

Used Fuel and High-Level Waste Management – Past, Present and Future

A stylized graphic of an atomic symbol, consisting of two intersecting elliptical orbits and two circular nuclei, rendered in a light gray color against the dark blue background.

American Nuclear Society

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ANS President, 2021-2022

April 28, 2022

Presentation to the Carlsbad Local Section of the
American Nuclear Society

Presenter Background



- 1992-1995: Yucca Mountain Project (Las Vegas)
- 1996: Centralized Interim Storage Project
- 2005-2006: Duke Energy Spent Fuel Manager
- 2019-present: American Nuclear Society Nuclear Waste Policy Task Force (Chair)
- Current or past member of
 - Nuclear Infrastructure Council Fuel Cycle Working Group (Back-End Task Force)
 - Nuclear Energy Institute Integrated Used Nuclear Fuel Management Working Group
 - Nuclear Waste Strategy Coalition

Outline

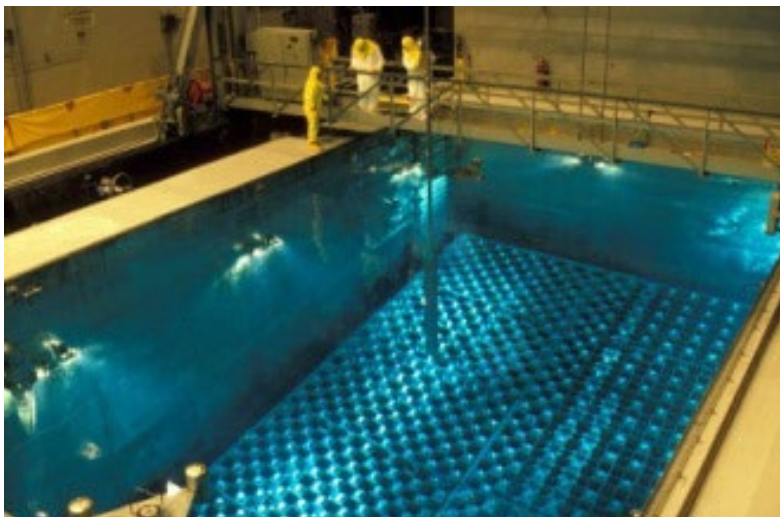


- Background and History
- The Situation Today
- Prospects
- Myths and Legends

Used Fuel and High-Level Radioactive Waste

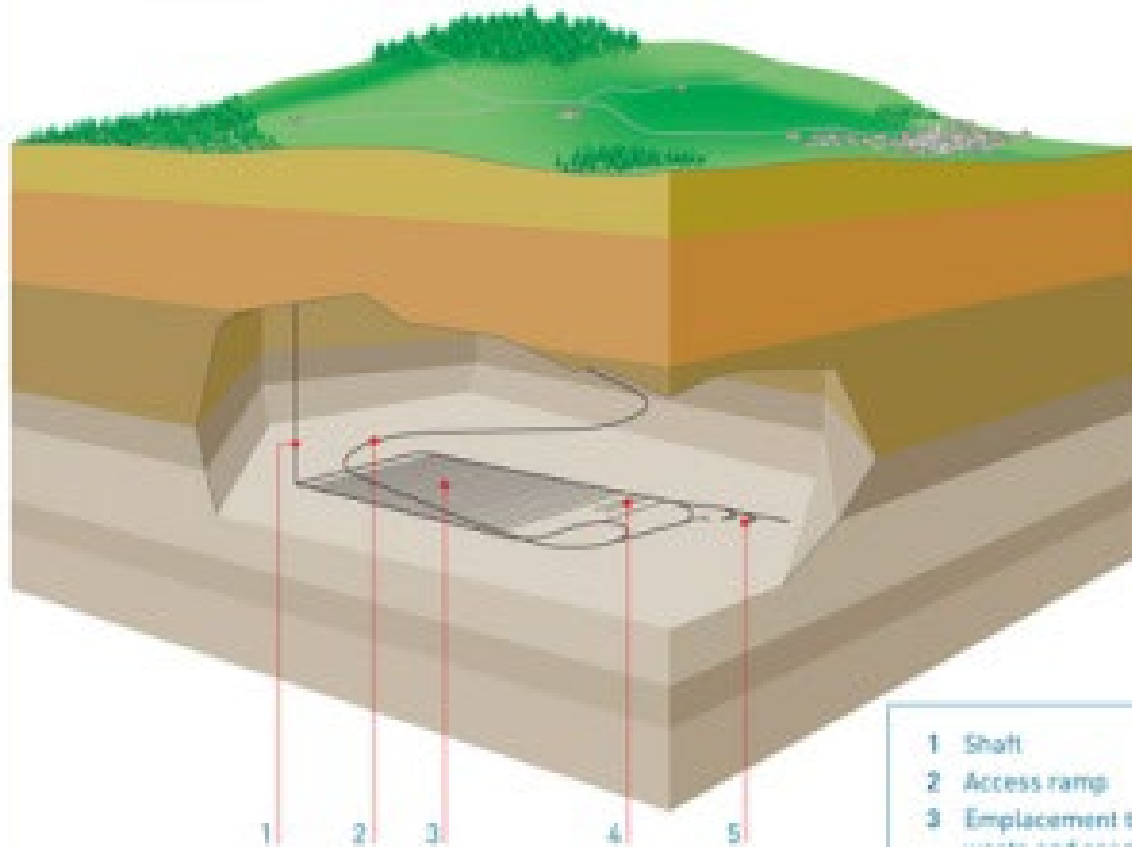


Highly radioactive fission products, actinides and activation products from electricity production, naval propulsion, weapons material production, isotope production and research and development



