



**Congressional Research Service**

Assisting the Congress with its deliberations and legislative decisions

# **Nuclear Waste Policy: How We Got Here**

Presentation to the Blue Ribbon  
Commission on America's Nuclear Future

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**March 25, 2010**

# Role of CRS

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- Organization within the Library of Congress that provides objective, timely, and confidential information and analysis specifically for Congress
- CRS does not advocate policy

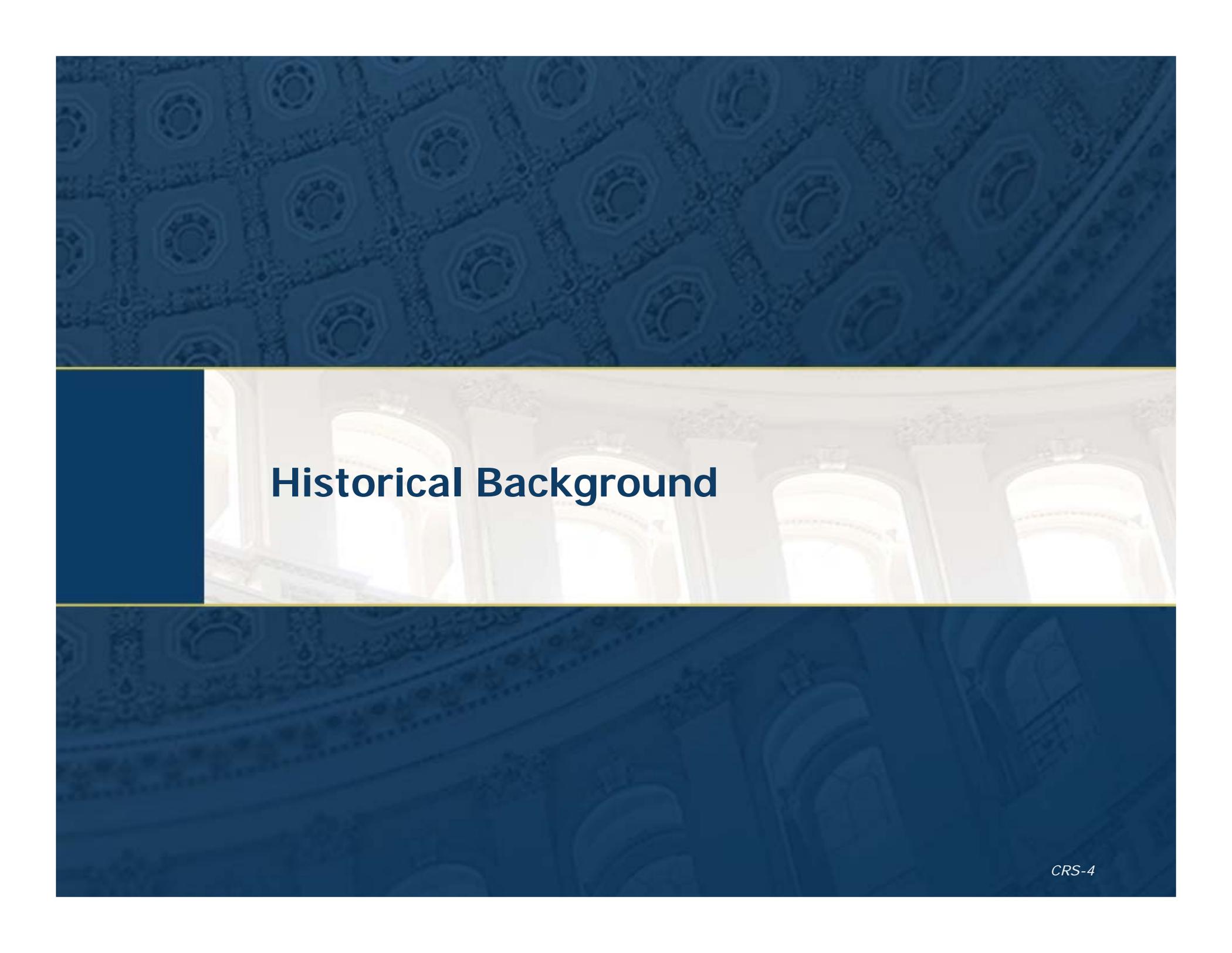


# Agenda

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- Historical background and early waste studies
- Nuclear Waste Policy Act: Debate and implementation
- Current inventories of commercial spent nuclear fuel



The slide features a dark blue background with a repeating pattern of circular architectural motifs. A horizontal band in the center shows a bright, overexposed photograph of a grand interior space with a series of arched windows and classical columns. The text "Historical Background" is centered in this band.

# Historical Background

## Early Weapons Production Waste

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- Irradiated reactor fuel dissolved in acid so that newly created plutonium can be separated for weapons, leaving highly radioactive liquid waste
- “High level” liquid waste from such “reprocessing” stored in large underground steel tanks
- Naval reactor spent fuel later also reprocessed to recover highly enriched uranium



# Initial Waste Management Planning

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- **National security** need for rapid production took precedence over waste management
- **Underground tanks** expected to be sufficient until long-term solution could be found
- **1949 AEC Report:** “better means of isolating, concentrating, immobilizing, and controlling wastes **will ultimately be required**”



## Early Planning for Commercial Waste

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- Atomic Energy Act of 1954 created framework for nuclear power industry
- Commercial spent fuel was expected to be reprocessed like defense spent fuel, producing similar liquid waste
- Reprocessing required for breeder reactors
- Volume of commercial high-level waste was expected to be far higher than defense waste by 2000



