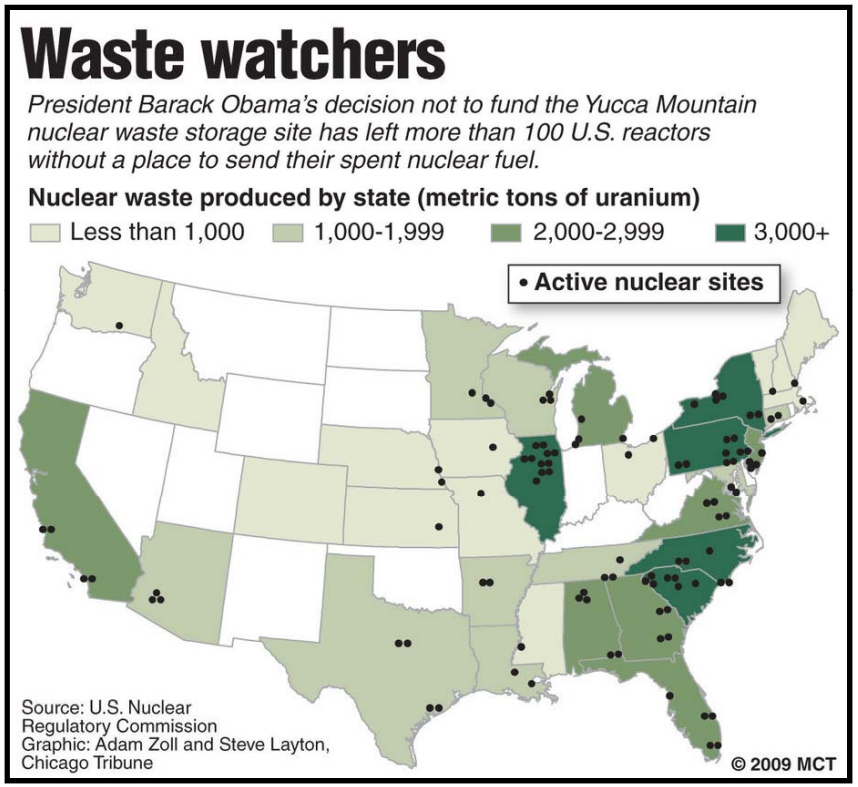
Geopolitical Reaction

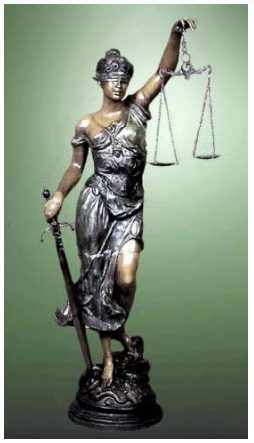
- March 2010: DOE files motion to withdraw license application with prejudice
  - "The Secretary's judgment here is not that Yucca Mountain is unsafe or that there are flaws in the (license application), but rather that is not a workable option and that alternatives will better serve the public interest," said DOE in papers filed in federal court.
- The motion to withdraw the license application sparks controversy…
  - Legal challenges by SC & WA
  - Administrative ruling by ASLB
  - Inquiries, resolutions and questions by Congress opposing the action
  - Editorials and trade groups raise objections



- Staff (federal, lab and contractor) are reassigned or terminated, support systems shut down, offices closed.

What's Next?

- Court to allow the NRC to exhaust administrative remedies
- NRC Commission to rule on whether the DOE can withdraw the application
  - NRC Commissioners either uphold or reverse ASLB's earlier denial of DOE motion to withdraw the LA
  - Regardless of the NRC ruling, one party will be unsatisfied and will likely petition the court to resume the case that is now stayed (pending NRC ruling)
- November Election
  - Democrat Harry Reid vs. Republican (& Tea Party favorite) Sharron Angle



