Recent Status of Geological Disposal Programs in the U.S. and Canada

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The General Framework

- Brief, selective U.S. history
- International experience
- Canadian program development
- The Blue Ribbon Commission report and implications

What is High-Level Radioactive Waste?

- Spent nuclear power reactor fuel
- The raffinate resulting from reprocessing
- Defense related wastes
- Naval reactor cores
- Hot and long-lived

How is it handled?

- Stored at reactor sites
  - Pools
  - Dry casks
- Centralized storage
- Possibly reprocessed
  - Pu and U reused
  - Wastes vitrified
- Ultimate disposal in a deep geologic repository

Spent Nuclear Power Reactor Fuel

- >260,000 MT generated worldwide
- Generate >10,000 MT/yr
- >60,000 MT in the U.S.
- U.S. inventory grows >2,000 MT/yr.
- 30 countries, 15 with 5 or fewer reactors

Some Highlights and Lowlights

- National programs have been abandoned or siting stopped
  - France, U.K., Canada, Germany, Spain, Switzerland, U.S.A
- National (re)reviews have been undertaken
  - Canada, France, U.K.,…
- Schedules have been delayed
  - Almost everywhere
- Some countries have moved forward and others have restarted
  - Finland, Sweden, France, Canada, U.K.…

What makes nuclear waste management special?

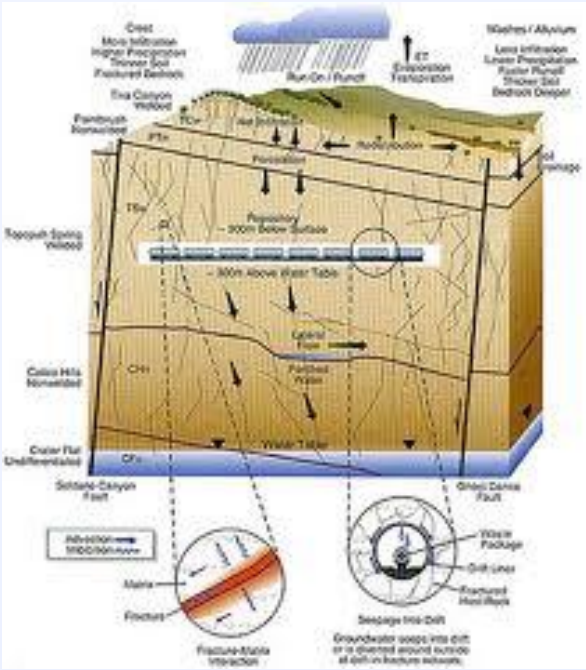
- The technical challenge
  - Performance over geological time
  - “Proof” not possible
  - Central role of “ologists”

- The institutional challenge
  - The extraordinary time frame
  - Siting
  - Linkage to other agendas
  - Values and ethics in conflict
  - Political implications
  - Nuclear stigma and fears

» But there are unique advantages…

Virtues of a Repository

- Passive
- Occurrences will be slow
- No inherent energy to release materi
- Retrievable
- Only a repository upon closure, when future generations are comfortable



Pre-1982 in the U.S.A.

- No sense of urgency
- Expected to reprocess
- 1957 National Academy of Science Report
- Policy alternated between focus on storage and disposal
- Intermittent site screening

The Nuclear Waste Policy Act of 1983

Nuclear Waste Policy Act of 1983 (NWPA)