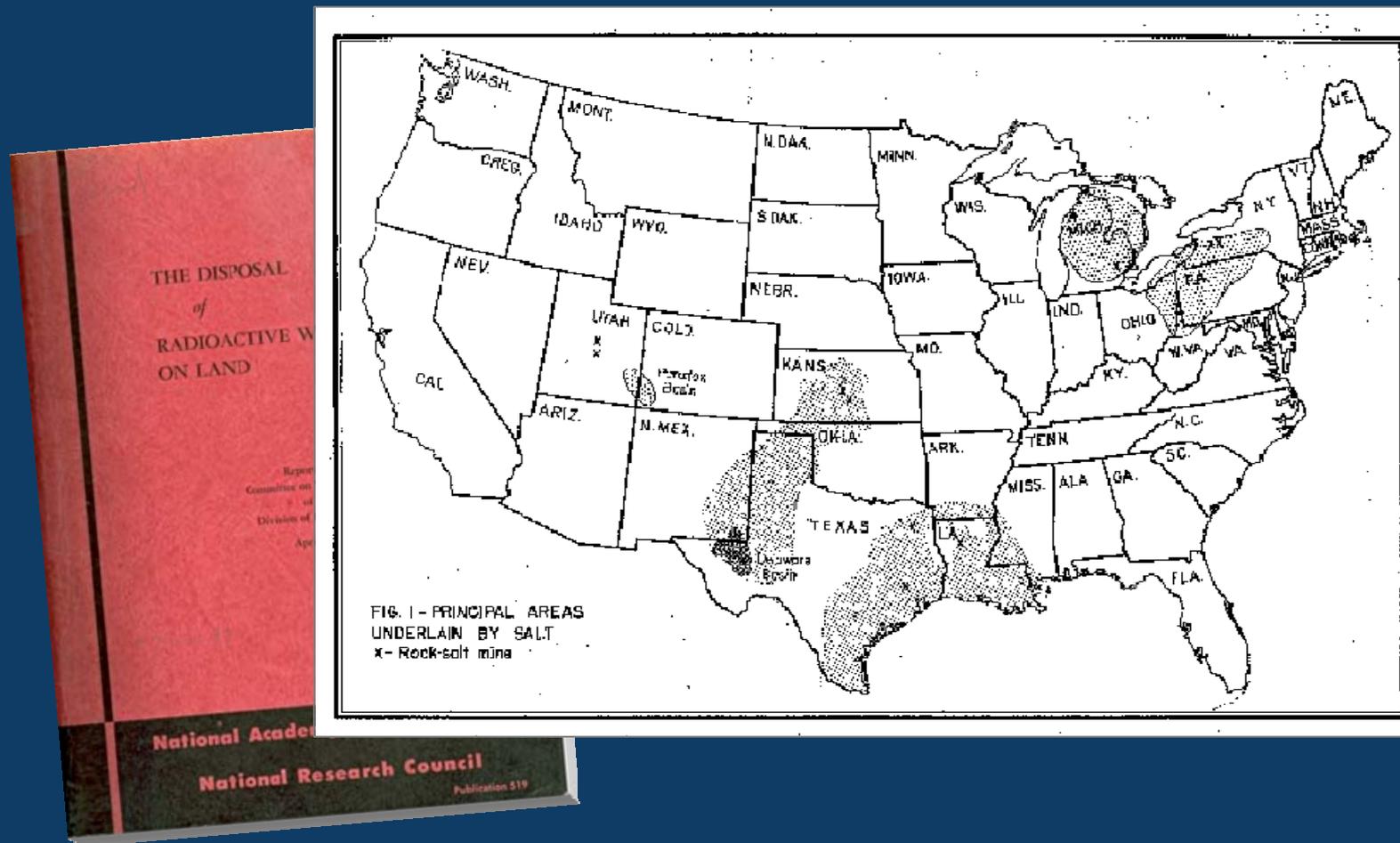
## 1957 NAS Waste Disposal Study

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- “The Committee is convinced that radioactive waste can be disposed of safely in a variety of ways and at a large number of sites in the United States.”
- Salt deposits found to be the “most promising method of disposal”
- Reactor waste expected to be liquid for transportation and disposal, but solidification “would be advantageous”
- Transportation must be considered in the location of nuclear facilities



# From "Disposal of Radioactive Waste in Salt Cavities" *Appendix to 1957 report to the National Academy of Sciences*



## Initial AEC Site Search

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- Focus on salt formations, as recommended by NAS in 1957
- Experiments conducted in salt mines with solids and liquids
- Solidification methods investigated
- Deep injection of liquid waste considered at tank storage sites
- First commercial reprocessing plant opens at West Valley, NY, in 1966, producing first commercial liquid high-level waste



## First Repository Plan: Lyons, Kansas

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- AEC announced plan in June 1970 to investigate abandoned salt mine for disposal demonstration project
- Six-month site investigation anticipated
- Low-level plutonium waste (transuranic waste) disposal could begin by 1974, high-level waste by 1975
- Strong state opposition by 1971:  
“The Federal Government cannot compel a sovereign State to do itself and its citizens possible irreparable injury if its officials refuse to be stampeded.” – *Representative Joe Skubitz*