Blue Ribbon Commission on America's Nuclear Future

U. S. Department of Energy

- CHARTER: The Secretary of Energy, acting at the direction of the President, is establishing the Commission to conduct a comprehensive review of policies for managing the back end of the nuclear fuel cycle, including all alternatives for the storage, processing, and disposal of civilian and defense used nuclear fuel, high-level waste, and materials derived from nuclear activities. Specifically, the Commission will provide advice, evaluate alternatives, and make recommendations for a new plan to address these issues, including:
  - a) Evaluation of existing fuel cycle technologies and R&D programs. Criteria for evaluation should include cost, safety, resource utilization and sustainability, and the promotion of nuclear nonproliferation and counter-terrorism goals;
  - b) Options for safe storage of used nuclear fuel while final disposition pathways are selected and deployed;
  - c) Options for permanent disposal of used fuel and/or high-level nuclear waste, including deep geological disposal;
  - d) Options to make legal and commercial arrangements for the management of used nuclear fuel and nuclear waste in a manner that takes the current and potential full fuel cycles into account;
  - e) Options for decision-making processes for management and disposal that are flexible, adaptive, and responsive;
  - f) Options to ensure that decisions on management of used nuclear fuel and nuclear waste are open and transparent, with broad participation;
  - g) The possible need for additional legislation or amendments to existing laws, including the Nuclear Waste Policy Act of 1982, as amended; and
  - h) Any such additional matters as the Secretary determines to be appropriate for consideration.

- *Yucca Mountain as a repository is off the table for the BRC consideration of alternatives.*

Blue Ribbon Commission Duties

- The duties of the Commission are solely advisory, report to the Secretary of Energy
- A draft report shall be submitted within 18 months (i.e., July 2011); a final report shall be submitted within 24 months (i.e., January 2012). The reports shall include:
  - a) Consideration of a wide range of technological and policy alternatives, and should analyze the scientific, environmental, budgetary, financial, and management issues, among others, surrounding each alternative it considers. The reports will also include a set of recommendations regarding policy and management, and any advisable changes in law.
  - b) Recommendations on the fees currently being charged to nuclear energy ratepayers and the recommended disposition of the available balances consistent with the recommendations of the Commission regarding the management of used nuclear fuel.
  - c) Such other matters as the Secretary determines to be appropriate.

- First Meeting Held March 25-26, 2010

BRC Membership

- **Lee Hamilton, Co-Chair & Brent Scowcroft, Co-Chair**
  Lee Hamilton represented Indiana's 9th congressional district from 1965-January 1999, and was ranking member of the House Committee on Foreign Affairs, and chaired the Permanent Select Committee on Intelligence. He is currently president and director of the Woodrow Wilson International Center for Scholars, and director of The Center on Congress at Indiana University. Previously, Hamilton served as Vice Chairman of the National Commission on Terrorist Attacks Upon the United States (the 9/11 Commission).

- Brent Scowcroft is President of The Scowcroft Group, an international business advisory firm. He has served as the National Security Advisor to both Presidents Gerald Ford and George H.W. Bush. Scowcroft served in the military for 29 years, and concluded at the rank of Lieutenant General following service as the Deputy National Security Advisor.

- **Mark Ayers,** President, Building and Construction Trades Department, AFL-CIO
- **Vicky Bailey,** Former FERC Commissioner; Former IN PUC Commissioner; Former DOE Assistant Secretary for Policy & Intl Affairs
- **Albert Carnesale,** Chancellor Emeritus and Professor, UCLA
- **Pete V. Domenici,** Senior Fellow, Bipartisan Policy Center; former U.S. Senator (R-NM)
- **Susan Eisenhower,** President, Eisenhower Group, Inc.
- **Chuck Hagel,** Former U.S. Senator (R-NE)
- **Jonathan Lash,** President, World Resources Institute
- **Allison Macfarlane,** Associate Professor of Environmental Science and Policy, George Mason University
- **Richard A. Meserve,** President, Carnegie Institution for Science, and former Chairman, U.S. Nuclear Regulatory Commission
- **Ernie Moniz,** Professor of Physics and Cecil & Ida Green Distinguished Professor, Massachusetts Institute of Technology
- **Per Peterson,** Professor and Chair, Department of Nuclear Engineering, University of California - Berkeley
- **John Rowe,** Chairman and Chief Executive Officer, Exelon Corporation
- **Phil Sharp,** President, Resources for the Future

Blue Ribbon Commission

- Organized into three sub-committees, with membership overlap for integration
- Sub-Committees have a separate meeting schedule from the Full Commission Meetings
- All meetings, testimony and submissions are available to the public
  - Visit www.brc.gov

Reactor & Fuel Cycle Technology

- **Pete Domenici – Co-Chairman**
- **Per Peterson – Co-Chairman**
- **Al Carnesale**
- **Susan Eisenhower**
- **Allison Macfarlane**
- **Dick Meserve**
- **Ernie Moniz**
- **Phil Sharp**