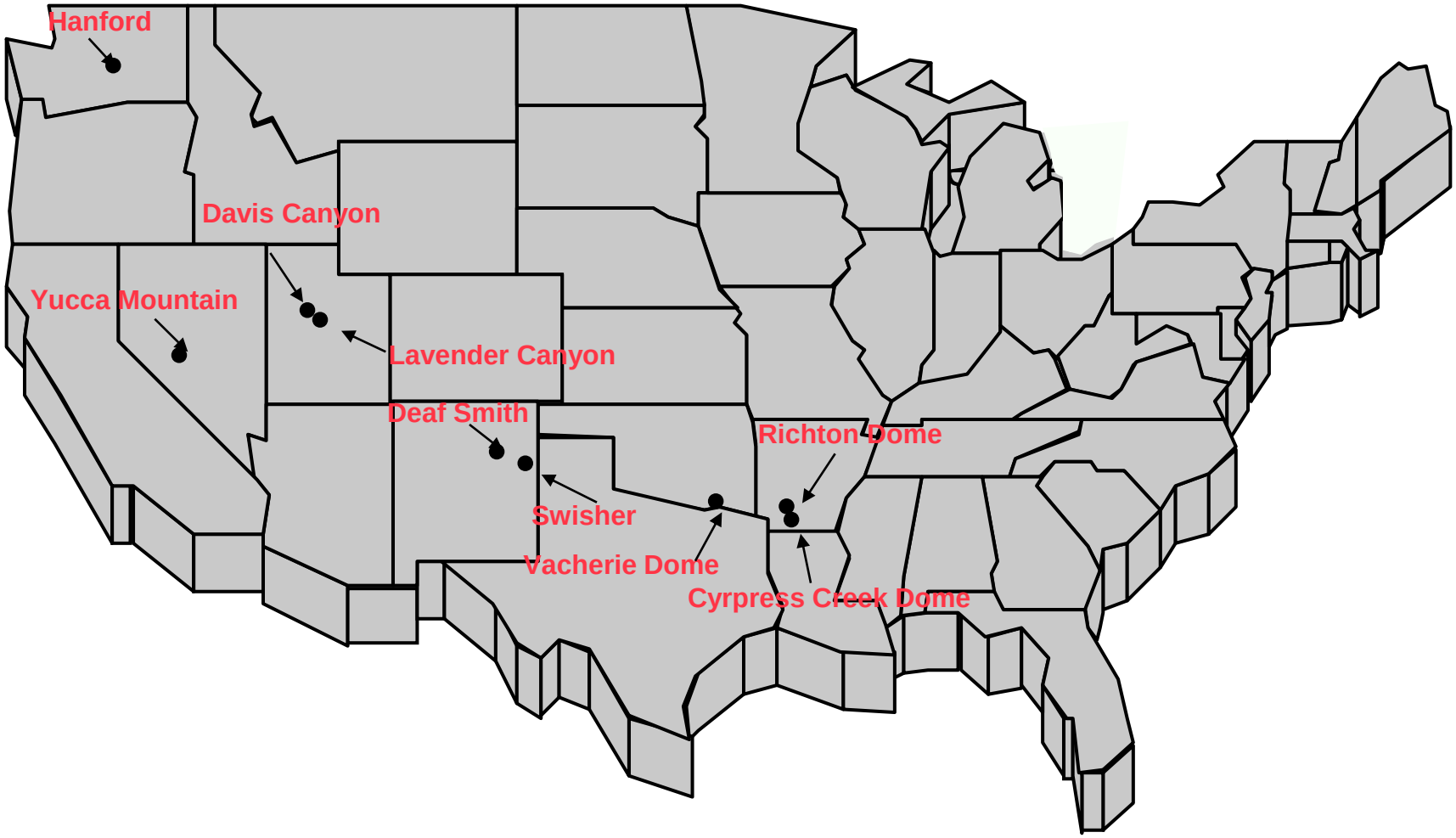
- **Key issue: Long-term monitored storage vs. disposal capability**
- **Decision: We owe the future the option of disposal**
- **Compromises allowed passage**

The Nuclear Waste Policy Act of 1983

Key Features of Act

- **Site two repositories and build one**
- **1998 deadline for initial repository operation and tight schedules for intermediate steps**
- **Quid pro quo: Utilities pay fee, government accepts waste**
- **Extensive State and public participation**
- **DOE study and proposal on surface storage**

Potentially Acceptable Sites for the First Repository



A few attributes of the decision environment

- There was a time crunch
- Stakes were very high
- Values were in conflict
- Scientists were using science to make a scientific/political decision
- The scientific component had large uncertainties
- The world was watching

The Outcome

- DOE recommended sites ranked #1,3,5
- Decision justified by additional factors (e.g., cost, portfolio considerations, possible common mode failure)
- Politically driven Congressional investigation
- Political firestorm and stalemate
- New law designating (#1 Ranked) Yucca Mountain in 1987

1987 Amendments

- Directed DOE to study only one candidate site at Yucca Mountain, Nevada
- Prohibited DOE from doing any work on a second site
- Established Office of Negotiator to seek voluntary hosts for a repository or Monitored Retrievable Storage (MRS)
- Rejected proposal for Oak Ridge MRS
- Authorized DOE to site and build an MRS, but limits on capacity and tied schedule closely to that of a repository
- Established MRS Commission

