International Experience Developing Deep Geologic Repositories

Presented to:

Blue Ribbon Commission on America's Nuclear Future
Disposal Subcommittee

Presented by:

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About the Board

- The Board is an independent Federal agency.
  - It was established in 1987 by the Nuclear Waste Policy Amendments Act.
  - Its mandate is to "…evaluate scientific and technical validity …" of activities undertaken by the Secretary of Energy to implement the Nuclear Waste Policy Act.
- The Board is composed of eleven members, selected strictly on the basis of their expertise.
  - They are nominated by the National Academy of Sciences.
  - They are appointed by the President.
  - They serve part-time.
- The Board reports to Congress and the Secretary of Energy on its findings, conclusions, and recommendations at least twice a year.

Background

- This presentation is largely based on the Board's October 2009 report: *Survey of National Programs for Managing High-Level Radioactive Waste and Spent Nuclear Fuel.*
  - Compendium of information on 30 institutional and technical program attributes in 13 countries
  - Does not make judgments or draw conclusions
- The Board expects in the coming months to follow up the "Survey of National Programs" report with an "Experience Gained" report. This report will have a historical dimension and will provide context—both technical and process—to the information contained in the "Survey" report.

Is a Disposal Facility Needed? (1)

- NEA Collective Statement: A deep geologic repository "provides a unique level and duration of protection" of public health and safety. It is "technically feasible."
- The only issue appears to be timing.
  - **Early operation:** United States (YM and WIPP), Sweden, France, and Finland
  - **Operation anticipated by mid-century:** Belgium, China, and Switzerland
  - **No official decision made on when operations might begin:** Canada, Germany, Japan, Korea, United Kingdom (except Scotland), and the United States
  - **No official decision to develop a deep geologic repository:** Scotland and Spain

Is a Disposal Facility Needed? (2)

Deep geologic repositories can be designed to isolate and contain a wide variety of waste forms.

- **High-level radioactive waste:** United States, Belgium, China, France, Germany, Japan, Switzerland, and United Kingdom (except Scotland)
- **Commercial spent nuclear fuel:** United States, Canada, Finland, Germany, Korea, Sweden, and United Kingdom (except Scotland)
- **Defense-related spent nuclear fuel:** United States, France, and United Kingdom (except Scotland)
- **Long-lived intermediate level waste:** France and United Kingdom (except Scotland)
- **Heat-generating intermediate level waste:** Germany
- **Transuranic-contaminated waste:** United States

Is a Disposal Facility Needed? (3)

Countries have made the decision to develop a deep geologic repository in a variety of ways.

- **Adopt disposal without a formal comparative analysis:** United States (early), Belgium, Canada (early), China, Finland, France (early), Germany, Japan, Korea, Sweden, Switzerland, and United Kingdom (early)
- **Adopt disposal after a formal comparative analysis:** United States (GEIS), Canada (NWMO), France (ANDRA), and United Kingdom (except Scotland) (MRWS)

Alternative Approaches? (1)

- Fundamental Prerequisites
  - Technical competence
  - Technical confidence and robustness (defense-in-depth, retrievability/reversibility, monitoring, and the use of natural analogues)
  - Socially acceptable process
  - Open, transparent, respectful, fair, and trustworthy behavior
- Focus will be on the site-selection process because it is here that the rubber first hits the road.
  - Technical filter
  - Nontechnical filter

Alternative Approaches? (2)

Technical filter

- **Focus on specific host-rocks**
  - Salt: United States and Germany
  - Granite: United States, France, Canada, China, Finland, Japan, Korea, Sweden, and Switzerland
  - Basalt: United States
  - Sedimentary rocks including clay: United States, Belgium, Canada, France, Japan, and Switzerland
- **Qualifying and disqualifying conditions**
  - General (host-rock neutral): Canada, Germany (AkEnd), Japan, Switzerland, and United Kingdom (except Scotland)
  - General (host-rock specific): China (granite), Finland (granite), France (granite), and Switzerland (clay)
  - Detailed (host-rock neutral): United States (10 CFR 960)

Alternative Approaches? (3)

Nontechnical filter (State/regional and local involvement)

- **Volunteer community with right of withdrawal deep into the repository development process:** Canada, Japan, Sweden, and United Kingdom (except Scotland)
- **State or local veto either at the beginning or the end of the site-selection process:** Finland and United States
- **Volunteer for URL with the understanding that a repository might be sited in community:** France
- **Informal regional participation, formal consultation, and possible national referendum:** Switzerland
- **No decision made:** Belgium, China, Germany, and Korea.

Alternative Approaches? (4)

- Selecting sites for development of a deep geologic repository that pass through both filters
  - **Serial approach:** United States (YM and WIPP) and France (clay).
  - **Parallel approach:** United States (NWPA), Finland, France (granite), Sweden, and Switzerland
  - **Depends on the number of volunteers:** Canada, Japan, and United Kingdom (except Scotland)
  - **No decision made:** Belgium, China, Germany, and Korea
- Formal designation of a site for a deep geologic repository typically is done by the legislature.
- What if no site can pass through both filters?

Development Process?

- Institutional form of the implementer
  - **Government agency:** United States (YM and WIPP), Belgium, Germany, Korea, and United Kingdom
  - **Government-owned corporation:** China and France
  - **Utility-owned corporation:** Canada, Finland, Japan, Sweden
  - **Public-private partnership:** Switzerland
- Step-wise development
  - What isn't?
  - Critical variables
    - How large are the steps?
    - What are the rules for moving from one step to the next?
  - Based on an incremental or "trial-and-error" theory of decision-making

Two Personal Observations

- There are no simple solutions to complex problems.
  - Alter institutional form
    - Empirical evidence is not compelling
    - AMFM report
  - Find a volunteer community/allow an absolute veto
    - Swedish “model”
    - Consultation and concurrence
- What should be the connection between “new build” and long-term management of HLW and SNF?
  - Public will never believe we have a permanent solution until there is evidence of one.
  - At least outside of the United States, the imperative to develop waste management solutions is independent of the future of nuclear power.