## Technical Problems With Lyons Site

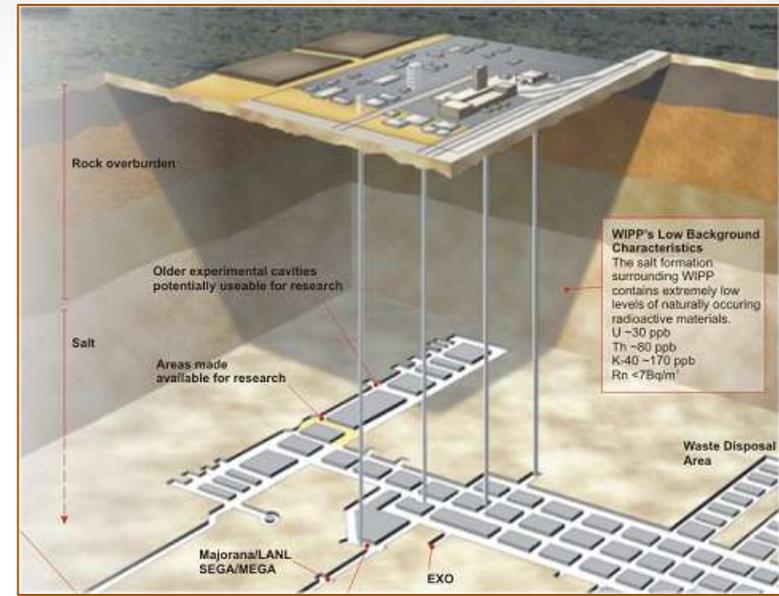
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- Too close to another salt mine
  - Numerous oil and gas wells in area, some of which struck pressurized brine pockets
  - Undocumented solution mining in the area
- “The Lyons site is a bit like a piece of Swiss cheese”  
– *Kansas State Geologist William W. Hambleton*
- AEC issued statement in 1974 that site is no longer under consideration



# Another Salt Site: Waste Isolation Pilot Plant

- Bedded salt site near Carlsbad, NM, selected for exploratory work in 1974 with local support
- Like Lyons, planned for high-level waste and defense transuranic (TRU) waste, but high-level waste dropped
- Congress authorized for TRU waste in 1979 but received first shipment in 1999
- Some local support for high-level waste but state officials strongly oppose



Source: DUSEL at Carlsbad, NM WIPP Site



# AEC Environmental Statement

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- 1974 Draft Statement on developing permanent repositories and storage sites
- AEC denies “complete reliance on perpetual storage in man-made surface structures”
- Anticipates Geologic Disposal Pilot Plant
- AEC to continue evaluating geologic formations at conventional depths
- Liquid waste to be solidified for transportation, storage, and disposal
- Hanford, Idaho, and Nevada Test Site named as surface storage candidates



# Unconventional Methods Rejected

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AEC Draft Environmental Statement found unconventional disposal methods not “viable”:

- Polar ice sheets
- Seabed disposal concepts
- Very deep boreholes and wells
- Melting in lava
- Outer space



# AEC and ERDA Continue Site Search in 1970s

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- Bedded salt
  - Salina Basin—Lake Erie and lower Michigan
  - Paradox Basin—Utah
  - Permian Basin—Texas
- Salt domes—Mississippi and Louisiana
- Basalt—Hanford
- Welded Tuff—Yucca Mountain, NV
- 1976 ERDA technical report expects repository demonstration by 1985



# Policy Change: Once-Through Fuel Cycle

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- AEC started GESMO for plutonium fuel in 1973
- Nonproliferation concerns about GESMO heightened by 1974 India nuclear test
- President Ford announced “deferral” of commercial reprocessing in October 1976
- President Carter extended deferral indefinitely in 1977
  - Develop “alternative designs” for breeders
  - Focus on non-weapons-material fuel cycles
  - Initiated study of spent fuel storage needs
  - NRC terminated GESMO