Recent DOE and Other Developments

- **Separation of Defense HLW from Spent Fuel**
- **Pilot and interim centralized spent fuel storage facilities**
- **Progress on repository siting leading to eventual operation**
- **Consent-based approach**
- **Derives from BRC recommendations**
- **NRC staff recommendation on YM license application**
- **WCS proposal for privately-owned storage facility**
- **Ongoing bi-partisan Congressional consideration**

The Seaborn Panel Conclusions (1998)

- "From a technical perspective, safety of the AECL concept has been on balance adequately demonstrated for a conceptual stage of development. But from a social perspective, it has not."

- "As it stands, the AECL concept for deep geological disposal has not been demonstrated to have broad public support. The concept in its current form does not have the required level of acceptability to be adopted as Canada's approach for managing nuclear fuel wastes."

Seaborn Commission program requirements

- Have broad public support
- Be safe from both a technical and a social perspective
- Have been developed within a sound and social assessment framework
- Have support of the Aboriginal people
- Be selected after comparison with the risk, cost, and benefits of other options
- Be advanced by a stable and trustworthy proponent and overseen by a trustworthy regulator

"Choosing a Way Forward": The Foundation

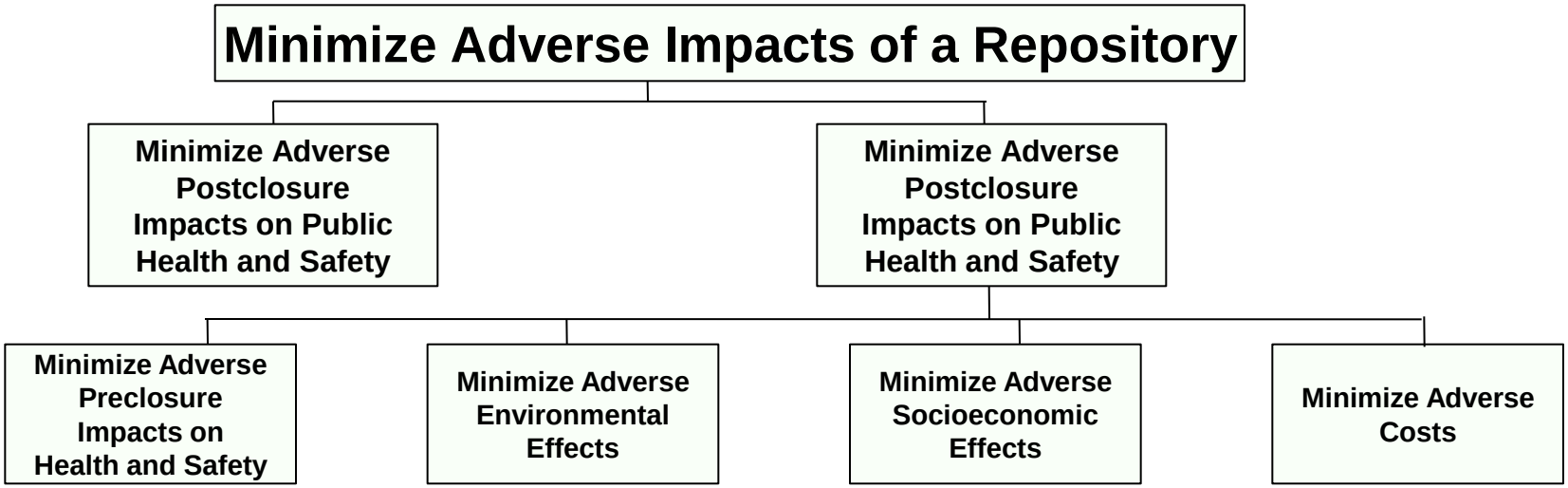
- "…this generation of citizens which has enjoyed the benefits of nuclear energy has an obligation to begin provision for managing that waste."

