

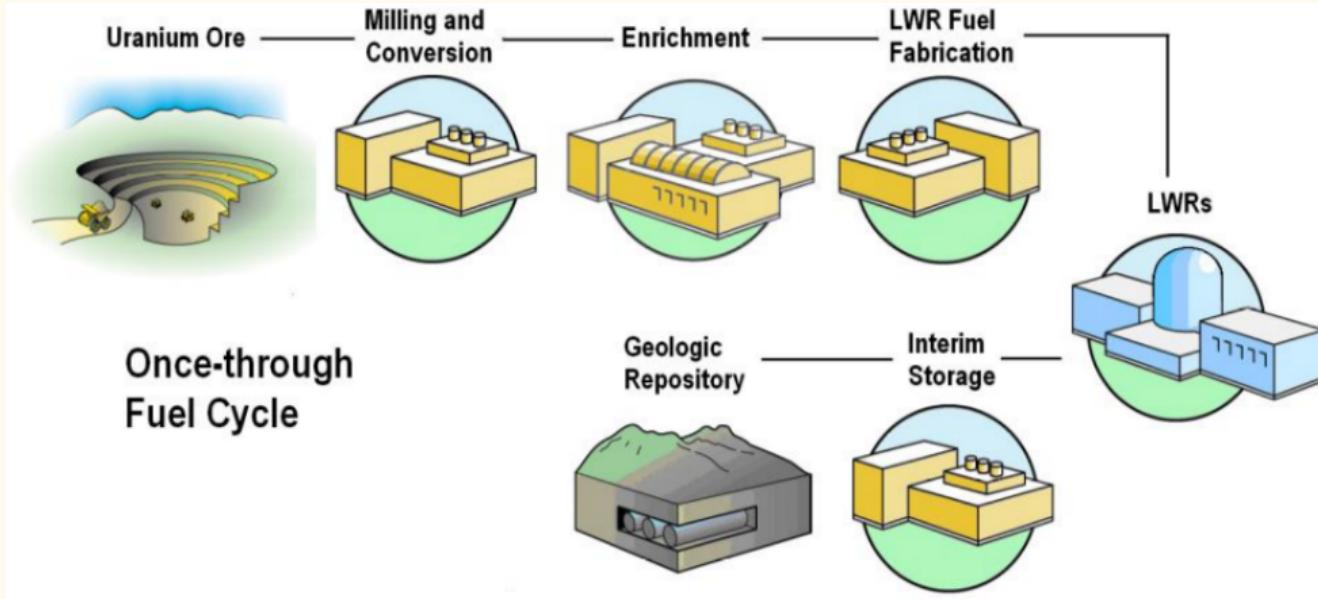
Yucca Mountain case study

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Nuclear fuel cycle



[1] Wigeland, R., et al., 2011. Identification, Description, and Characterization of Existing and Alternative Nuclear Energy Systems. INL/MIS-10-19680

Origins of nuclear power

The modern nuclear power age really began with the historic Atoms for Peace address delivered to the United Nations General Assembly by President Dwight D. Eisenhower in 1953 [2]

The United States knows that if the fearful trend of atomic military build-up can be reversed, this greatest of destructive forces can be developed into a great boon, for the benefit of all mankind. The United States knows that peaceful power from atomic energy is no dream of the future. The capability, already proved, is here today. . . . The more important responsibility of this atomic energy agency would be to devise methods whereby this fissionable material would be allocated to serve the peaceful pursuits of mankind. Experts would be mobilized to apply atomic energy to the needs of agriculture, medicine and other peaceful activities. A special purpose would be to provide abundant electrical energy in the power-starved areas of the world.