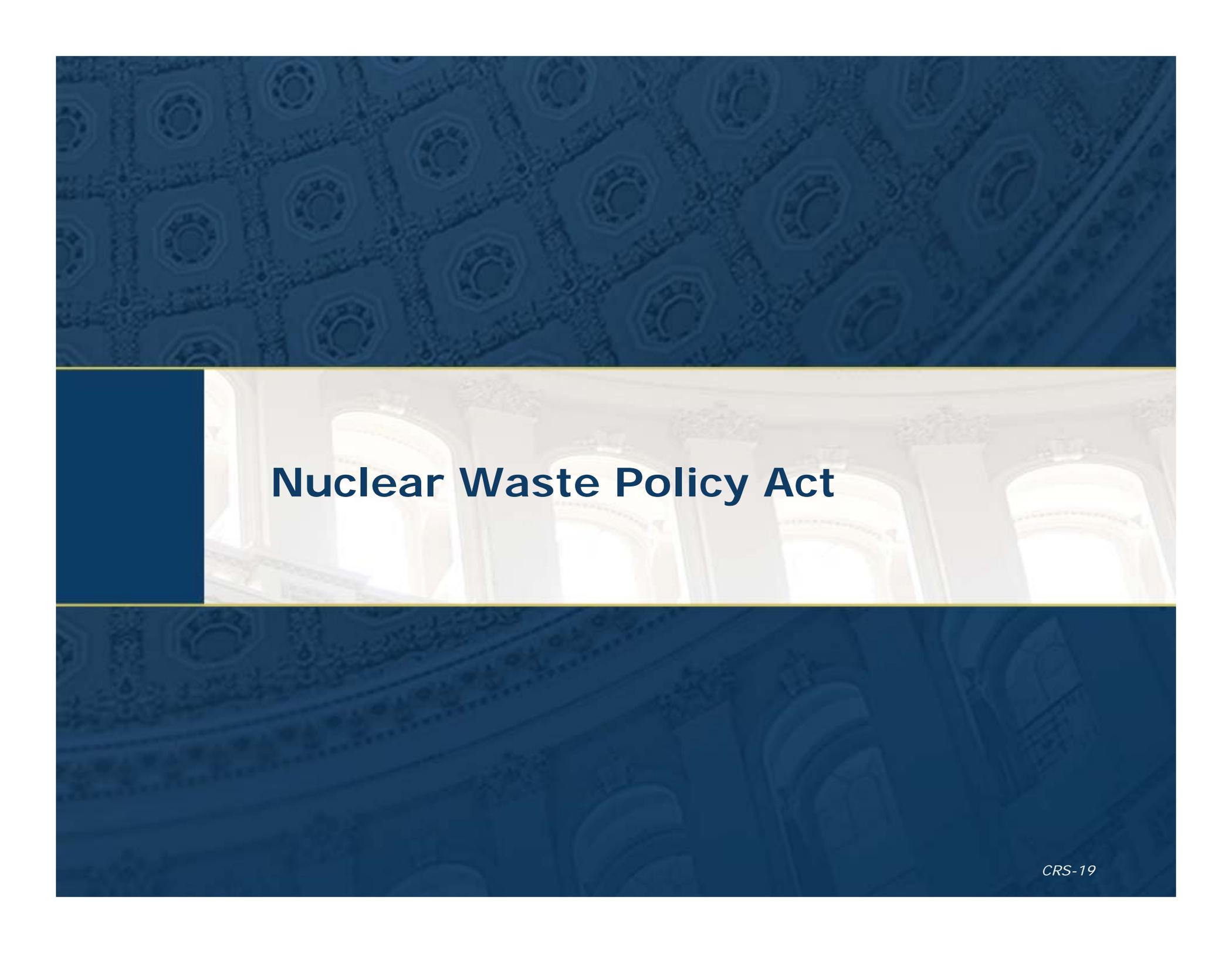


## Action Under New Policy

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- Away-from-reactor storage to prevent capacity problems at plant sites
- Repositories to hold larger amounts of uranium and plutonium
- Interagency Review Group reports in 1979
- Carter policy announced in 1980
  - Repository site to be chosen from several qualified alternatives
  - State Planning Council established





# Nuclear Waste Policy Act

## Considerations in NWPA Debate

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- Perception of imminent storage crisis at reactor sites
- Difficulty of developing waste sites without congressional mandate
- Concerns by potential host states
- NWPA enacted in late 1982 after nearly 4 years of debate (P.L. 97-425)



## Site Search Under NWPA

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- Concept: Technically driven process that would be considered fair by selected site
- Two repositories envisioned in East and West
- First repository chosen from previous candidate sites
- Second repository site to use different geologic media, subject to congressional approval
- First repository limited to 70,000 metric tons until second repository is licensed



## Other Key NWPA Provisions

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- OCRWM created in DOE to focus on waste
- DOE to sign contracts with utilities to dispose of waste by 1998 in return for fees
- Monitored retrievable storage (MRS) site search authorized
- Federal interim storage for emergencies
- Grants for state oversight and “state veto”
- Waste facilities licensed by NRC using EPA environmental protection standards



# Implementation: First Repository

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- DOE was to select 5 candidate sites from those under consideration (9 sites)
- Three sites for characterization (full study) to be chosen among the 5
  - Multiattribute Utility Analysis rankings:
    - Yucca Mountain (Nevada)
    - Richton Dome (Mississippi)
    - Deaf Smith (Texas)
    - Davis Canyon (Utah)
    - Hanford (Washington)
  - DOE in May 1986 selected Yucca Mountain, Deaf Smith, and Hanford
- Strong congressional opposition in selected states, lawsuits filed



# Potentially Acceptable Sites for the First Repository



Source: DOE Office of Civilian Radioactive Waste Management. Adapted by CRS.

# NWPA Implementation: Second Repository

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- Crystalline rock formations identified by DOE survey begun in 1979
- Region-to-area screening methodology issued in 1985
- Preliminary candidate sites named in Draft Area Recommendation Report in January 1986
  - Twelve candidate sites
  - Seven states
  - Eight additional candidate areas