Transportation & Storage

- **Dick Meserve – Co-Chairman**
- **Phil Sharp – Co-Chairman**
- **Mark Ayers**
- **Vicky Bailey**
- **Al Carnesale**
- **Pete Domenici**
- **Ernie Moniz**
- **John Rowe**

Disposal

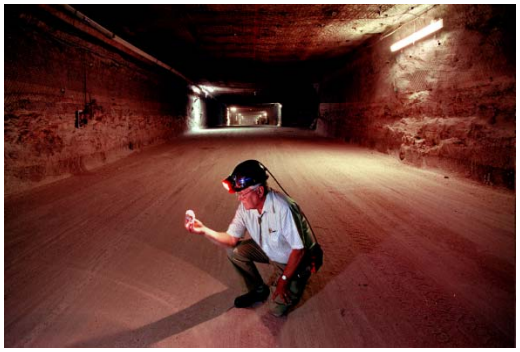
- **Chuck Hagel – Co-Chairman**
- **Jonathan Lash – Co-Chairman**
- **Mark Ayers**
- **Vicky Bailey**
- **Susan Eisenhower**
- **Allison Mcfarlane**
- **Per Peterson**
- **John Rowe**

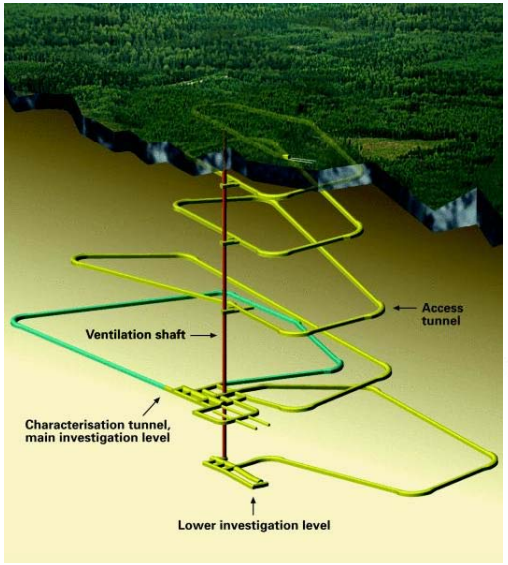
Speculation on BRC Outcomes

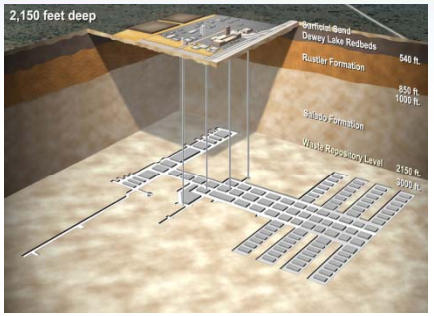
- Volunteer approach to repository site selection
- Revise the role of government
- Changes to the NWPA
- R&D for advanced fuel cycles
- Centralized interim storage
- Begin a repository development program

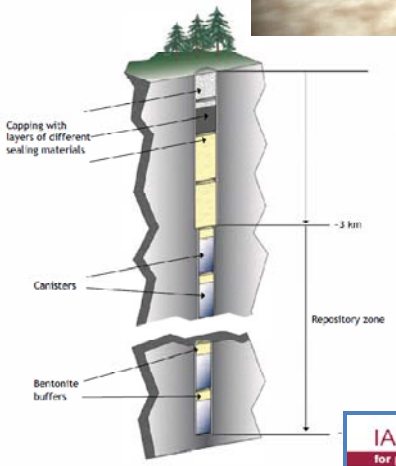
- Congress has to take action to implement
- Court of Appeals decisions may have influence

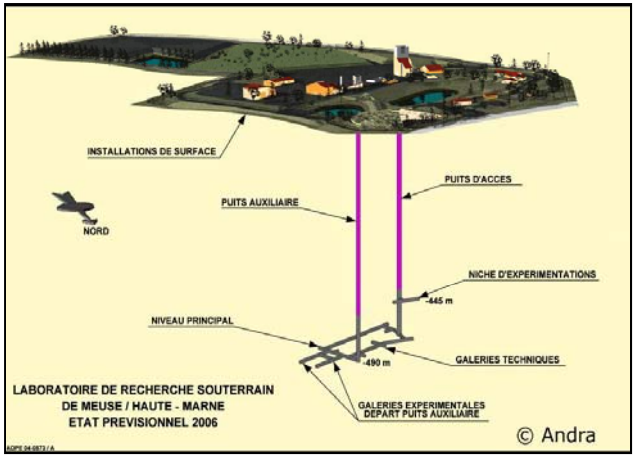
The Good News
Geologic Disposal is an Option