[2] Eisenhower, D. D., 1953. Atoms for Peace. Address to the 470th Plenary Meeting of the United Nations General Assembly

Relevant legislation in the early nuclear power era

Congress subsequently passed the Atomic Energy Act (AEA) in 1954

Created the Atomic Energy Commission (AEC) to promote ‘utilization of atomic energy for peaceful purposes to the maximum extent consistent with the common defense and security and with the health and safety of the public’

‘The development, use, and control of atomic energy shall be directed so as to promote world peace, improve the general welfare, increase the standard of living, and strengthen free competition in private enterprise’

AEC would go on to become the Nuclear Regulatory Commission (NRC)

DOE and EPA took on some responsibilities

USS Nautilus commissioned in 1954

Transit North Pole in 1958

Energy Reorganization Act of 1974 (EPA & NRC)

United States Department of Energy Organization Act of 1977

History of Yucca Mountain siting

Prior to 1982

Around the late 1950s political and social pressure mounted for a repository

National Academy of Sciences (NAS) concluded that geologic disposal was the ideal formation for HLW [3]

Public concerns about radioactive fallout due to nuclear weapons testing and dumping of low level radioactive waste into the ocean [4]

Senator Frank Church wanted High-Level Radioactive Waste (HLW) out of Idaho
SNF accumulation due to NPP big expansion in the 1960s

Oak Ridge National Laboratory (ORNL) conducted tests at a salt mine near Lyons, Kansas 1959 – 72

Given up in 1972 due to a host of social and technical issues causing friction between federal and state officials

[3] Hess, H. H., et al., 1957. The disposal of radioactive waste on land. National Academy of Science

[4] Walker, J. S., 2009. The road to Yucca Mountain: The development of radioactive waste policy in the United States

In 1975, the Nevada State Assembly Joint Resolution 15 invited the United States Department of Energy (DOE) to explore the Nevada Test Site (NTS) as a repository [5]

High unemployment in Clark County

Co-locate with solar Research & Development (R&D)

Expand on existing infrastructure at the Nevada Test Site

Public confidence in safety record and experience in nuclear materials handling

WHEREAS, National energy independence and a clean environment are dependent upon tapping nonfossil fuel sources of energy for heating, cooling, and electricity.

Sound familiar?

Then Three Mile Island and Watergate happened with Vietnam going on for a while and people were not so pleased with the federal government

[5] Nevada State Assembly, 1975. Assembly Joint Resolution No. 15. Assembly History, Fifty-eighth Session

There was still plenty of activity in the Ford Administration

The Energy Research and Development Administration (ERDA) (precursor to DOE) proposed the National Waste Terminal Storage (NWTS) for national SNF management

This is the first time multiple barriers were proposed

Construct six facilities at multiple sites across the US so no one place ‘bore the burden’

General criteria were formulated; hydrology testing, geologic mapping, in situ experiments

Very probably, a satisfactory solution to the problem of nuclear waste disposal will not be possible unless there is public and political acceptance in the local areas where geologic studies and facility development must proceed program to the people who need to know so that they have full information to base their decisions on. . . . In other words, there must be an aggressive program of public affairs for best results. . . . the public perception of waste management might well determine its success [6].

[6] Zerby, C. D. et al., 1976. Waste Isolation in Geologic Formations in the United States

The Willrich Report was the the first comprehensive analysis for HLW management [7]

Criticized the federal government (Hanford)

Raised health concerns regarding releases and *accumulation of SNF at Nuclear Power Plants (NPPs)*

A national Radioactive Waste Authority should be established as a federally chartered public corporation

Nevertheless, through political means and legal and procedural delays, a state government may effectively oppose attempts by the federal government to establish a federal repository within its borders without state consent.

[7] Willrich, M., et al., 1976. Radioactive waste management and regulation. Energy Laboratory Report No. MIT-EL 76-011

Willrich was largely supportive of nuclear energy as a credible alternative to fossil fuels

Assist in developing public policy and institutions which are necessary for the safe management of radioactive waste, currently and in the long term

Today we do have dry storage but with no reprocessing still SNF is still accumulating

Not really technical criteria for isolation at the time

Did not like existing organization for radioactive waste management

Willrich recommended NRC assume sole regulatory oversight for nuclear waste management

President Carter formed the Interagency Review Group on Nuclear Waste Management (IRG) to generate policy recommendations for long term nuclear waste management [8]

States were passing laws banning repository and NPP construction

Chaired by Secretary of Energy and included fourteen agencies

Solicited comment from diverse stakeholders

Advocated for a strong role for the states in planning

Proposed to collect fees from ratepayers

Institutional approaches should include socially acceptable processes and diverse participation