# Proposed potentially acceptable sites and candidate areas for second repository

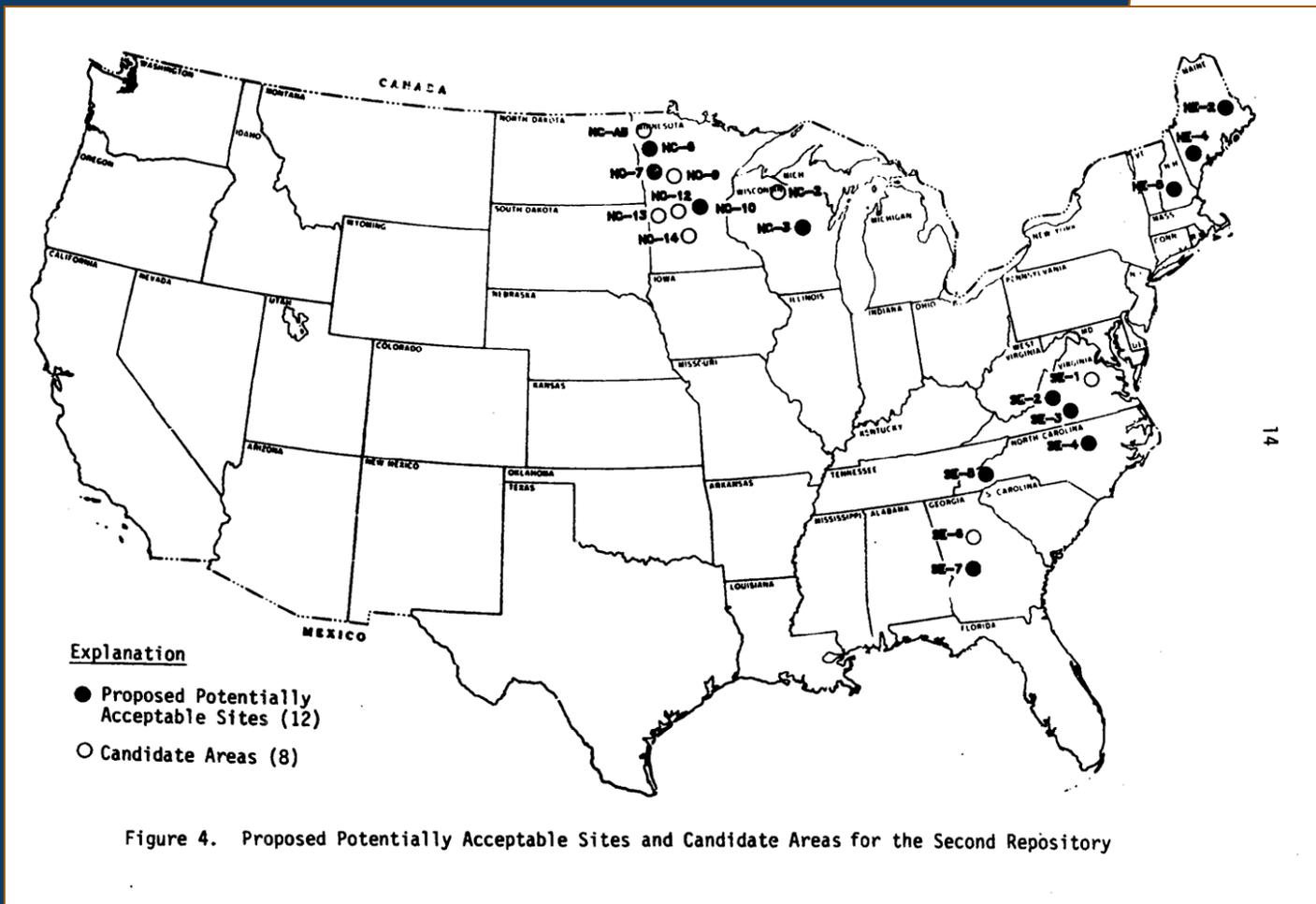


Figure 4. Proposed Potentially Acceptable Sites and Candidate Areas for the Second Repository

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DOE  
DISTRIBUTION CATEGORY

DOE/C  
DE87

DRAFT

EA RECOMMENDATION REPORT  
CRYSTALLINE REPOSITORY PROJECT  
OVERVIEW

JANUARY 1986

DEPARTMENT OF ENERGY  
RADIOACTIVE WASTE MANAGEMENT  
REPOSITORY PROJECT OFFICE

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# Opposition to Second Repository

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- DOE community meetings drew large crowds of opponents
- Host state officials and congressional delegations fought project
- Energy Secretary Herrington suspended second repository in May 1986
  - Lower spent fuel projections
  - Rising cost projections



## Potential Hosts Criticize Program

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- Methodology for ranking candidates for first repository attacked
- DOE cancellation of second repository angered western states
- Tennessee opposed MRS site choice
- Opposition threatened to paralyze program after only five years
- Emergency federal interim storage not needed because of dry storage technology



## Summary of Congressional Sentiment by Representative Morris Udall

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“We created a principled process for finding the safest, most sensible place to bury these dangerous wastes.”

“Today, just 5 years later, this great program is in ruins.”

Potential host states “no longer trust the technical integrity of the Department of Energy’s siting decisions.”

*Statement on the House floor,  
December 21, 1987*

**Image source:** Addresses and Special Orders Held in the U.S. House of Representatives and the Senate, Presented in Honor of The Honorable Morris K. “Mo” Udall, A Representative from Arizona, One Hundred Second Congress, First Session. Washington, D.C.: U.S. Government Printing Office, 1993.



## NWPA Amendments of 1987

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- Named Yucca Mountain as sole repository candidate site
  - Sequential site characterization cuts costs
  - Technical support cited for Yucca Mountain
  - Political dynamics
- Eliminated second repository program
- Rescinded MRS site selection and tied future operation to Yucca Mountain progress
- Offered benefits to host states
- Established Nuclear Waste Negotiator to find voluntary sites
- Established Nuclear Waste Technical Review Board to increase confidence in DOE program



# Implementation of 1987 Amendments

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- DOE quality control problems caused delays
- Nevada not interested in benefits, denies state permits
- Yucca Mountain found to have trouble meeting EPA general repository standards
- Energy Policy Act of 1992 (P.L. 102-486)
  - Required EPA standards just for Yucca Mountain, based on NAS study
  - Language to eliminate the need for state permits was dropped



# Nevada Nuclear Waste News



Nevada Nuclear Waste News  
Vol. 3, No. 10

*"There is no right way to do a wrong thing"*

**Fundamental problems with DOE decisions**

**'Expert judgment' at Yucca Mountain?**

The federal government's use of expert judgment in place of hard, scientific data in conducting risk assessments for the proposed Yucca Mountain high-level nuclear waste dump could result in serious miscalculations of the health and safety risks to present and future Nevadans.

That is one of the principal findings of a report entitled "Expert Judgment in Assessing RADWASTE risks: What Nevadans Should Know About Yucca Mountain," written by Dr. Kristin Shrader-Frechette and recently published by the Nevada Nuclear Waste Project Office.

Shrader-Frechette, Distinguished Research Professor at the University of South Florida's Center for Urban Ecology, analyzed risk assessments done for other nuclear waste facilities in the United States to evaluate how effective they are in predicting risks and to understand how the use of assumptions and expert judgment strengthen or weaken such assessments.

