

Scientific Uncertainties and Political Maneuvering: the US Experience

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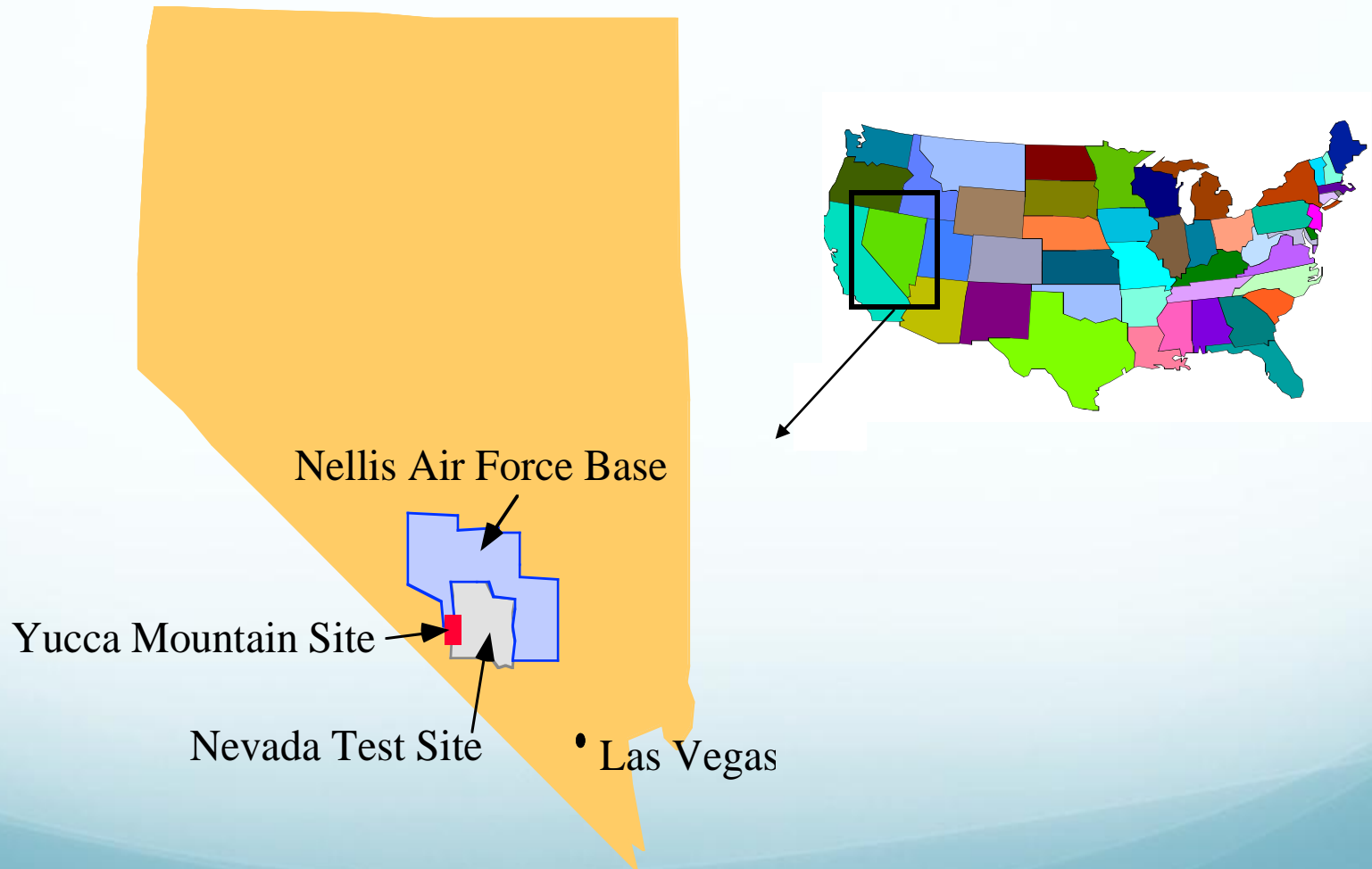
September 19, 2016

Governing Nuclear Waste Conference, Freie Universitat Berlin

History of U.S. High Level Waste

- 1957 National Academy study
- 1970s Lyons, Kansas
- 1970s Crisis: Ford/Carter policy on reprocessing
- 1982 Nuclear Waste Policy Act
 - Mandated disposal in a geologic repository
 - DOE, NRC, EPA roles
- 1987 Nuclear Waste Policy Act Amendments
 - One site for study: Yucca Mountain, NV
- 2002 DOE, Presidential, Congressional approval of site
- 2008 DOE sends license application to NRC (Bush administration)
- 2010 DOE withdraws application (Obama administration)
- 2012 Blue Ribbon Commission on America's Nuclear Future
- 2016 Stalemate