Technical challenges of disposal were not considered to be as steep as social and institutional issues

'Consultation and concurrence' recommended for state and federal interactions

[8] Interagency Review Group on Nuclear Waste Management, 1979. Report to the President. TID-29442

President Carter then addressed Congress [9]

...for disposal of high-level radioactive waste, I am adopting an interim planning strategy focused on the use of mined geologic repositories capable of accepting both waste from reprocessing and unprocessed commercial spent fuel. An interim strategy is needed since final decisions on many steps which need to be taken should be preceded by a full environmental review under the National Environmental Policy Act. In its search for suitable sites for high-level waste repositories, the Department of Energy has mounted an expanded and diversified program of geologic investigations that recognizes the importance of the interaction among geologic setting, repository host rock, waste form, and other engineered barriers on a site-specific basis. Immediate attention will focus on research and development and on locating and characterizing a number of potential repository sites in a variety of different geologic environments with diverse rock types. When four to five sites have been evaluated and found potentially suitable, one or more will be selected for development as a licensed, full-scale repository.

[9] Carter, J., 1980. Radioactive Waste Management Program Message to the Congress. The American Presidency Project

Nuclear Waste Policy Act (NWPA) 1982

The NWPA built upon the prior work from the Ford and Carter Administrations

DOE responsible to site, build, construct, and operate a geologic repository

DOE responsible to foster public trust and confidence

EPA sets standards for radiation protection of the environment and radioactive releases

NRC issues licenses

Office of Civilian Radioactive Waste Management (OCRWM) created to execute the NWPA

President Ronald Reagan commended the bipartisan effort [10]

The Nuclear Waste Policy Act of 1982, which I'm signing today, provides the long overdue assurance that we now have a safe and effective solution to the nuclear waste problem. It's an important step in the pursuit of the peaceful uses of atomic energy, a program that was launched by President Eisenhower some 30 years ago. The outlines of that program have changed with the years, but America's leadership in the development and use of peaceful atoms remain strong.

[10] Reagan, R., 1983. Remarks on Signing the Nuclear Waste Policy Act of 1982. Ronald Reagan Presidential Library & Museum

Siting would account for regional distribution

That meant there would be a site in the west and in the east

Select three sites out of five proposed to recommend to the President for site characterization 1985.01.01

Then five more with three recommended to the President for the second repository 1989.07.01

Cannot include sites previously nominated but not recommended

The President would submit a decision for the first repository to Congress by 1987.03.31

The second by 1990.03.31

NWPA required further congressional action to authorize construction on the second repository

NWPA stipulated that DOE would take title of SNF on 1998.01.31

'Consultation and concurrence' was changed to 'consultation and cooperation'

Several mentions of consulting with governors of affected States and Tribes
DOE could provide financial support to States and Tribes for their own analyses
Any affected State or Tribe was afforded a veto
Congress could overrule the veto with a majority vote in both houses

Electric utilities were required to provide economic support for nuclear waste management

Treasury would collect 1 mill per kWh of electricity generated into a Nuclear Waste Fund (NWF)

Commercial NPP operators were required to enter into a contract by 1983.06.30 with DOE to manage disposal

Colloquially called the 'Standard Contract' and anyone from DOE has to have this huge disclaimer anytime they give a presentation anywhere

A Monitored Retrievable Storage (MRS) was conceived as a site at which SNF would be stored prior to permanent disposal

'Interim storage' defined as managing at existing NPPs

NRC licenses any expansions

DOE to inform Congress by June 1985 on MRS status

Develop three sites

1983 – 1987 activities relevant to Yucca Mountain

Potentially suitable sites are identified

Prior to developing siting criteria, DOE already recommended nine sites for nomination

Mississippi (2)

Louisiana

Texas (2)

Utah (2)

Yucca Mountain

Hanford

June 1983

Licensing guidelines for construction and operation of a geologic repository

Design parameters for a repository at the site of interest

Each candidate site requires site characterization report demonstrating compliance

November 1984

Provided criteria for the Secretary of Energy to recommend suitable sites to the President for further site characterization

Go/no go requirements

Population density, site ownership, meteorology, socioeconomic impacts, transportation, geology, hydrology...

