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Siting Criteria in the US

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Nuclear Waste Technical Review Board
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1957 NAS Report

- **". . . radioactive waste can be disposed of safely in a variety of ways and at a large number of sites in the United States."**
- **". . . the most promising method of disposal of high-level waste . . . seems to be in salt deposits."**
- **"It will not be possible to dispose safely of large quantities of high-level waste in many large sections of the country."**
- **"The answer almost certainly is that waste cannot be disposed of safely anywhere near that site." (Tarrytown, NY)**
- **"…the probability of finding a safe ultimate disposal means at the Savannah River plant appears equally gloomy."**
- **"Next most promising seems to be a stabilization of the waste in a slag or ceramic material forming a relatively insoluble product."**
- **"…site selection…must be based on…a disposal area within economic transportation distance."**

National Research Council, 1957, *The Disposal of Radioactive Waste on Land*; *Report of the Committee on Waste Disposal of the Division of Earth Sciences*, National Academy of Sciences, Publication 519.

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Lyons, Kansas

- **The AEC tentatively selected the abandoned Carey salt mine near Lyons, Kansas**
  - The site of an underground research laboratory in salt studying heat dissipation operated by Oak Ridge National Laboratory between 1963 and 1967
  - There were a large number of boreholes for mineral exploration and solution mining near the mine.
- **There were technical concerns**
- **In the early 70's, the AEC abandoned the project**

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1972-74 USGS

- In ‘72 the AEC asked the USGS to look at media other than salt
- Five modes of disposal were to be considered:
  - very deep drill holes
  - geometric array of shallow to moderate depth drill holes
  - shallow mined chambers,
  - cavities with manmade (engineered) barriers, and
  - explosion cavities.
- The final report cited 30 previous reports on geologic disposal and concluded that hydrologic isolation was of paramount importance.

Ekren, E.B., G.A. Dinwiddie, J.W. Mytton, W. Thordarson, J.E. Weir, E.N. Hinrichs, L.J. Schroder. 1974. *Geologic and Hydrologic Considerations for Various Disposal Concepts of High-Level Radioactive Waste Disposal in Conterminous United States*. Open-File Report 74-158. Reston, VA: US Geological Survey.

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1975: Energy Research and Development Administration (ERDA) National Waste Terminal Storage Program

- In 1975, ERDA began a search for possible repository sites.
- Three geologic media considered: salt, argillite, crystalline
- Decision to examine Federal sites that were previously contaminated from weapons related activity
- Potential areas identified in 36 states
- Concerns from the 36 states caused reconsideration of the scope of the search

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1978: USGS

- **"…are confident that acceptable geologic repositories can be constructed."**
- **"The inability to predict can be offset in part by adoption of a multiple-barrier or "defense-in-depth" philosophy for radionuclide containment."**
- **"First, the many questions concerning the behavior of rock salt must be resolved…" (high solubility)**
- **"Second, systematic examination of media other than salt should continue."**

Bredehoeft, J.D., A.W. England, D.B. Stewart, N.J. Trask, and I.J. Winograd, 1978, *Geologic Disposal of High-Level Radioactive Waste: Earth-Science Perspectives,* US Geological Survey, Circular 779.

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1978: NAS Geological Criteria for Repositories for High-Level Radioactive Wastes

- Three geo-economic (exclusionary): historic resources, potential resources, and potential dam site
- Three geometrical and dimensional: depth, size, and data available
- Five stability (two exclusionary): stable block, must avoid faults, should avoid volcanism, strength and stress, and able to backfill and seal
- Three hydrological: flow rate, able to seal, and paleo/future hydrology
- Four geochemical: heat effects, water and waste interaction, water and rock interaction, and ability to affect transport

National Research Council, 1978, *Geological Criteria for Repositories for High-Level Radioactive Wastes,* National Academy of Sciences, Washington, DC.

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1980: Earth Science Technical Plan Working Group – Criteria/Factors

- Nation (48 states)/Province/Region/Area/Site
- Rock: nine factors
- Groundwater: five factors
- Tectonics: four factors
- Mineral resources
- General Considerations
  - "It will be difficult to develop a universally acceptable set of criteria..."

U.S. Geological Survey, 1980, *Plan for Identification and Geological Characterization of sites for Mined Radioactive Waste Repositories,* Water-Resources Investigations, Open-File Report 80-686

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1980: EIS for Commercially Generated Radioactive Waste

- **Alternatives**
  - **Sub-seabed**
  - **Island**
  - **Ice sheet**
  - **Deep borehole**
  - **Rock melt**
  - **Deep well**
  - **Outer space**
  - **Storage**
  - **Treatment (e.g., transmute)**
- **Mined geologic disposal selected**
  - **Salt (beds and dome), granite, shale, and basalt considered**

Department of Energy, 1980, *Environmental Impact Statement on Management and Disposal of Commercially Generated Radioactive Wastes*, DOE/EIS-0046

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1980: USGS – Salt and Crystalline

- **Concerns with salt: resources and stability**
- **Crystalline favorable attributes**
  - **Widespread**
  - **Stable**
  - **Low permeability**

Smedes, Harry W., 1980, *Rationale for the Geologic Isolation of High-Level Radioactive Waste, and the Assessment of the Suitability of Crystalline Rocks,* U.S. Geological Survey, Open-File Report 80-1065

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1982: Nuclear Waste Policy Act Process

- **Section 112**
  - **Issue guidelines and consult with affected Governors**
  - **Secretary nominate at least 5 sites as suitable for characterization (1st repository)**
  - **Secretary recommend 3 nominated sites**
  - **President review recommendations**

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1982: Nuclear Waste Policy Act Section 112 (a) Guidelines

- Consult: CEQ, EPA, USGS, and interested Governors
- Concurrence of NRC
- "...shall specify detailed geologic considerations that shall be primary criteria for the selection of sites in various geologic media."
- "...shall specify factors that qualify or disqualify any site..."
- Include "... factors pertaining to the location of valuable natural resources, hydrology, geophysics, seismic activity, and atomic energy defense activities, proximity to water supplies, proximity to populations, ..."
- "... take into consideration the proximity to ... waste ..."
- "... shall specify population factors that will disqualify any site ..."
- "... consider the cost and impact of transporting"
- "... consider the various geologic media"
- "... use guidelines ... in considering candidate sites for recommendation"

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1984: 10 CFR 960 Guidelines

- 960.3 Implementation Guidelines (*process*)
- 960.4 Postclosure Guidelines (*criteria*)
- 960.5 Preclosure Guidelines (*criteria*)
  - Includes safety, socioeconomics, and cost
- A process and criteria to lead to the identification, nomination, recommendation, and characterization of sites

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40 CFR 197/10 CFR 63/10 CFR 963

- **The approach in 960 is fundamentally subsystem oriented, with go/no go criteria for the subsystems**
- **For Yucca Mountain, the NAS recommended a system-oriented, risk based approach that produced 40 CFR 197, *Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV*; 10 CFR 63, "*Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada*"; and 10 CFR 963, *"Yucca Mountain Site Suitability Guidelines".***
- **960 and 963 consider the same information, but can use them differently**
  - **960 as go/no go criteria**
  - **963 as inputs to an assessment, that can lead to a go/no go result**

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Summary

- **Ever since the 1957 NAS report**
  - **More than site characteristics were considered, e.g., the waste form, cost, and societal**
  - **Multiple geologic media have been considered**

- **"*Today, I am announcing an internal working group to assess the Blue Ribbon Commission recommendations and develop a strategy that builds on its excellent work.*" 2/15/2012**