Geologic Repository

Deep geological repository for HLW, SF and ILW

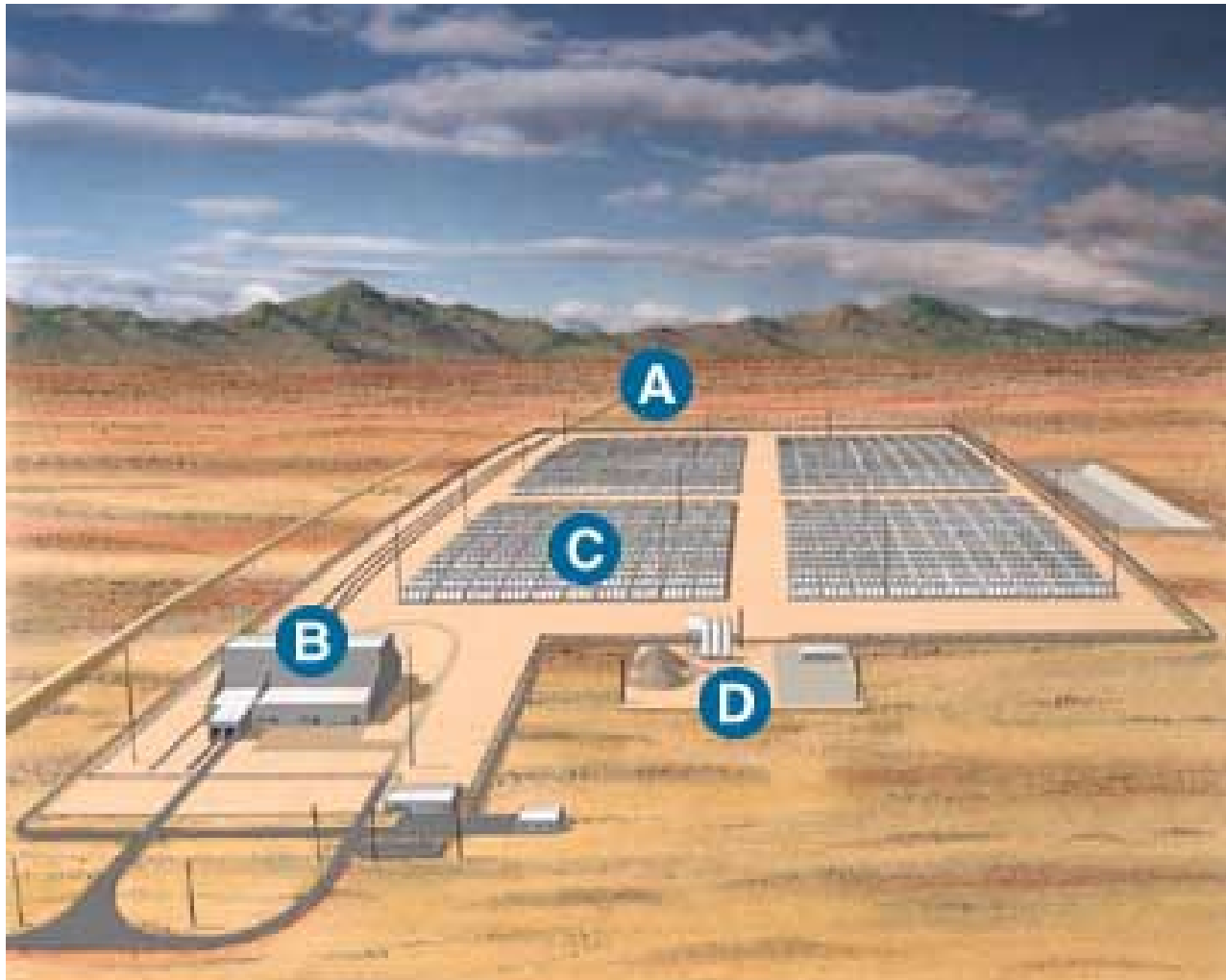


- 1 Shaft
- 2 Access ramp
- 3 Emplacement tunnels for high-level waste and spent fuel
- 4 Pilot facility
- 5 Emplacement tunnels for long-lived intermediate-level waste