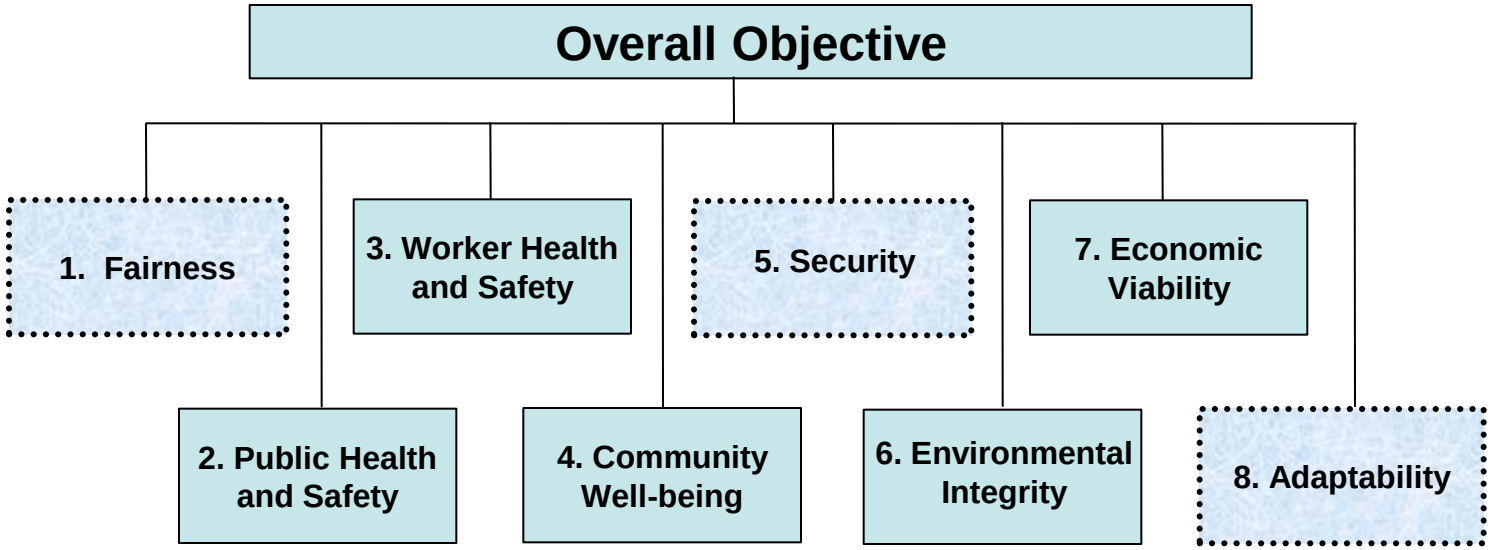
- "…our obligation is to give them (succeeding generations) a real choice and the opportunity to shape their own decisions while at the same time not imposing a burden which future generations may not be able to manage."

Some Keys to the Canadian Approach

- Process is as important as the choice itself
- Intense, widespread, and continuing dialogue with citizens, affected parties and decision makers
- Extensive use of the web
- Ethics roundtable
- Transparency of process
- Systematic site investigations and selection

A Comparison of Objectives 20 years apart





The many scientific disciplines

- Geology
- Hydrology
- Seismology
- Climatology
- Vulcanology
- Geochemistry
- Materials science
- Radiation science...

The emerging need for social science

- Ethics
- Sociology
- Public engagement
- Risk communication
- Socio-economics
- Cultural understanding
- Sustainability
- Political science
- Psychology

The many non-technical dimensions of siting

"Choosing a Way Forward": Some Key Recommendations

- Centralized isolation in a deep geologic repository
- Flexibility in the pace and manner of implementation through phased decision-making: **"Adaptive Phased Management"**
- Program of continuous learning and R&D
- Long-term monitoring with potential for retrievability
- Seek a willing and informed community as host

Does “Adaptive Staging” present a reasonable approach?

- Sequential decision making
- Continuous learning
- Cautious start-up
- Responsive to stakeholder input
- Continual improvement
- Retrievability / Reversibility

The Current Status in Canada

- In a consent-based process
- Numerous steps, both scientific and institutional
- 22 communities expressed initial interest to learn more
- 9 communities remain in the process
- Site investigation and community engagement continue
- No site has been asked to volunteer at this time
- Goal is to have 1 or 2 sites for detailed characterization

Allowing the Current Impasse to Continue Is Not an Option…

The waste exists.

We have an ethical, legal, and financial responsibility to manage and dispose of it safely, at a reasonable cost, and in a reasonable timeframe.