Yucca Mountain Site Location

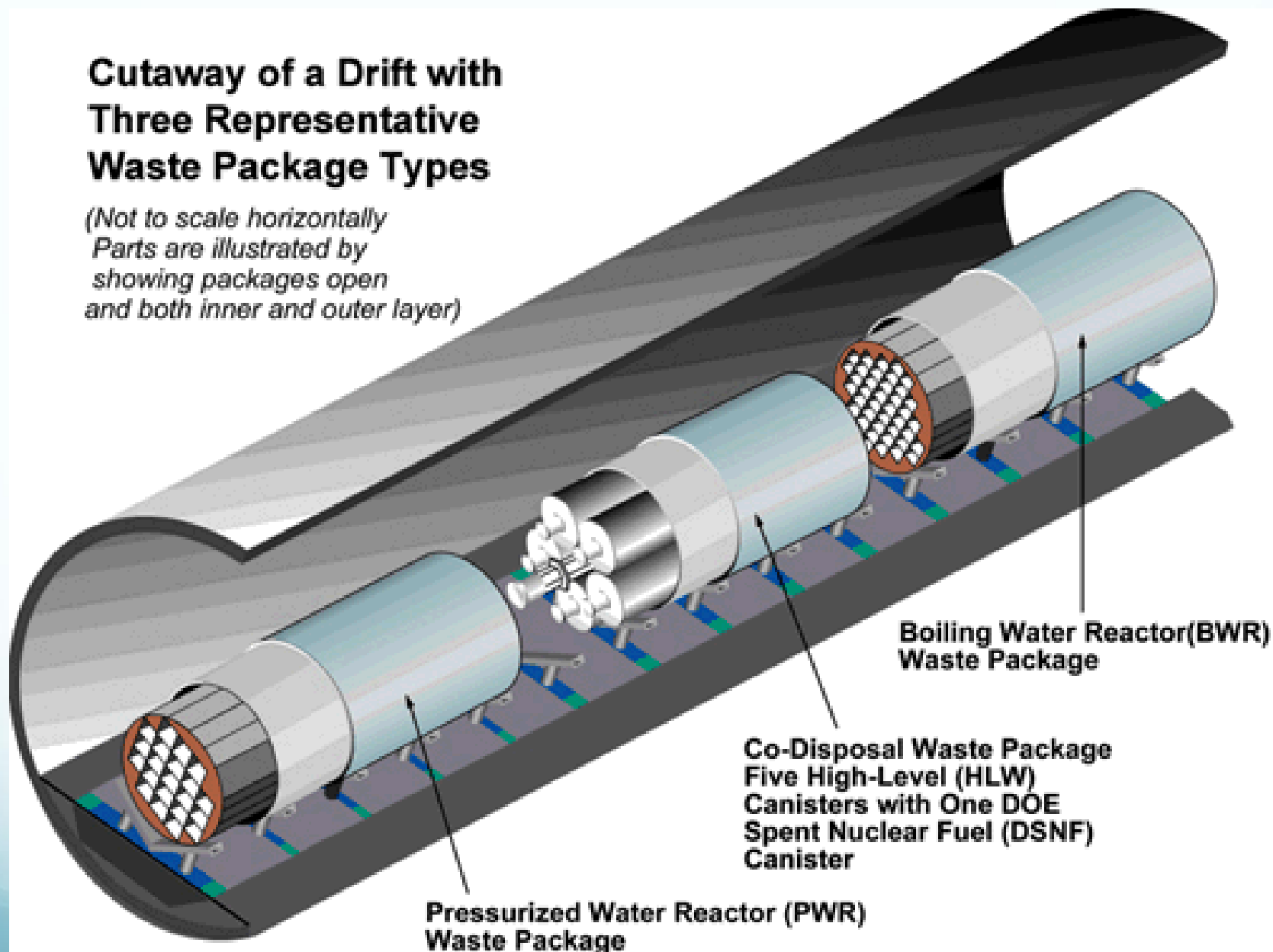




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Cutaway of a Drift with Three Representative Waste Package Types

*(Not to scale horizontally
Parts are illustrated by
showing packages open
and both inner and outer layer)*