Consolidated Interim Storage Facility



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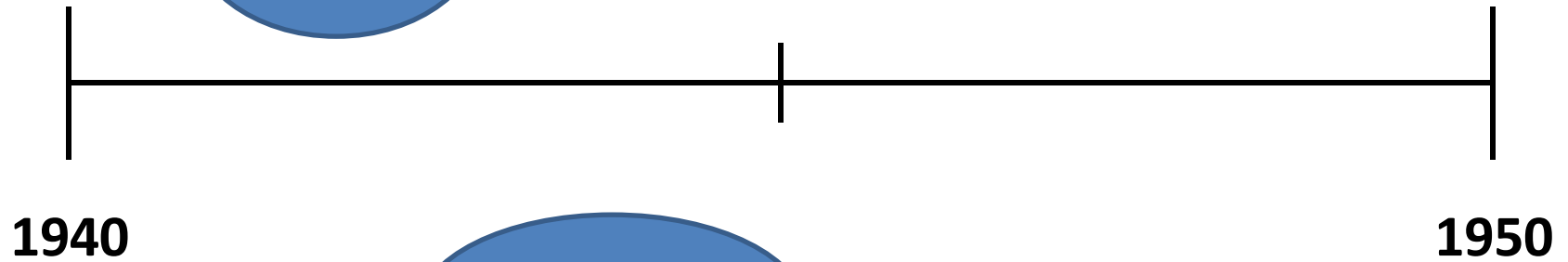


1940s



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First
Nuclear
Reactor



1940

Plutonium
Production

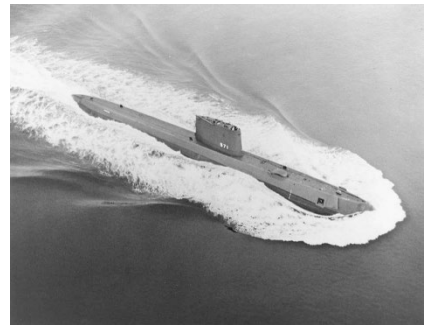
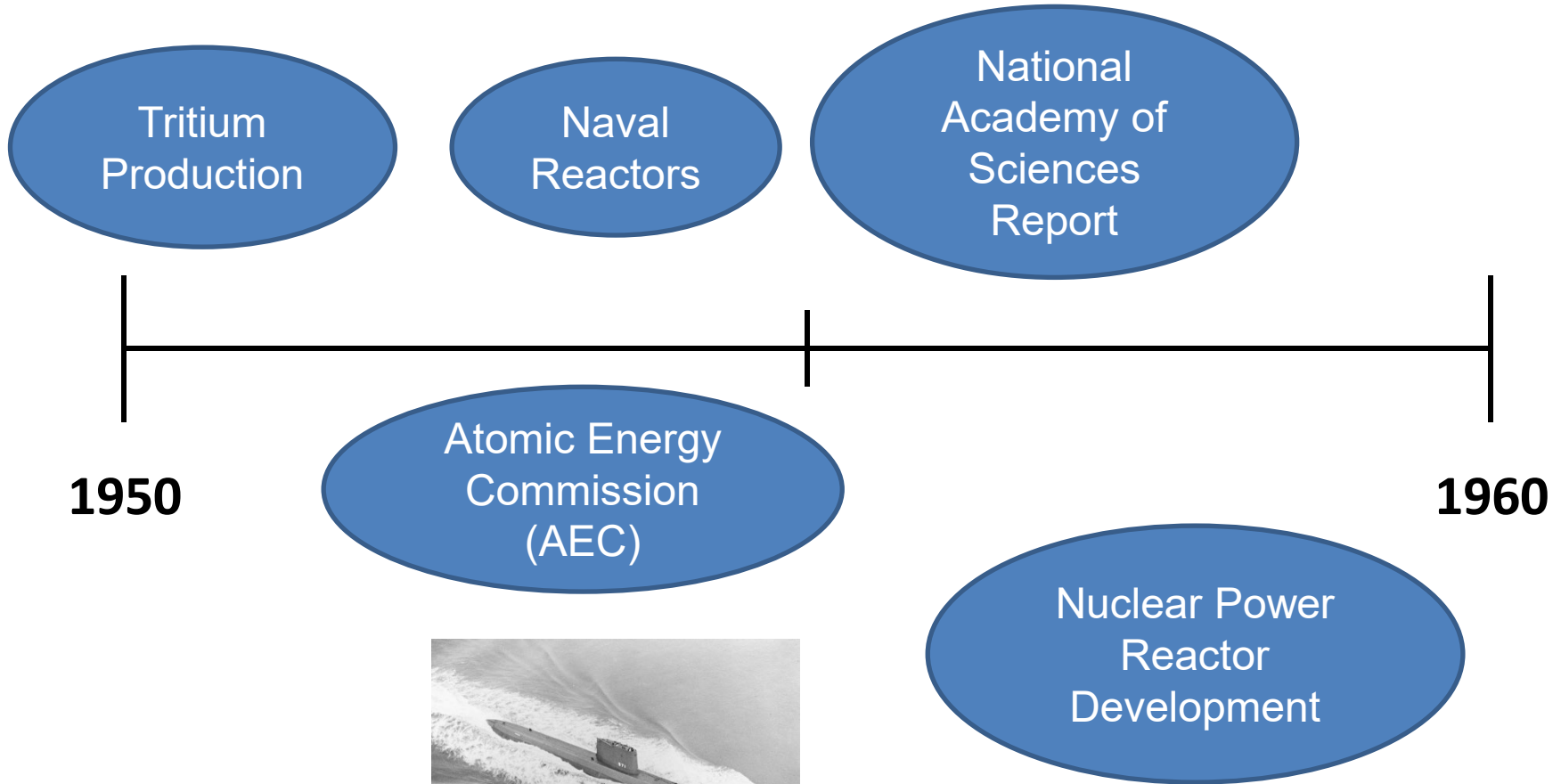
1950