This was the driving impetus for the Commission. It is the basis for our shared sense of urgency about seeing our recommendations implemented.

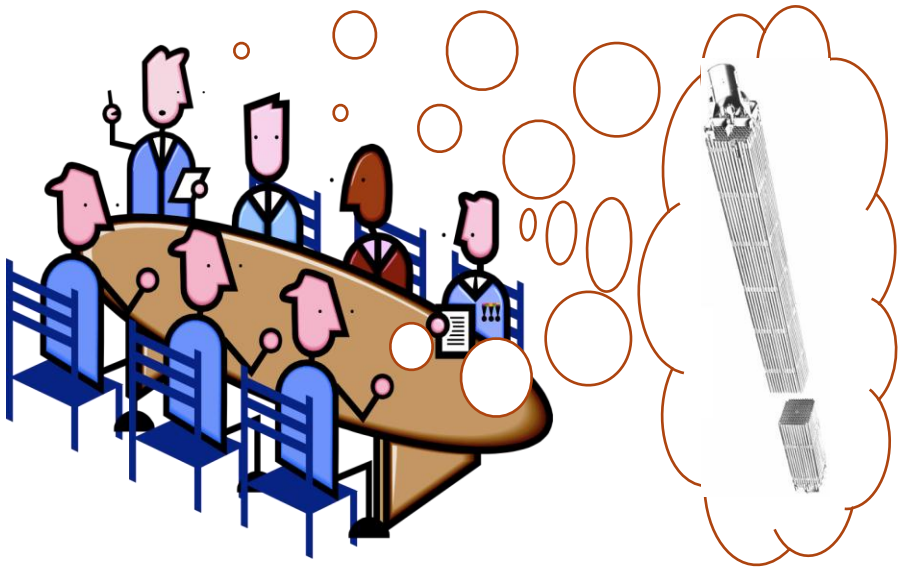
8 Key Recommendations

1. A new, consent-based approach to siting and development

Blue Ribbon Commission on America's Nuclear Future

8 Key Recommendations

2. A new organization dedicated solely to implementing the waste management program and empowered with the authority and resources to succeed



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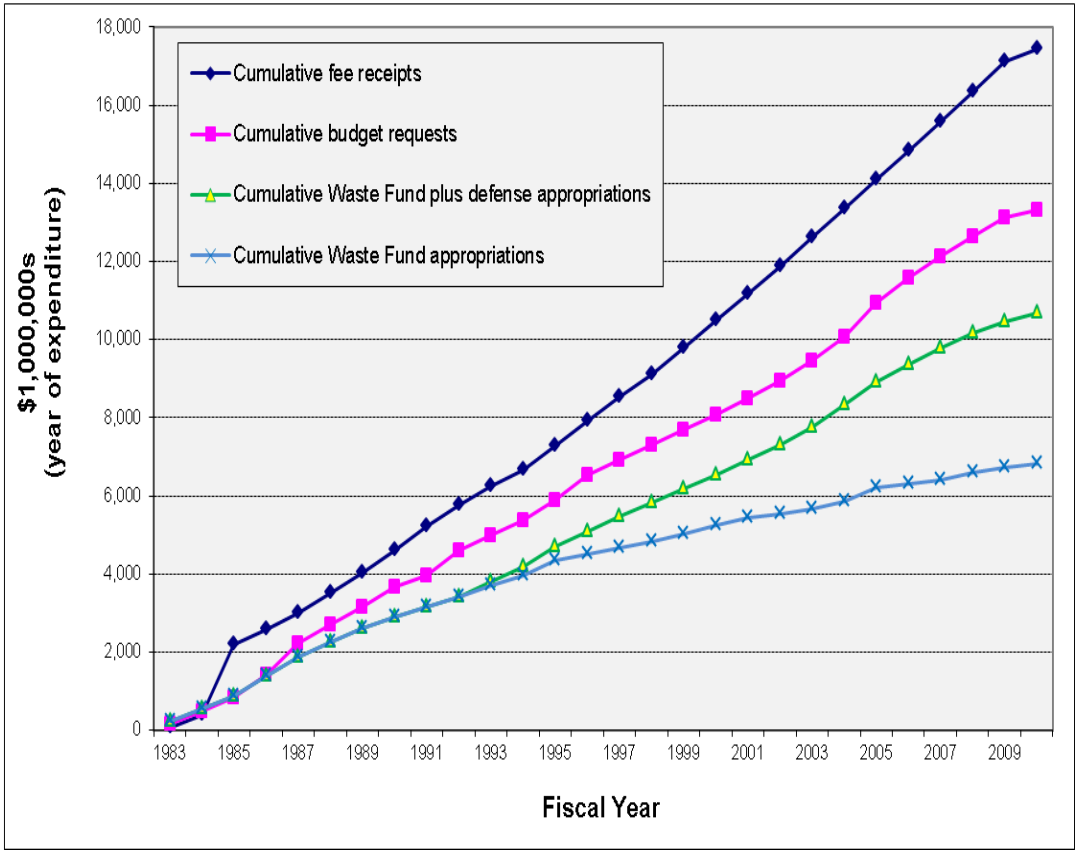
8 Key Recommendations