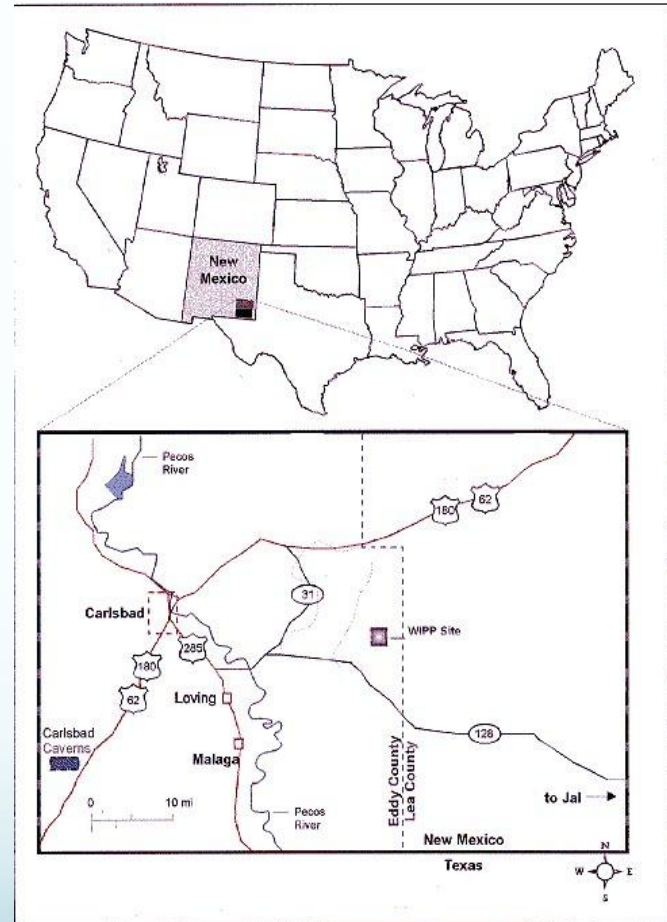


BRC Recommendations

- Need a new approach to repository siting that is
 - Consent-based, adaptive, staged, transparent, and standards and science-based
- Need a new organization to manage waste program
 - Integrated program of waste storage, transportation, and disposal
- Assured access to nuclear waste funds
- Expedite development of one or more geologic repositories
- Expedite development of one or more interim storage facilities
 - “orphaned” spent fuel a priority

Waste Isolation Pilot Project (WIPP)

- Only operating geologic repository for long-lived waste
- Defense-only TRU
- 800 m deep in bedded salt near Carlsbad, NM
- Opened in 1999
- To date received over 10,200 shipments
- Supported by locals



WIPP Accidents

WIPP drift with wastes

(courtesy ANL)

- February 2014: 2 Accidents
 - Feb 5: Salt hauling truck fire
 - Feb 14: Waste canister explosion
 - Release of radioactivity above-ground
 - 22 workers received internal doses of $<100 \mu\text{Sv}$
 - Organic vs. inorganic kitty litter
 - Cost of accident remediation: \$2B
- DOE self-regulates the site