The author noted that in 1962, scientists calculated risks associated with a site for burial of transuranic and low-level radioactive wastes at Maxey Flats, Ky., and determined that it

## Nevada Nuclear Waste News



**Inside**

- The science of selling out to the nuclear power industry
- *Journal of Commerce*: Utilities should take the job back from DOE
- State publishes four new reports in its ongoing study of Yucca Mountain
- Economist warns that dump may not be economical
- Congress rushes to weaken dump site safety standards

Vol. 3, No. 10      *"There is no right way to do a wrong thing"*      November 1992

**Fundamental problems with DOE decisions**

**'Expert judgment' at Yucca Mountain?**

The federal government's use of expert judgment in place of hard, scientific data in conducting risk assessments would take 24,000 years for the waste to migrate one-half inch. Yet only 10 years after opening the data are interpreted and what assumptions are made. For example, she concludes that

*"In fact, there is a disturbing pattern of overly optimistic and inaccurate risk assessments and predictions when dealing with things nuclear."*

In fact, there is a disturbing pattern of overly optimistic and inaccurate risk assessments and predictions when dealing with things nuclear.

She attributes this to a tendency on the part of risk experts in the nuclear field to use methodological value judgments (consciously or unconsciously) which color and influence the way

Shrader-Frechette also found that radioactive waste risk assessments are especially prone to a number of deficiencies in logic that make predictions of future performance extremely problematic.

Fallacies of logic such as the appeal to ignorance (concluding something is true or accurate in the absence of information to the contrary), begging the question (assuming what one is trying to prove), and numerous others have caused serious consequences whenever they were used in risk assessments of radiation-related facilities (such as Hanford, Wash., Fernald, Ohio, and Maxey Flats) in the past.

(Continued on Page Four)

Source: Nevada Agency for Nuclear Projects. Adapted by CRS.

# Nuclear Waste Negotiator

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- Authorized to offer any incentives to host waste facilities
- Negotiated agreement could not take effect without enactment into law
- By early 1990s, negotiated agreement for MRS seemed the best hope for meeting 1998 NWPA deadline
- Some localities interested, but blocked by state governments
- Indian tribes beyond state control, but Congress cut funding
- PFS site in Utah received NRC license in 2006, but Interior Department denied permits





## Proposed Rewrites of NWPA in 1990s

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- 104<sup>th</sup> Congress considered bills to authorize interim surface storage at Yucca Mountain to meet 1998 deadline
- House and Senate passed Yucca Mountain storage bills in 105<sup>th</sup> Congress; President Clinton opposed
- 106<sup>th</sup> Congress passed bill, vetoed by President Clinton, Senate narrowly sustained veto. Bill would have:
  - set deadlines for Yucca Mountain licensing
  - authorized surface storage at Yucca Mountain within 18 months of NRC repository construction permit



## Most Recent Actions

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- Several proposals in appropriations bills for federal storage sites
- Secretary of Energy issued Yucca Mountain “site suitability determination” in 2002 triggering action under NWPA:
  - President Bush recommended site to Congress
  - Nevada Gov. Guinn issued state disapproval
  - Approval legislation enacted (P.L.107-200)
- Yucca Mountain license application submitted June 2008
- DOE requested license application withdrawal in March 2010



# Summary of Past Siting Approaches

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- Administrative process (pre-NWPA)
- DOE selection of MRS site
- Site ranking process for first repository
- Screening process for second repository
- Benefits agreement for hosts
- Negotiations for voluntary sites
- Congressional designation of site (with multiple votes in support)
  - 1987 NWPA amendments
  - 1992 Energy Policy Act
  - Congressional votes for Yucca Mountain storage
  - 2002 Yucca Mountain approval legislation



## Challenges for Future Policy

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- Develop promising approaches—or combinations of approaches—not previously tried
- Determine why previous approaches didn't work and modify them accordingly
- Identify changed circumstances that may lead to better results