Nine sites got narrowed down to five

Davis Canyon, Deaf Smith, Hanford, Richton Dome, Yucca Mountain

This is the Standard Contract

Operators responsible to pay for on-site SNF storage and packaging until the 1998 date

DOE responsible for transport

Procedures, fees, payments

NRC still licenses any storage, transport casks

Sets standards for public protection from nuclear waste management activities to include all HLW, TRU

Any NRC licensed facility or any storage facility operated by DOE

Limits are placed on radiation exposure to the public, radionuclide containment for disposal systems, groundwater protection requirements

Exposures limited to 25 mrem whole body

Containment requirements 10,000 years after disposal based on performance assessments

Also 10,000 years for radioactivity in groundwater under the Safe Drinking Water Act

Three sites emerge

Further evaluation of the nine original sites advanced five — Davis Canyon, Deaf Smith, Hanford, Richton Dome, and Yucca Mountain under 10CFR960 in 1984

They were evaluated using multiattribute utility analysis based on the 10CFR960 criteria [11]

In 1986 DOE formally recommended Deaf Smith (TX), Hanford, and Yucca Mountain for site characterization

In announcing the three western finalists, the Secretary of Energy also postponed siting efforts in the east

Results had ranked Yucca Mountain first, Deaf Smith third, and Hanford last

Rankings were strongly a function of preclosure and transportation costs

[11] Merkhofer, M. W. et al., 1987. A multiattribute utility analysis of alternative sites for the disposal of nuclear waste. Risk Analysis 7, 173

1987 amendments to the NWPA

DOE was directed to consider only Yucca Mountain for the first repository

Eastern siting is terminated

Most SNF is in the east

Congress accused the Secretary of violating the original NWPA

In 1986, DOE had announced possible eastern sites in Georgia, Maine, Minnesota, New Hampshire, North Carolina, Virginia, and Wisconsin

November 1986 featured many important state and congressional races in these affected states

And a presidential primary in New Hampshire in 1988

The Secretary denied the decision was political but to save money

A decision for a second repository would not be needed until 1995 due to lower projections of SNF

That is not true now

Western siting focused on Yucca Mountain

Controversy Hanford was selected as a finalist when the multiattribute analysis ranked the site fifth

Calling into question as to whether the siting process was scientifically sound or politically motivated

In conference committee for the amendments, the Speaker of the House was from Texas, and the House Majority Leader was from Washington

Three out of four of the Nevada delegation were in their first terms

None on the conference committee

Rep. Al Smith (WA) – *What you are watching is an exercise in pure politics . . . I am participating in a nonscientific process – sticking it to Nevada* [12]

[12] Church, F., 1990. Federal Report: Nuclear Waste – Can Nevada Keep America's Sizzling Nuclear Waste Out of Its Backyard. Governing



[13] Wikipedia, 2024. Yucca Mountain nuclear waste repository

Post NWPA 1987 – Termination

DOE sued for breach of the Standard Contract

DOE could not take title to SNF in 1998

The MRS program collapsed and utilities were bearing storage costs

About 80 lawsuits filed over 1998 – 2012 for breach of contract

Basically, the utilities won and were awarded damages still being paid today

\$800M annually

Yucca Mountain ends

DOE recommended Yucca Mountain to President George W. Bush and notified Nevada of the decision in 2002

Nevada vetoed – Congress overrode the veto

Nevada mounted a host of legal challenges to delay progress on scientific investigations and site characterization

In 2008 DOE submitted a construction license to NRC

With Harry Reid as Senate majority leader the FY2010 budget only provided funds to continue the licensing process

Funding was eliminated in FY2012 and closed the OCRWM

DOE withdrew the license and faced lawsuits over its authority to do so

NRC finally ruled that Yucca Mountain met post-closure requirements, but issues regarding land ownership and water rights for construction required further work

And that was it

The Nuclear Waste Fund suspended

DOE ordered to suspend collection of fees in 2013

Legally, the fee was not eliminated but reduced to zero

At the time of suspension, \$750 million was collected annually

Currently, there is about \$45 billion with \$1.5 billion added annually in interest