3. Access to the funds nuclear utility ratepayers are providing for the purpose of nuclear waste management



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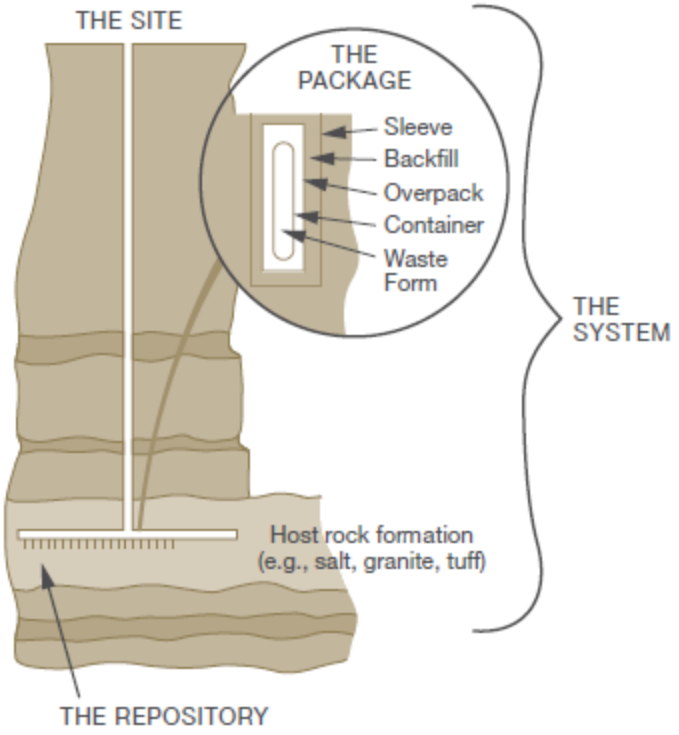
8 Key Recommendations

4. Prompt efforts to develop one or more geologic disposal facilities



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8 Key Recommendations

5. Prompt efforts to develop one or more consolidated storage facilities

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8 Key Recommendations

6. Prompt efforts to prepare for the eventual large-scale transport of spent nuclear fuel and high-level waste to consolidated storage and disposal facilities when such facilities become available

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8 Key Recommendations

7. Support for continued U.S. innovation in nuclear energy technology and for workforce development

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8 Key Recommendations

8. Active U.S. leadership in international efforts to address safety, waste management, non-proliferation, and security concerns

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International Implications

- The nuclear power world order is changing
- There is a growth and spread of nuclear power
- Spread of sensitive fuel cycle facilities is key
- Opportunities lie at the intersection of nuclear power, non-proliferation and waste management

Some Key Enduring Features

- Program need convincingly established
- Core, stable goal
- Roles and responsibilities clear
- Clear, open, and transparent decision making process
- Respect for fairness and societal consent apparent
- Sequential decision-making and contingency planning
- Possibility of altering or reversing course
- Appropriate compensation

Trust: firm belief in the reliability, truth, ability or strength of someone or something

Confidence: the feeling or belief that one can rely on someone or something

Some Potential Lessons Learned

- Take the necessary time - go slow in order to go fast
- Assign importance to the societal considerations as well as the technical ones - safety is always a top priority
- There are many ways to effectively engage the public and key stakeholders
- Listening, respecting, and then responding can build trust and even advocacy, particularly with local community
- Plan carefully and involve the right experts
- Be prepared to respond in real time to unexpected events