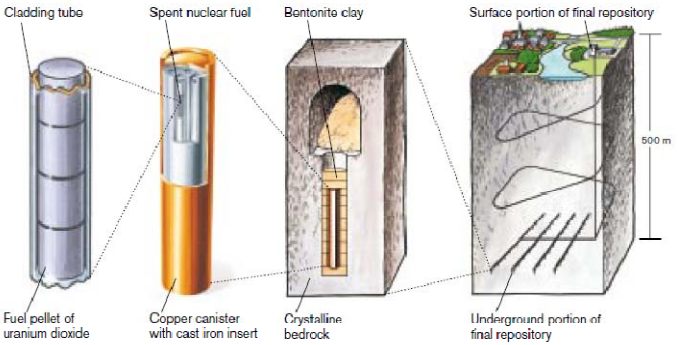


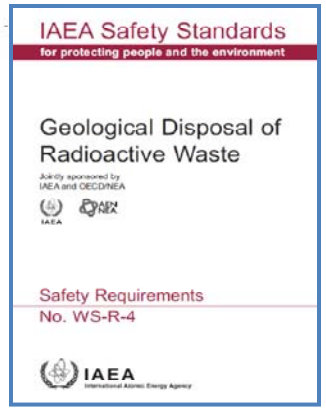












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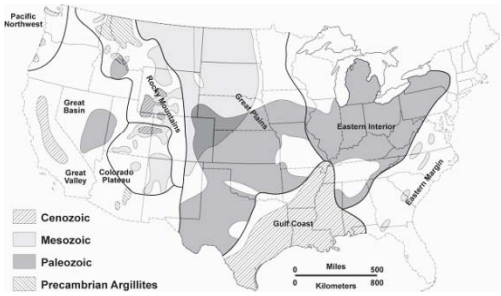
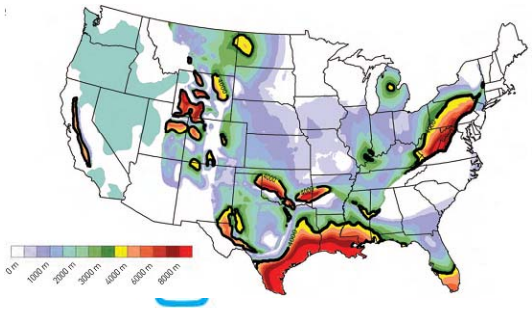
Potential Repository Host Rocks in the USA

Property	Salt	Shale	Granite	Deep boreholes
Thermal conductivity	High	Low	Medium	Medium
Permeability	Practically impermeable	Very low to low	Very low (unfractured) to permeable (fractured)	Very low
Strength	Medium	Low to medium	High	High
Deformation behavior	Visco-plastic (creep)	Plastic to brittle	Brittle	Brittle
Stability of cavities	Self-supporting on decade scale	Artificial reinforcement required	High (unfractured) to low (highly fractured)	Medium at great depth
In situ stress	Isotropic	Anisotropic	Anisotropic	Anisotropic
Dissolution behavior	High	Very low	Very low	Very low
Sorption behavior	Very low	Very high	Medium to high	Medium to high
Chemical	Reducing	Reducing	Reducing	Reducing
Heat resistance	High	Low	High	High
Mining experience	High	Low	High	Low
Available geology*	Wide	Wide	Medium	Wide
Geologic stability	High	High	High	High
Engineered barriers	Minimal	Minimal	Needed	Minimal

Favorable property Average Unfavorable property





How to Open a Repository

It's all about addressing risk and benefit

- Perceived *and* actual risk are important factors for success;
  - informally as a determinant of public acceptance, and,
  - formally as meeting regulatory criteria.