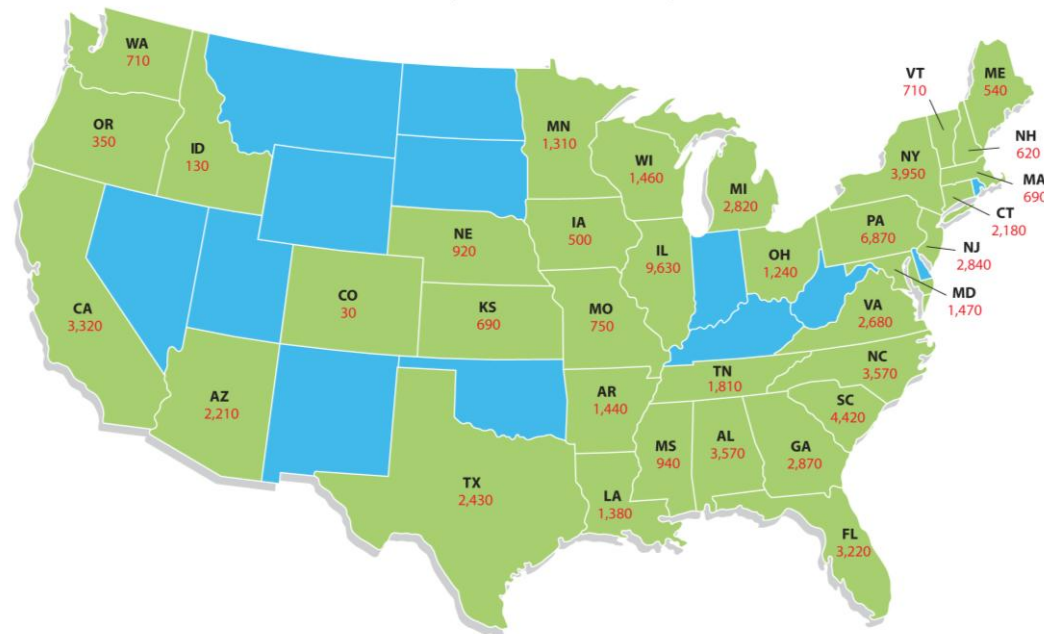


US Waste Status

- 100 operating reactors
- Spent Fuel
 - >74,000 metric tons at 65 reactor sites
 - >15,000 metric tons HLW and spent fuel in weapons complex
- A 1000 MWe reactor produces about 20 metric tons spent fuel/year

Used Nuclear Fuel in Storage

(Metric Tons, end of 2014)



Source: ACI Nuclear Energy Solutions

Trend: Plant Shutdowns

Shutdown Plants	Status
Crystal River	SAFSTOR
Kewaunee	SAFSTOR
Vermont Yankee	SAFSTOR
San Onofre	DECON
Humboldt	Done
Lacrosse	Done
Zion 1 & 2	DECON
Haddam Neck	Done
Maine Yankee	Done
Yankee Rowe	Done
Rancho Seco	Done
Trojan	Done
Ft St Vrain	Done

Planned Shutdown	Date
Ft Calhoun	12/2016
Fitzpatrick	2016?
Clinton	2017
Quad Cities 1 & 2	2018
Oyster Creek	2019
Pilgrim	2019
Diablo Canyon 1 & 2	2025

Recent Developments

- Consent-based siting process – Department of Energy
 - Public engagement to develop a consent-based siting method
 - Use above to design a consent-based process
 - Work with potential communities
- Potential new centralized storage facilities:
 - Waste Control Specialists Texas site (40,000 MT)
 - License application submitted to NRC, 4/2016
 - Holtec International New Mexico site
 - License application to be submitted 11/2016
- Continued Storage Rule (NRC)
 - Indefinite storage results in only small impacts



Waste Control Specialists site plan

Analysis

- Current Stalemate
 - **Congress**: waste safe now, next election important
 - **Dept of Energy**: no legal authority to solve it entirely
 - **Utilities**: Need to reduce costs – will do nothing
 - **Dept of Justice**: (Judgment Fund) – forces lowest cost option
 - **Nuclear Regulatory Commission**: no forcing mechanism in current regulations for action
 - **Anti-nuclear groups**: oppose repository, waste transport
 - **Decommissioning sites**: want waste out of there