1950s



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1960s



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Continued Production of Weapons Materials and HLW

Accumulation of Used Fuel from Commercial Nuclear Reactors

Growing Concerns about HLW (NAS, GAO, Public)

1960

AEC Waste
Disposal
Research

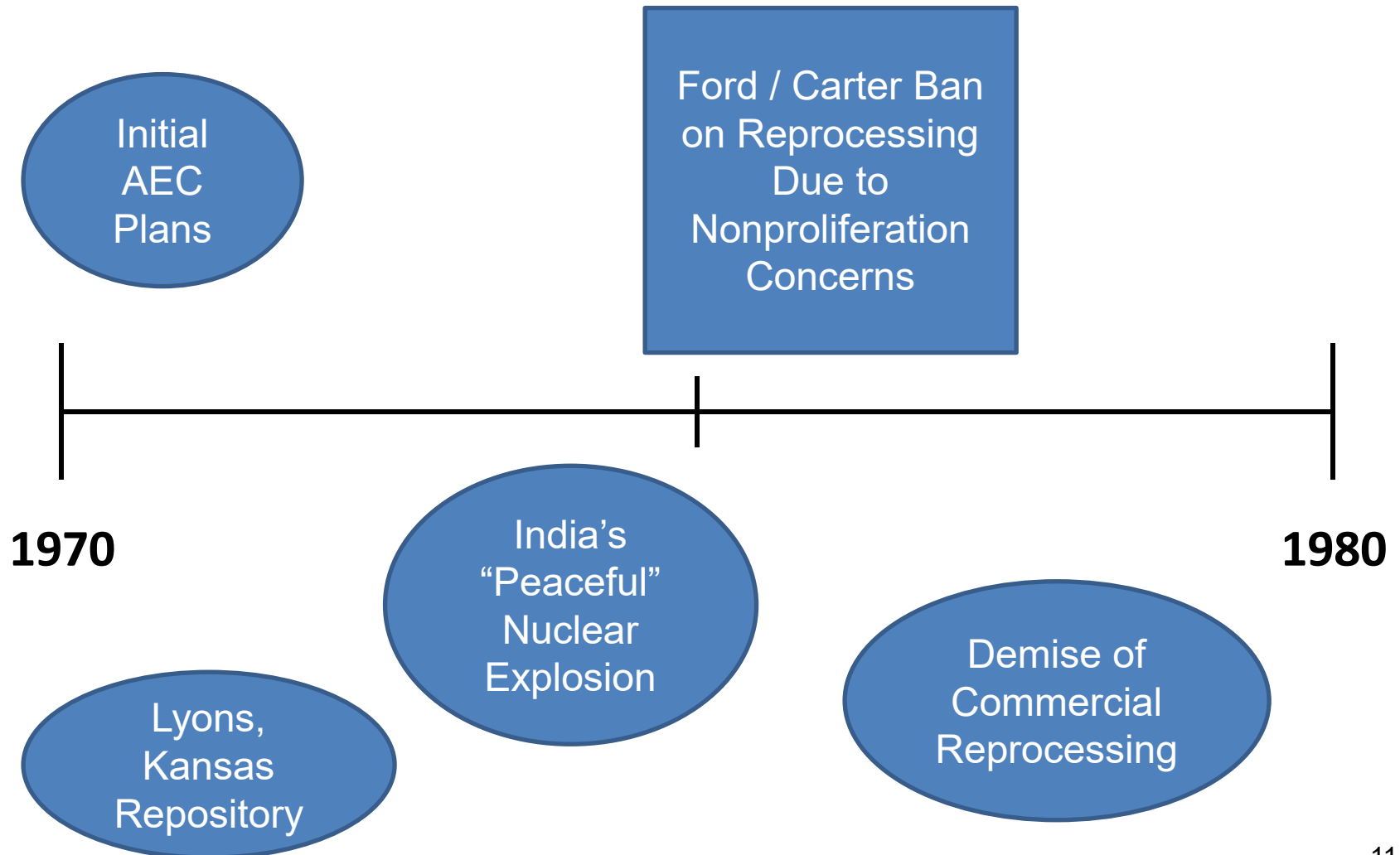
1970

Commercial
Reprocessing at West
Valley, NY

1970s



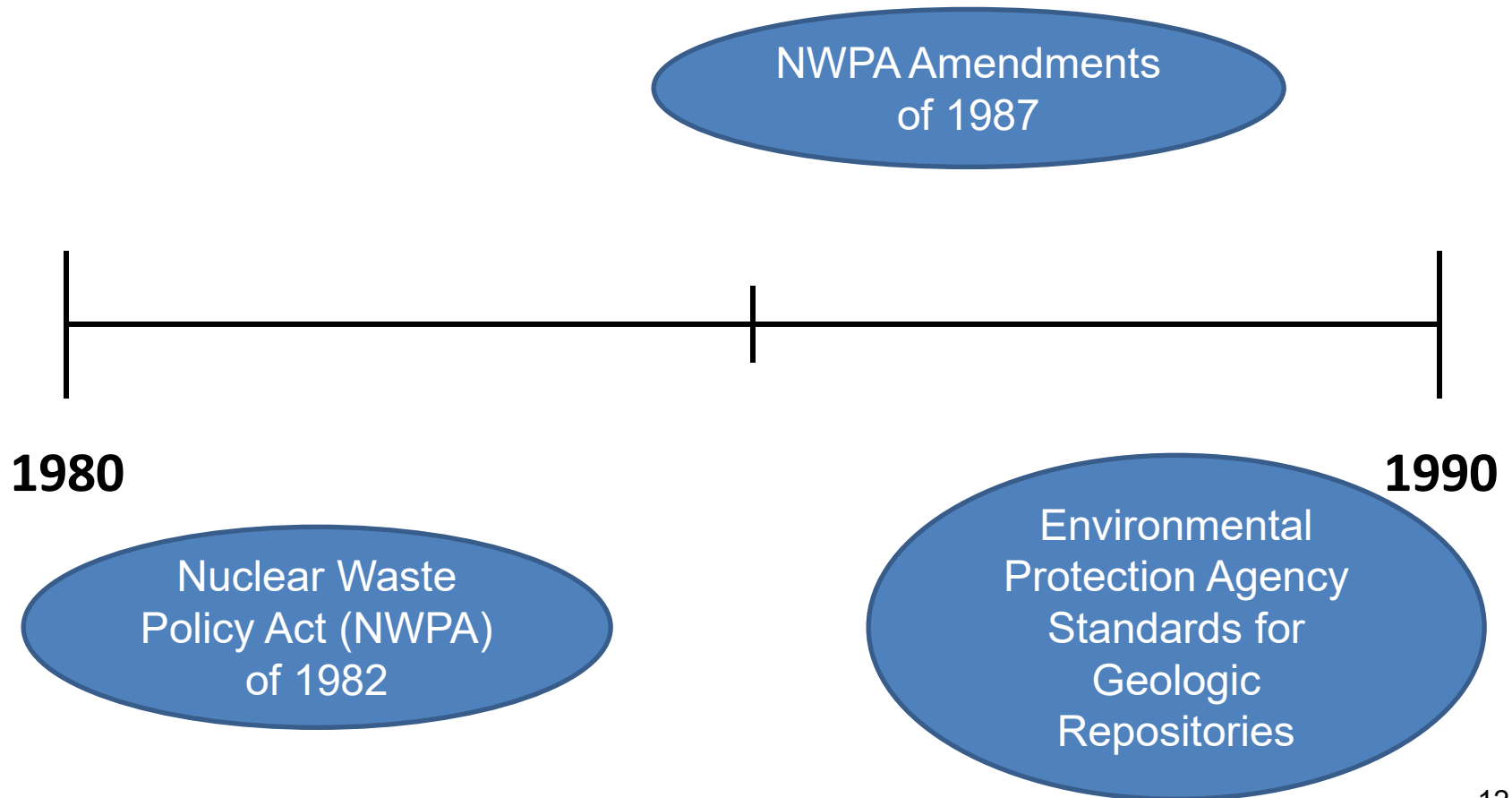
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1980s



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- Bipartisan effort culminating in federal legislation
- Widespread feeling the time had come to break the logjam on nuclear waste
- Began in 1980 and completed in the next Congress in 1982
- Generally considered a milestone accomplishment
- Minority opinion at the time: “It deals with none of the technical disputes and leaves the highly difficult task of site selection to the bureaucracy.”

- **Established responsibilities**
 - Department of Energy (DOE) – Develop and operate a geologic repository for the disposal of used nuclear fuel and HLW, including defense wastes
 - Environmental Protection Agency (EPA) – Establish standards for the protection of public health and safety at a geologic repository
 - Nuclear Regulatory Commission (NRC) – Ensure protection of public health and safety
- **Established funding**
 - Government collection of a \$0.001/per kilowatt-hour fee on nuclear-generated electricity

- Established repository site selection process (emphasis on “find the best site”)
 - Select three sites for detailed characterization
 - Select one for a repository
 - Study additional sites and select a second repository site (understood to be in the east)
- Established deadlines, including DOE to begin removing used fuel from reactor sites by 1998

NWPA Amendments of 1987



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- Reaction to
 - Slow, contentious and expensive site selection
 - Lack of appetite for a second repository
- Designated Yucca Mountain, Nevada, as the only site to be characterized
 - Engendered massive opposition from the state of Nevada
 - “Screw Nevada” bill
- Established process for voluntary siting of a monitored retrievable storage facility (not accomplished)

EPA Standard for Repositories



- Generic standard for geologic repositories for used fuel and high-level radioactive waste
- Initially promulgated in 1987
- Based on 10,000 year “release standard” for individual radionuclides
- Promptly challenged in court and overturned
 - Appeals court decided that standards for underground injection wells might apply because injection wells involve flowing liquids and radiation flows from radioactive waste (*I am not making this up*)
 - Eventually repromulgated in the 1990s for all repositories except Yucca Mountain