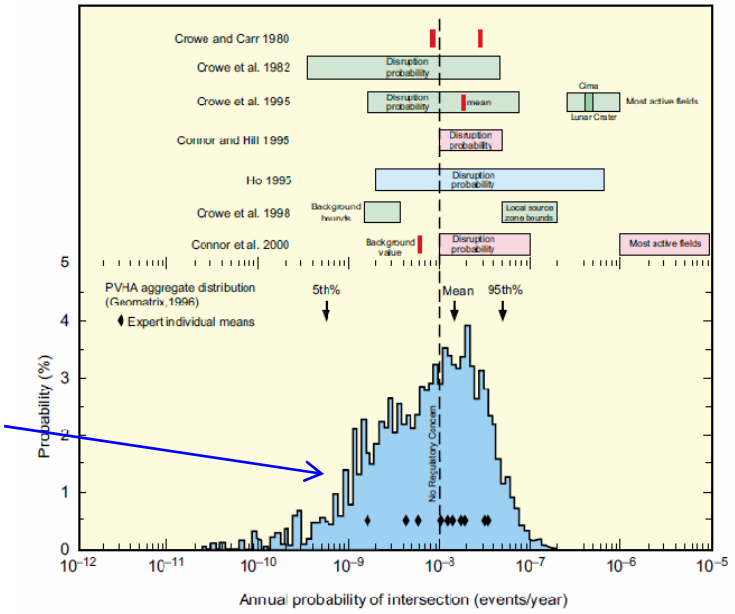
Public Risk Perception

Informal

vs.

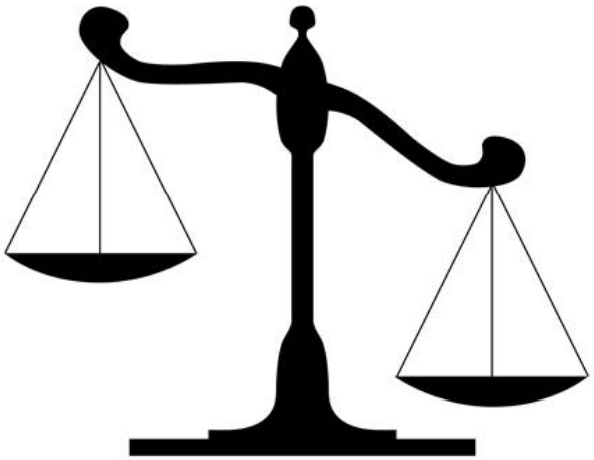
Formal

Expert Risk Perception



The Delicate Balance of Public Acceptance
Can Local, State and Federal Interests Be Aligned?

- Perceived Risks
- State Unacceptability



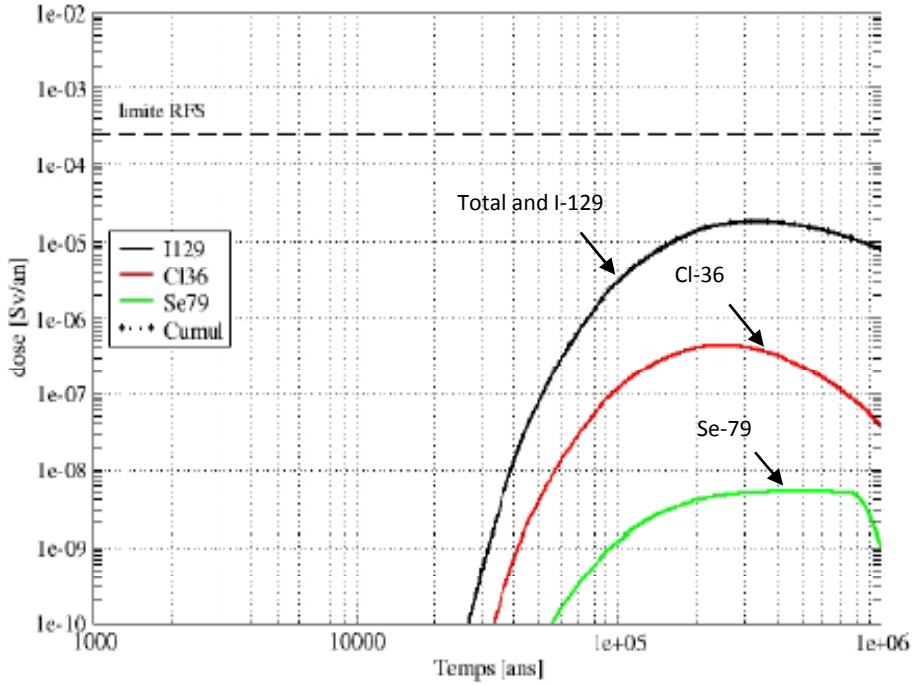
- Tangible Benefits
- Actor Confidence
- Technical Confidence
    - Intrinsic and Explicit

