Making the Case for an Integrated Nuclear Waste Management System

David S. Kosson, CRESP Co-PI, Vanderbilt University

Questions
(That must be answered)

Why do we need a complete system for nuclear waste management, including geologic repositories?

Rationale:

- Benefits of nuclear for energy security as ***part of a national energy portfolio*** that includes conservation, renewables and reduced reliance on fossil fuels.
- Environmental Protection
  - Avoid emissions of greenhouse gases and other emissions (mercury, arsenic, selenium, etc.).
  - Responsible management of residuals/wastes – full life-cycle management – greater care than any other waste management.
- National security – leadership in management of nuclear materials to prevent potential future proliferation as other nations seek energy security through nuclear energy.

Why is the proposed approach safe and responsible, in light of our current knowledge and uncertainties?

Rationale:

- Best technical evaluation based on current knowledge provides multiple, redundant protective systems through engineered barriers and natural systems.
- System of continuous learning through on-going, long-term testing of system components and integrated system with feed back to system performance evaluation, design and operations, as well as other knowledge (medical, etc).
- Pre-emptive monitoring in-place and designed to facilitate detection and correction in response to unforeseen processes or events.
- Retrievability for many generations to come to allow review and changes in decisions based on future resource needs, knowledge and values.
- Stable and credible institutions to ensure proper management.

Why is it in a community's, state's and the national interest to host a repository?

Rationale:

- Fair site selection and credible regulatory processes.
- Convincing safety case.
- Host community benefits from, and familiar with, nuclear energy and/or nuclear systems.
- Equitable distribution (state, local) of benefits from repository or other management facility.
- Long-term commitment to economic development
  - Responsive to community needs.
  - High quality infrastructure and educational opportunity.
  - On-going research and development engine.
  - Financial incentives alone are not sufficient.
- Supporting national need and environmental stewardship.

Essential Elements

National Energy Policy

Addresses needs and values through a balanced portfolio and integrated approach:

- Security,
- Demand and conservation,
- Multiple energy sources,
- Climate change and other environmental concerns, including full life-cycle consideration.

Institutional Requirements

Leadership – long-term, high credibility, focused.

Professional staff - technical competence and excellence.

Financial Support – sufficient and stable, independent of political manipulation.

Organizational stability.

Continuous learning – throughout program.

Site Selection

Stable, credible and transparent.

State and local involvement.

Geographic equity (re-establish).

Appropriate geologic and geographic setting.

Criteria that establish a reference case based on best technical understanding and values:

- Reference storage intervals (e.g., 100 y decay period to reduce thermal load),
- Potential for future resource utilization,
- Retrievability – vitrified waste vs. spent nuclear fuel.

Stakeholder Engagement

Multiple levels and methods.
Sustained and responsive.
Continuous evaluation and improvement.

Sustained Commitment to Nuclear Education

Long-term commitment at multiple levels:

- National and community education,
- Primary and secondary education,
- Higher education.

Target diverse population.

Collaborative research and development investment

- Universities, national laboratories, federal agencies, industry.

Nuclear waste management/Nuclear Environmental Protection, Nuclear Chemical Engineering, Nuclear Construction Mgmt, Nuclear Engineering, Health Physics.

Regulatory Processes

Transparency.

Allow adaptive management.

Nuclear waste classification system based on the hazard not the origin of the material.

- Existing materials and facilities either "grandfathered" under existing system or regulated based on the new system.

Acceptability of estimated risks should be in context of

- other natural risks over the time-frames considered,
- potential for early detection and corrective intervention, the nature and magnitude of uncertainties, evolving science and values.

De-link energy and defense waste management.

Distinguish spent nuclear fuel from vitrified (and other) waste forms – containment shells vs. distributed barriers.

Safety Case

Multiple lines of evidence for long-term performance:

- Engineered barriers,
- Geologic barriers, systems and processes,
- Natural analogues.

Probabilistic performance assessment as organizing and assessment tool:

- Includes range of cases and scenarios.
- Uses best phenomenological understanding for processes which effect outcome, not "bounding" estimates.
- Addresses model, parameter and intrinsic uncertainty.
- Incorporates science-based analysis, e.g., safety, risk sciences, materials, geology, contaminant mass transfer, …

Quantitative evaluation criteria based on 1,000 to 10,000 yrs.

Long-term qualitative evaluation consistent with known processes at multiple scales (e.g., corrosion, geologic science).

Repository as on-going research to continuously learn, enhance operations and reduce uncertainty in safety case.

Emphasize passive systems (fail safe) and combined contributions of engineered and natural systems.

A standing independent review board should be required as a consultative review body for criteria, licensing, demonstration, monitoring and research, etc.

Ethical Perspectives

"…The generation of citizens which has enjoyed the benefits of nuclear energy has an obligation to responsibly dispose the waste in-perpetuity."

"…Our obligation is to give them (succeeding generations) a real choice and the opportunity to shape their own decisions while at the same time not imposing a burden which future generations may not be able to manage." [paraphrased from Canadian Nuclear Waste Management Organization study & Tom Isaacs]

"…Our connection to 10 or 100 generations in the future is more remote than our sense of obligation to distant world events with which we do not engage. Therefore, our judgments of prudent use of current resources should be a balanced reflection of our values and immediate generations because many generations in the future will likely derive little benefit and have different norms and values." [after Milton Russell, 2008].

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Three Thoughts

- There is never time to do it right, but always time to do it over! (and resources)

- Must avoid paralysis by analysis!

- We must recognize where we are, how we got their, and use our experience to move forward – we cannot change the past, but must learn from it.