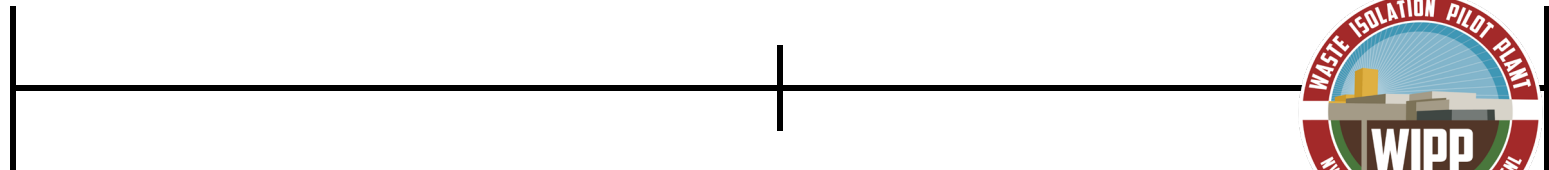
1990s



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Strong Opposition from State of Nevada

Technical Issues – Earthquakes, Volcanos, Water



1990

2000

Uneven Appropriations

Inability of EPA to Promulgate Yucca Mountain Standards

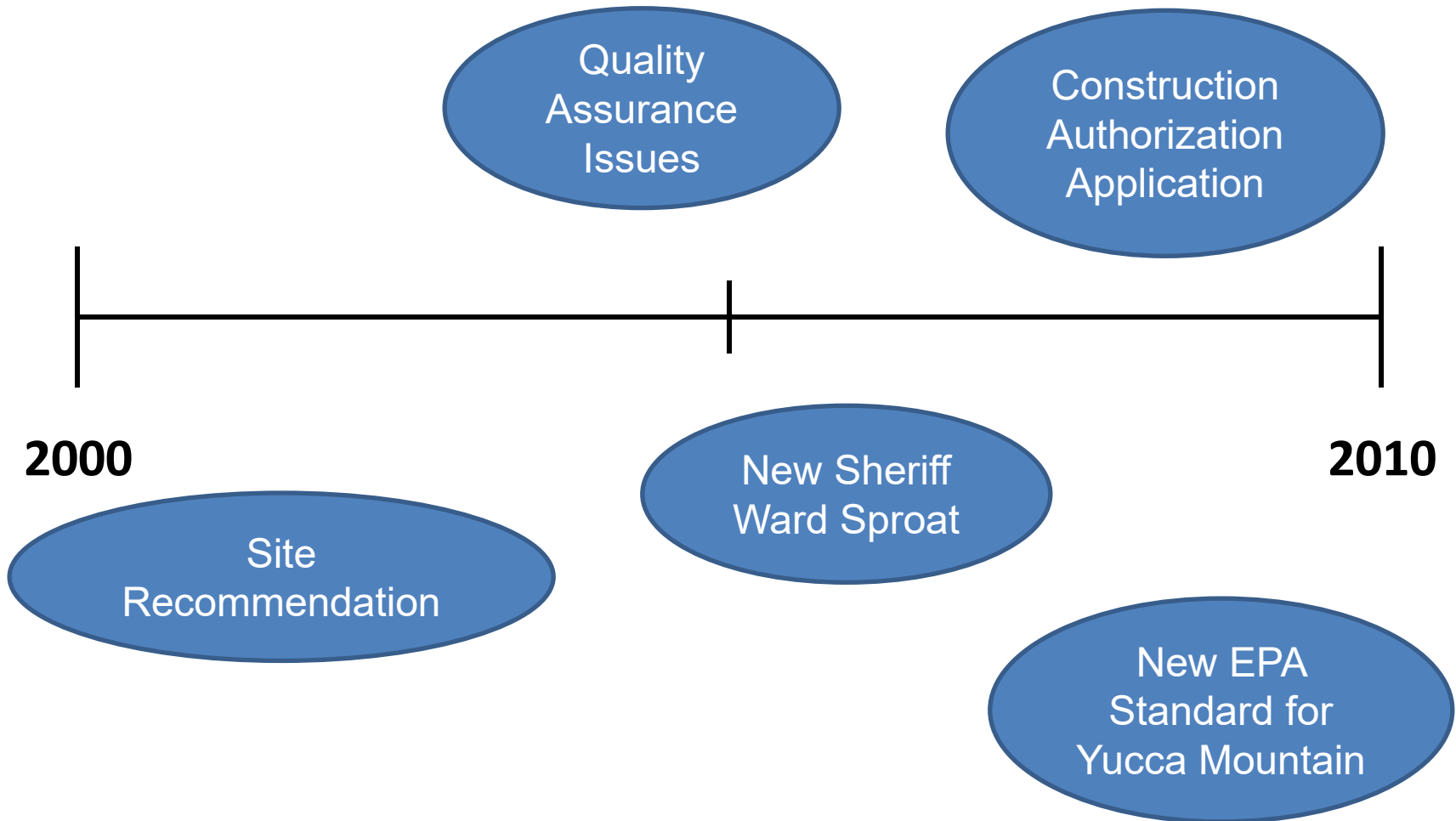
Progress at the Mountain



2000s



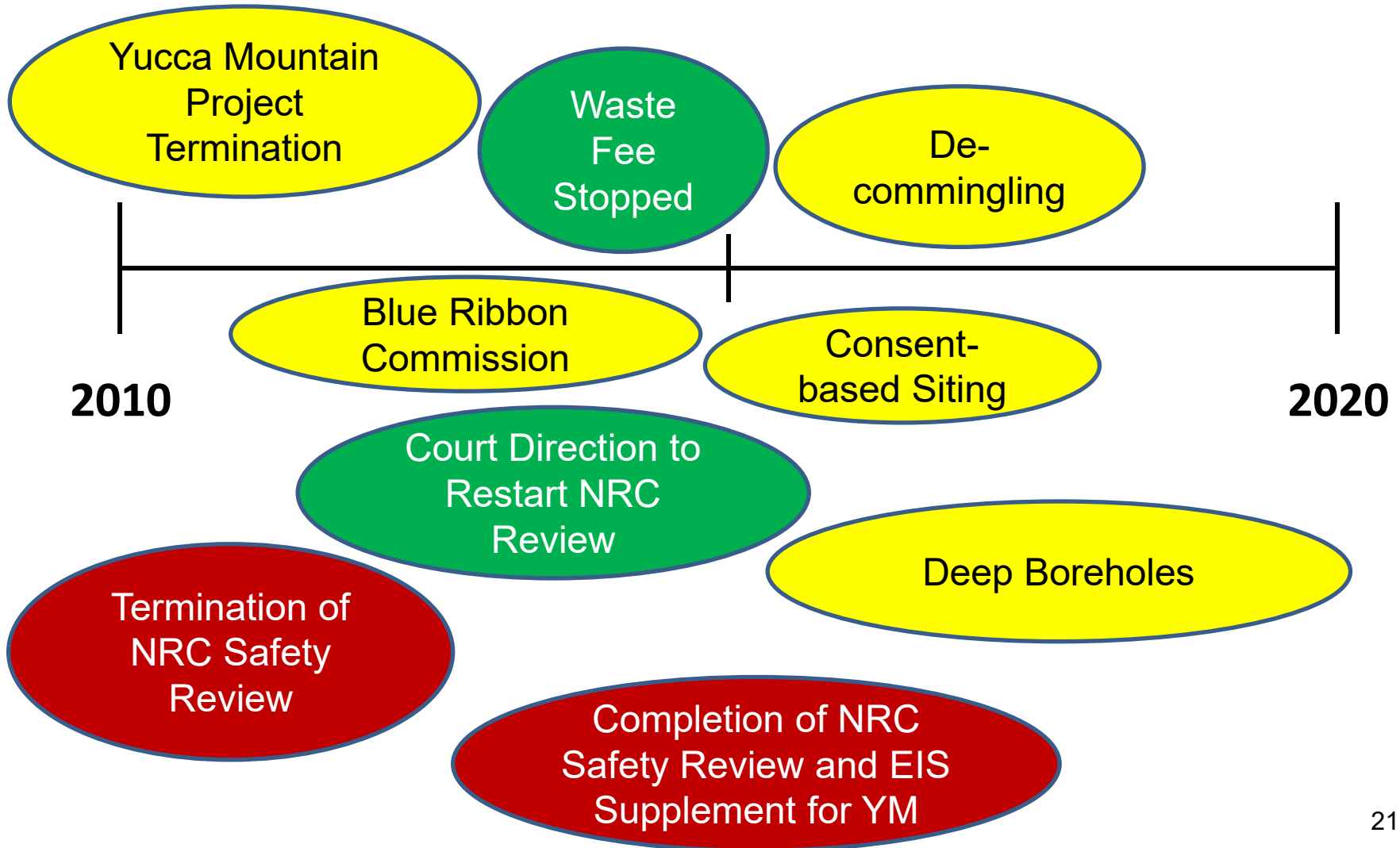
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2010s



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The Yucca Mountain Licensing Situation Today



- Safety Evaluation complete
 - Issues with land withdrawal and state permits
- Environmental Impact Statement complete
- Atomic Safety and Licensing Board hearings to be done
 - Quasi-judicial process
 - Nearly 300 contentions
 - Eight intervenors and 17 parties to the adjudication
 - Would require years and hundreds of millions of dollars to complete
- No work since 2016 (lack of funding)

- The Bush (43) Administration recommended the Yucca Mountain site in 2002 and worked with Congress to override the Nevada veto with a substantial bipartisan majority
- The Obama Administration cancelled the Yucca Mountain Project and abolished the Office of Civilian Radioactive Waste Management

Presidential Politics (cont.)



- The Trump Administration initially proposed funding to continue the Yucca Mountain licensing process
 - Strong support in House
 - Senate refused to appropriate money
- In 2019 President Trump tweeted that he would no longer pursue a Yucca Mountain repository
- The Biden Administration opposes Yucca Mountain and appears to support consolidated interim storage as a short-term alternative

Congressional Situation Today



- Uniform opposition to Yucca Mountain from Nevada state officials
- Senate Democrats have solidified behind Nevada and Senate Republicans will not push Yucca Mountain
- Strong bipartisan House support for Yucca Mountain evaporated after opposition from Democratic leadership
- Representatives Levin (D-CA) and Davis (R-IL) formed a “Spent Nuclear Fuel Solutions” Caucus
- Both houses have supported appropriations for a program of consent-based consolidated interim storage to address issue of used fuel, particularly for “stranded sites”

- Budget proposal would fund consolidated interim storage program
- Last year DOE issued a “Request for Interest” (RFI) in a consolidated interim storage program
 - ANS and others submitted comments
 - DOE developing plans and next steps

Private Initiative - Disposal



- Deep Isolation
 - Directional drilling technology
 - Waste canisters emplaced end-to-end in stable geologic formations
 - Amenable for used fuel assemblies and other waste forms