Reprocessing & Direct Disposal

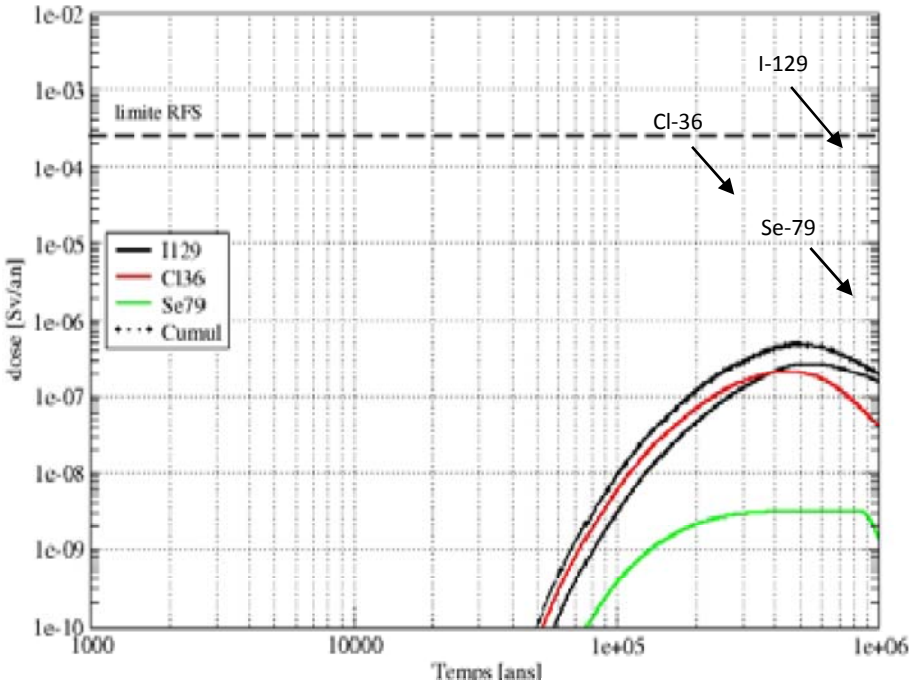
- Reprocessing is one approach to supporting energy security, and thus the 'costs' may be determined acceptable
- Oft heard argument for reprocessing is the benefits will:
  - Reduce volume, heat, and radiotoxicity, and thereby implies…
    - a simplified repository design, and,
    - improved stakeholder acceptance.
- To reprocess or direct-dispose?
  - For the US it may not be either-or, but both.

Dose
SNF Direct Disposal vs. HLW Disposal

"Recycling reduces toxicity. The main contributors to the long-term radioactive toxicity of used nuclear fuel are plutonium and uranium. Consequently, extracting these materials from the used fuel significantly reduces the toxicity of the final waste form. The main contributor to the long-term radioactive toxicity of used nuclear fuel is plutonium for the first several hundreds of thousands of years, at which point minor actinides and uranium become predominant. Consequently, extracting plutonium and uranium from the waste for final disposal significantly reduces the waste's toxicity, by a factor of about 90 percent." (BRC testimony: Aug 30, 2010)



ANDRA 2005, *Dossier 2005: Argile. Tome: Evaluation of the Feasibility of a Geological Repository in an Argillaceous Formation*, Figure 5.5-18, SEN million year model, CU1 spent nuclear fuel



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

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US Spent Fuel Inventory

- Is all of our SNF Inventory an Asset?
  - US has ~60K MTHM at present, producing ~2K / yr
  - Assume NPP license renewals and new build replacements keep this pace through 2050, and then no new SNF production
    - Reprocessing @ 2.0K MTHM/yr reaches 0 backlog in 2095
    - Reprocessing @ 2.6K MTHM/yr reaches 0 backlog in 2084
    - Reprocessing @ 3.4K MTHM/yr reaches 0 backlog in 2082
  - Under more reasonable scenarios, the backlog is never fully consumed
  - If we can't consume it, is it an asset or a waste?

Concluding Remarks

- Interim Storage
- Waste Acceptance
- Repository Program