Takeaways

Main players

The federal government was the main player

DOE

Speaker of the House

House Majority Leader

Senate Majority leader

The President(s) – Ford, Carter, Reagan, W, Obama

the Carter Administration and Congress should be given credit for the groundwork and study leading up to and then crafting and passage of the NWPA in 1982

Solely designating Yucca Mountain was politically based

State players were diverse but lacked a voice

Governors were not on equal footing with the federal government though
Localities, like Nye County, received funds but no authority

The courts affected waste management policy probably the most

Predicted by Willrich in 1976

Nevada used the legal system to mount myriad legal challenges to delay

Utilities used the courts to sue DOE for breach of contract and damages

Nuclear Waste Fund fees were suspended

Willrich has more details that inform Consent-Based Siting today

Processes

A top down approach was the main process in siting Yucca Mountain

DOE identified sites and then communicated to the States

A decide-announce-defend strategy emerged

Starting with the identification of the nine original sites

Before DOE issued the siting criteria in 10CFR960

Termination of eastern siting was unilateral

Siting will always be inherently political

Designated a second site to be in the east was a political compromise in 1982

The compromise was reasonable as most SNF is located in the east

Selecting Yucca Mountain was entirely political

The law still designates Yucca Mountain as the repository site

The law will have to be amended to designate a new site, remove Yucca Mountain from its current designation, or establish the legality of constructing a Consolidated Interim Storage Facility

All stakeholders must act in good faith to ensure success

All stakeholders will need access to the political process

What does this mean within the context of consent?

States

The concept of consent has been acknowledged as necessary from the Willrich report in 1976

Called consultation and concurrence by the Interagency Review Group on Nuclear Waste Management in 1979

Changed to consultation and cooperation in the NWPA

States were allowed a veto

It was meaningless in the end

No consent for localities

Nye County support was eradicated by the Nevada delegation

Public involvement

Public involvement mainly only included public comments

Is that enough?

The Consent-Based Siting approach seeks to give the public agency

We do have a success story in WIPP

Consent will likely vary regionally and locally

Consent also needs to include a binding veto

Capacity building

Capacity building is precluded in a top down approach

Capacity building that could have included expertise 'on the ground'

Include local officials or community leaders early on in the process

Mayor Casper of Idaho Falls told the Nuclear Waste Technical Review Board that local leaders should be an essential part of the siting process

Include other groups that have not historically been part of the siting process in an effort to co-produce new knowledge

References

1. Wigeland, R., et al., 2011. Identification, Description, and Characterization of Existing and Alternative Nuclear Energy Systems. INL/MIS-10-19680.
2. Eisenhower, D. D., 1953. Atoms for Peace. Address to the 470th Plenary Meeting of the United Nations General Assembly.
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13. Wikipedia, 2024. Yucca Mountain nuclear waste repository.



Acronyms I

AEA Atomic Energy Act.

AEC Atomic Energy Commission.

CBS Consent-Based Siting.

CFR Code of Federal Regulations.

CISF Consolidated Interim Storage Facility.

DOE United States Department of Energy.

EPA Environmental Protection Agency.

ERDA Energy Research and Development Administration.

FY Fiscal Year.

HLW High-Level Radioactive Waste.

IRG Interagency Review Group on Nuclear Waste Management.

Acronyms II

kWh Kilowatt-Hour.

MRS Monitored Retrievable Storage.

NAS National Academy of Sciences.

NPP Nuclear Power Plant.

NRC Nuclear Regulatory Commission.

NTS Nevada Test Site.

NWF Nuclear Waste Fund.

NWPA Nuclear Waste Policy Act.

NWTRB Nuclear Waste Technical Review Board.

NWTS National Waste Terminal Storage.

OCRWM Office of Civilian Radioactive Waste Management.

ORNL Oak Ridge National Laboratory.

Acronyms III

R&D Research & Development.

SNF Spent Nuclear Fuel.

TMI Three Mile Island.

TRU Transuranic Waste.

US United states.

WIPP Waste Isolation Pilot Plant.

YM Yucca Mountain.