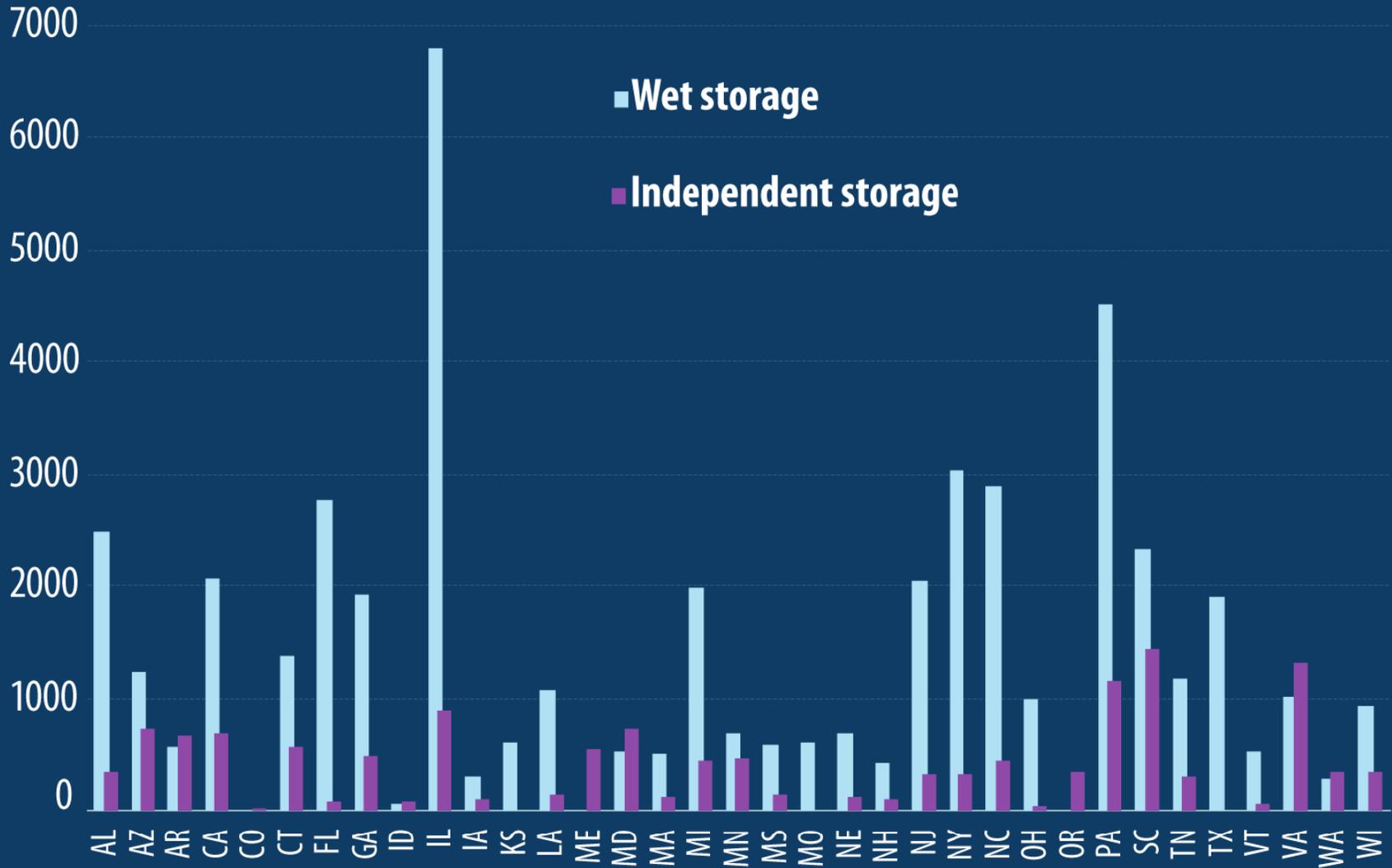
# Current Situation

## Commercial Spent Fuel in Storage at the End of 2009

	Metric tons	Assemblies	Dry casks
Reactor pool storage	48,818	169,732	
Independent (mostly dry) storage	13,865	49,121	1,232
<b>Total</b>	<b>62,683</b>	<b>218,853</b>	<b>1,232</b>

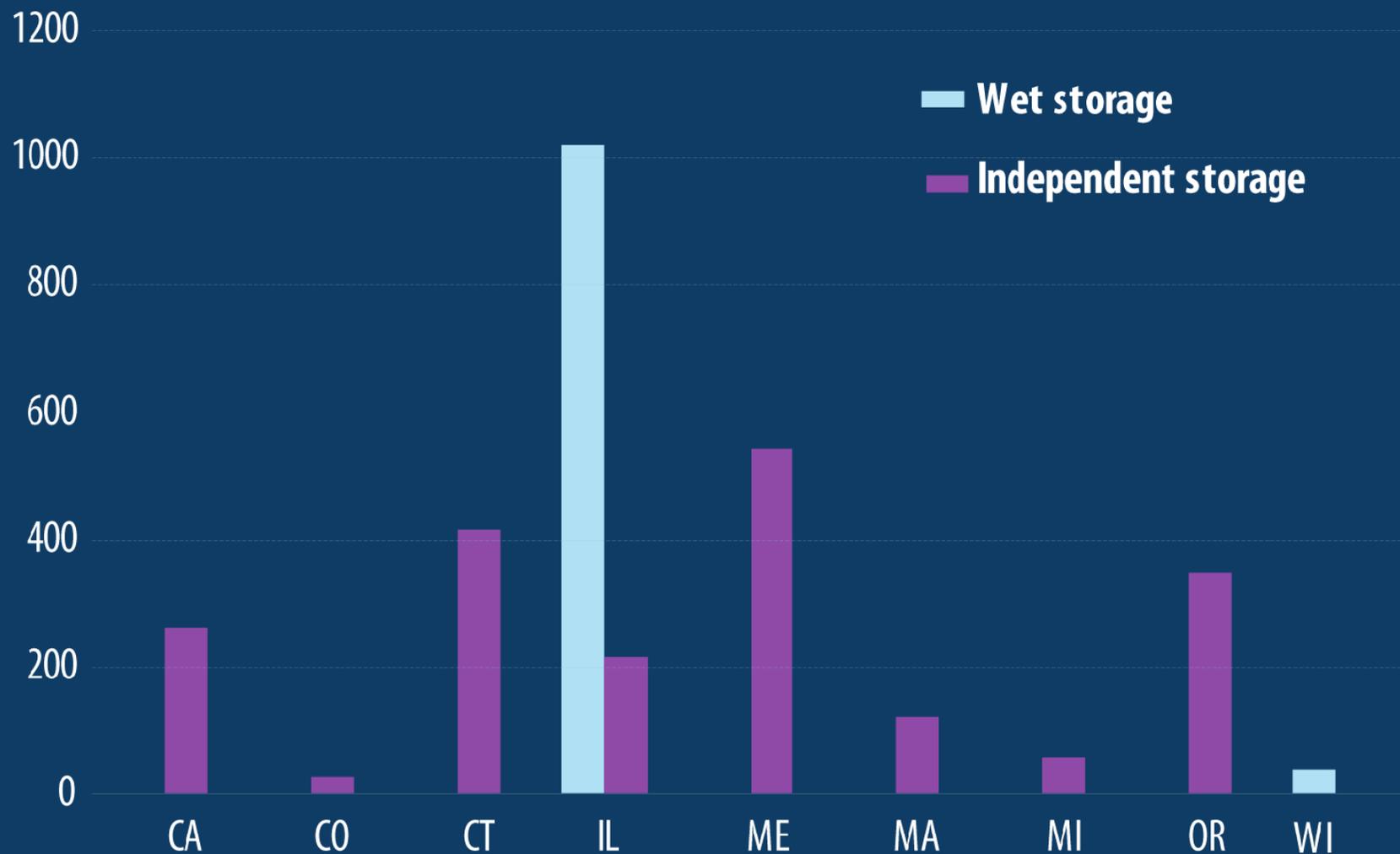
# State Breakdown of Waste Storage in 2008

(metric tons)



Source: ACI Nuclear Energy Solutions. Adapted by CRS.