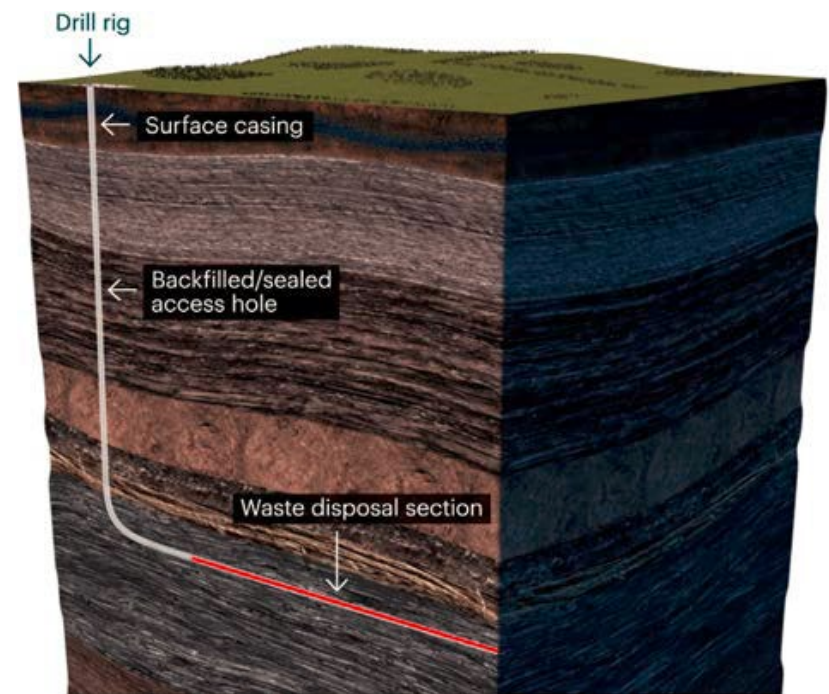


Image courtesy of Deep Isolation

Private Initiatives – Consolidated Interim Storage



- **Andrews County (Texas)**
 - Orano and NAC dry storage technology
 - License issued Sept 2021
- **Eddy-Lea County (New Mexico)**
 - Holtec dry storage technology
 - License anticipated 2022
- **Both projects experiencing significant state opposition**

The Technical Situation Today



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Utilities are establishing and expanding on-site dry storage of used fuel

- The federal government is paying utilities ~\$800 million per year in damages

DOE sites are storing material that was destined for Yucca Mountain

- Government-owned used fuel
- High-level radioactive waste in liquid and solid forms

Several other countries are moving ahead with repository programs

- Finland, Sweden, France and Canada

The Technical Situation Today (cont.)



- Dry storage is a mature technology
- High confidence in long-term integrity of used fuel in dry storage
 - Technical work coordinated through the Extended Storage Collaboration Project of the Electric Power Research Institute
 - Research at national labs, universities, and reactor sites
 - NRC Continued Storage Rule

Prospects for Progress



- Yucca Mountain is going nowhere
- Private consolidated storage facilities challenged by state opposition
 - Lack of repository program
 - General reluctance to host nuclear waste
- Interest in recycling
 - More practical for advanced reactors
 - National Academy of Sciences study of advanced reactor fuel cycles winding up
- Federal government is not following current law and congressional action is necessary to pursue a new course of action

Issues to Resolve



- Constraints in Nuclear Waste Policy Act
- Feasibility of consent-based siting with state governments
- Environmental justice
- Partisanship
- Impacts of advanced reactors
- Governance reform
- Financing reform
- Separate treatment of government and commercial waste
- Ongoing cost to government
- Waste fee

Government Accountability Office Report GAO-21-603



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- September 2021 report on commercial spent nuclear fuel management
- Recommendations for Congress
 - Authorize a consent-based siting process for repositories and consolidated interim storage facilities
 - Restructure management for continuity of leadership and political isolation
 - Reform funding
 - Implement an integrated waste management policy

What is ANS Doing?



- February 2020 Issue Brief on eight recommendations for progress (<https://www.ans.org/file/1245/Progress+on+Nuclear+Waste+Management.pdf>)
- Ongoing development of recommendations on new generic standards for geologic repository public health and safety
- Ongoing dialog with congressional staff, including new Spent Nuclear Fuel Solutions Caucus
- Cooperation with Nuclear Energy Institute, U.S. Nuclear Industry Council, Nuclear Waste Strategy Coalition, and other groups

Myths and Legends



- “Everything would have been fine if we only hadn’t stopped reprocessing.”
 - You still need a repository!
- “Nevada doesn’t want nuclear waste.”
 - Except for nine out of 17 counties, including the host county
- “We need to move used fuel where it will be safer.”
 - Risk from dry storage of used fuel is imperceptible

Myths and Legends (cont.)



- “Transportation is too dangerous. We need to leave used fuel and waste where it is.”
 - Transportation of used fuel and high-level radioactive waste has occurred routinely over the past 70 years and no member of the public has ever been harmed as a result of a radiation release
- “The nuclear industry can’t manage its waste.”
 - The commercial nuclear power industry has managed used fuel safely for about 50 years
- “The next generation of reactors will solve the problem.”
 - Doubtful – there is more than 80,000 metric tons of used fuel now

Questions?



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Ask away!



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