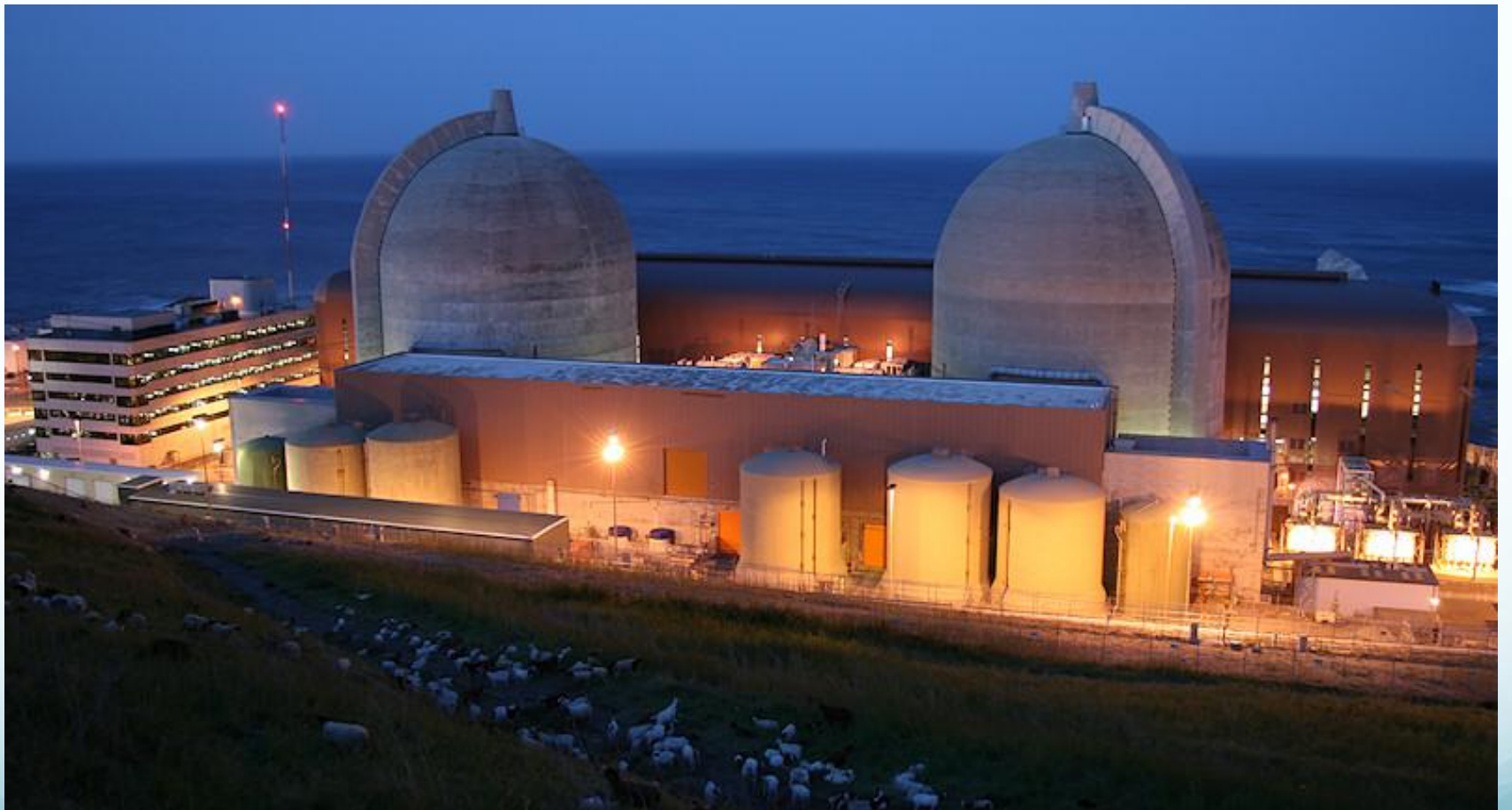


Why has the US failed so far?

- Started with Decide, Announce, Defend
 - Not consent-based
 - Nevada never wanted it
- Appeal to contractual law
 - Set a deadline in federal law
 - established a legal liability
- Yucca Mountain was always used by political forces
 - Affected budget, management
- Appeal to the quantitative
 - Site evaluation based solely on probabilistic risk assessment results

Elements to establish a repository?

- Comparison to WIPP, Finnish, Swedish sites
 - Approval comes from positive experience with things nuclear (Wynne 1991)
 - Jobs, improved economic climate
 - No threats to other endeavors (gaming industry in Nevada)
 - Compensation necessary, as is ability to seek out technical information
 - Trust of waste management organization/regulator necessary
 - Ability to retain some control over the ability of the facility to operate necessary (if there's a violation, can shut it down)
 - Difficult in US case because of Atomic Energy Act
 - Ability to veto site



Backup Slides

Back end: Nuclear Waste Disposal

- Prediction is used to evaluate a repository and judge its future performance
- Most countries plan on some sort of modeling to make this prediction

Country	Evaluative Approach
Canada	Variety of options
Finland	Deterministic analysis and qualitative judgment
France	Deterministic analysis
Sweden	Probabilistic & Deterministic analysis
Switzerland	No decision
UK	No decision
USA	Probabilistic performance assessment

WIPP

- 1974: Local S NM officials interested to host repository
- 1979: Congress authorizes R&D facility at site
- 1981: NM sues because Congress denied state a veto and prohibited NRC from licensing site
- Suit settled, but other problems appeared, including waste transport
 - Site ready to open in 1988, but didn't
- 1992 Land Withdrawal Act
 - Required EPA to certify site
 - Gave the state authority to regulate mixed waste at WIPP under RCRA
 - Prohibited HLW at WIPP, even for experiments
- New roads built to direct waste around Santa Fe
- 1998: WIPP opened

Back end: Modeling = Performance Assessment

- Dept. of Energy used “Total System Performance Assessment”
- “Probabilistic analysis identifies all the features, events, and processes [FEPs] that affect repository performance”
- A series of ‘cascading models meant...to capture repository performance’