# Waste Storage at Shutdown Sites



Source: ACI Nuclear Energy Solutions. Adapted by CRS.

# Waste Storage Trends

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- Recent annual U.S. spent fuel discharges range from **2,000-2,400 tons**
- **Need for dry cask storage** has increased as reactor pools have filled up
- **Higher marginal costs** incurred at shutdown sites
  - 3,000 metric tons in storage
  - 11 sites in 9 states



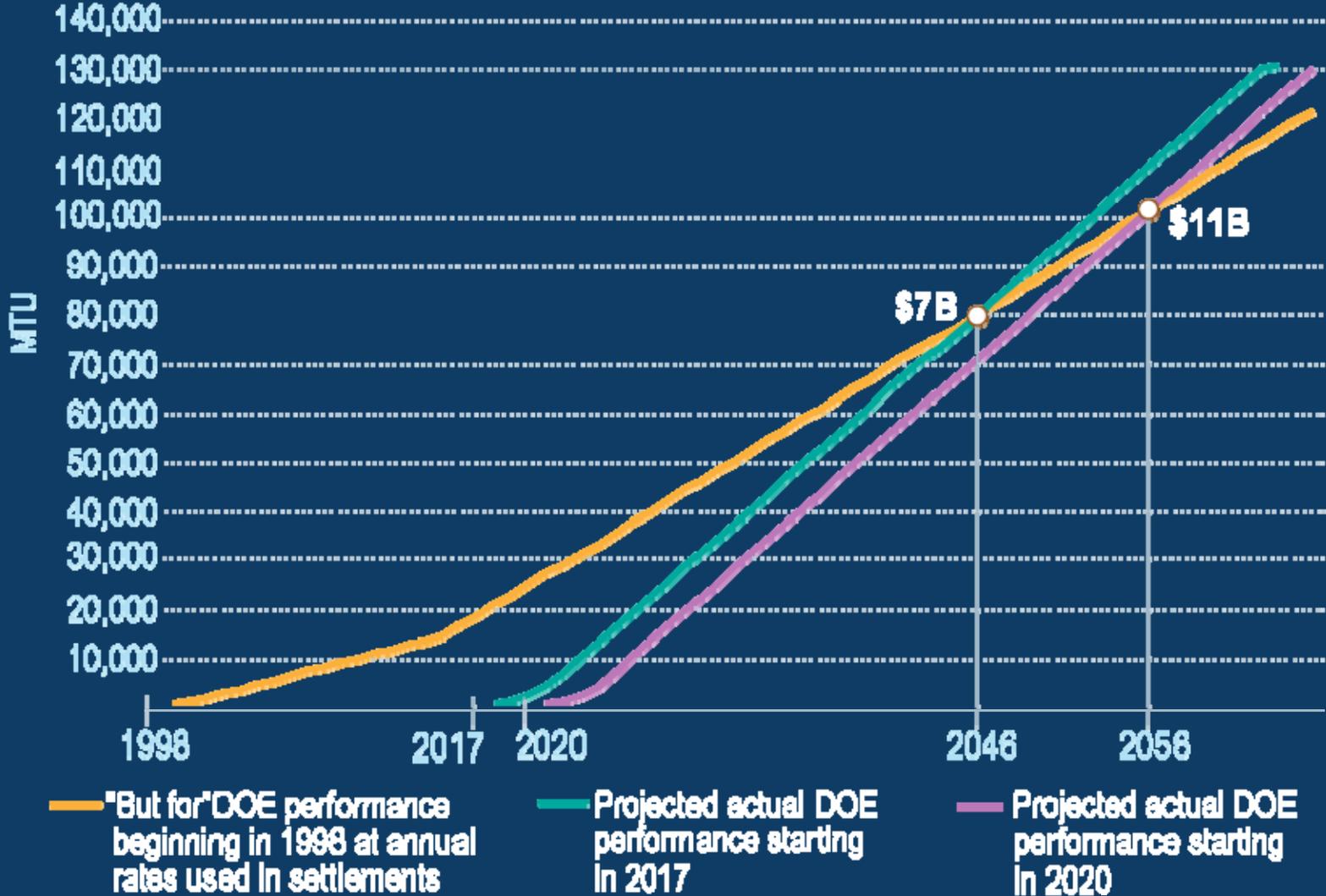
# Long-Term Storage Issues

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- Federal liabilities under breach of nuclear waste contracts
  - Partial breach:** storage cost payments of \$500 million per year
  - Full breach:** return of all payments plus interest, \$30 billion
- Impediments to new reactors
  - NRC** “waste confidence decision”
  - NWPA** requirement for waste contracts
  - Public opinion**
- DOE environmental cleanup penalties
- Long-term waste storage risk unknown



# DOE estimate of waste delay liabilities



Source: Yucca Mountain Program Status Update. DOE (2008). Adapted by CRS.

# Contact information

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