# *REPORT AND RECOMMENDATIONS*

# *OF THE NEVADA COMMISSION ON NUCLEAR PROJECTS*

***Presented to***

***The Governor and Legislature***

***Of the State of Nevada***

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## Table of Contents

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## LIST OF ACRONYMNS

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| BLM | Bureau of Land Management (U.S. Department of Interior) |
| BRC | Blue Ribbon Commission on America's Nuclear Future |
| CAB | Construction Authorization Board (NRC) |
| CBS | Consent-based Siting |
| CISF | Consolidated Interim Storage Facility |
| DOE | U.S. Department of Energy |
| EIS | Environmental Impact Statement |
| EPA | U.S. Environmental Protection Agency |
| FEIS | Final Environmental Impact Statement for Yucca Mountain (2002) |
| HLW | High-Level Radioactive Waste |
| MTHM | Metric Tons of Heavy Metals |
| MTU | Metric Tons of Uranium |
| NAS | National Academy of Science |
| NEPA | National Environmental Policy Act |
| NRC | U.S. Nuclear Regulatory Commission |
| NWPA | Nuclear Waste Policy Act of 1982 – original legislation that governed the federal high-level radioactive waste program from January 1983 to December 1987; NWPA, as amended – 1987 Nuclear Waste Policy Amendments Act amended the NWPA and singled out Yucca Mountain as the only site to be studied as a potential repository site |
| OCRM | Office of Civilian Radioactive Waste Management |
| SEIS | Supplemental Environmental Impact Statement for Yucca Mountain |
| SER | Safety Evaluation Report (NRC) |
| SNF | Spent Nuclear Fuel |
| TAD | Transport, Aging and Disposal canister |

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## Executive Summary

Through the tireless, bipartisan opposition of the State of Nevada, the proposed Yucca Mountain high-level nuclear waste repository has never been licensed nor constructed because it is scientifically unsound. Currently, the proposed Yucca Mountain repository remains the only location being considered for high-level geologic repository site in the United States under federal law. Although Congress has not funded the proposed repository project at Yucca Mountain for over a decade, Nevada remains at risk because of Yucca Mountain's unique prominence in existing law. Removal of Yucca Mountain from the Nuclear Waste Policy Act (NWPA) is a logical prerequisite to development of an alternative, consent-based approach to siting geologic repositories, and the most straight forward means for Nevada to avoid becoming an unwilling radioactive dumping ground. Without Yucca Mountain as a "default" repository site, the country will be compelled to find more acceptable alternatives using a consent-based, technically adequate disposal process. New federal legislation is needed to reform the country's nuclear waste program, provide for viable consent-based siting processes and terminate the flawed Yucca Mountain project. Unless the law is changed, Nevada remains at risk.

Yucca Mountain was never the right location to be the country's only geologic repository site. Given its unstable geology, Yucca Mountain simply cannot isolate long-lived high-level nuclear waste (HLW) and commercially generated spent nuclear fuel (SNF) for the million years the waste remains lethal. Unlike the stable geologic settings considered in Sweden and Finland, the fractured, seismically active geology of Yucca Mountain provides little to no protection against degradation of waste packages and the movement of leaked waste through highly corrosive groundwater into the accessible environment.

To help offset Yucca Mountain's shortcomings, the U.S. Department of Energy (DOE) proposed to robotically install 11,500 titanium drip shields over the waste 100 years after the waste is emplaced in Yucca Mountain. This is an uncertain proposition at best. Whether a future Congress would fund, and DOE could actually implement installation of the titanium drip shields remains a serious question. The emplacement tunnels would be located in fractured tuff rock above the water table and would inevitably leak radionuclides into the groundwater. Within Yucca Mountain itself, rapid groundwater movement would transport radionuclides offsite to where the Amargosa Valley's limited water resources are being fully utilized for purposes incompatible with high-level waste disposal, including farming, mining and solar electricity generation. Proposed surface facilities for staging and handling high-level waste at Yucca Mountain would also be vulnerable to military aircraft and rocket crashes flying in and out of Nellis and Creech Air Force bases.

Yucca Mountain is also within 65 miles of the City of Las Vegas and Clark County, home to 76% of the state's population. Because of the difficulty accessing Yucca Mountain, a 316-mile-long rail spur would need to be constructed. Even with this construction, between 4 and 110 train loads of spent nuclear fuel and 1-2 trucks per week will travel through Las Vegas for fifty years.

Just as Yucca Mountain is incapable of isolating HLW and SNF from the human and natural environment, Yucca Mountain is also inappropriate for reprocessing or interim storage. Notably, proposals to reprocess SNF (to be used as fuel in nuclear reactors) or for interim storage (distinguishable from proposed surface "staging" facilities) are not authorized by current law. Neither are feasible at Yucca Mountain.

There is no market for reprocessed fuel nationally. Yucca Mountain is distant from where the reprocessed fuel could be utilized even if there was a market. Reprocessing is a highly water and energy consumptive activity and groundwater resources within Amargosa Valley are unavailable. Reprocessing also produces deadly liquid waste which would require management and disposal. Yucca Mountain is not suitable for that kind of industrial activity.

The country's perspective on nuclear waste siting is beginning to shift. Following examples set by Canada and the United Kingdom, DOE, has taken preliminary steps toward developing a consent-based siting (CBS) process for nuclear waste. Congress has directed that DOE focus its CBS efforts on siting the nation's first federal consolidated interim storage facility (CISF). An actual CBS process to site a federal interim storage facility cannot occur without a change in the NWPA.

Despite lacking a disposal path forward for HLW and SNF produced by the country's current fleet of light water nuclear reactors, the nuclear industry is nevertheless promoting "advanced" reactors. While advanced reactors may offer size and safety advantages over traditional reactors, they produce new types of waste that are not yet sufficiently understood. Unlike light water reactor waste, which has been successfully stored and managed for seventy years, some types of advanced reactor waste have not existed for long periods of time and their performance in a repository is unknown. Advanced reactor waste will undoubtedly require new strategies for disposal and storage. Yucca Mountain is not designed for advanced reactor-generated nuclear waste, nor can the Yucca Mountain license application be readily reconfigured to accept advanced reactor waste. Current HLW and SNF waste inventories in the queue to be disposed of at Yucca Mountain have already exceeded the statutory cap of 70,000 metric tons.

The nuclear industry has made significant strides toward nuclear fusion energy development. In fusion, energy is produced by fusing atoms together rather than traditional fission where energy is produced by splitting atoms. If successful, fusion-generated electricity may someday offer a waste-free source of energy. However, fusion reactors have yet to be successfully demonstrated. Because the nuclear industry remains intrinsically tied to light waste reactor-produced nuclear waste, it is the Commission's opinion that Nevada should remain a nuclear free state.

Nevada must remain steadfast in its opposition to any attempt to resurrect the defunct Yucca Mountain project. While attitudes in this country are shifting towards a consent-based process for repository and interim storage development, Yucca Mountain remains the only site authorized by law for geologic disposal and remains a likely contingency plan if DOE's consent-based siting efforts fail to produce results. Yucca Mountain was imposed on Nevada without the State's consent, and the decision to identify Yucca as the nation's only repository was not a scientific one. The Yucca Mountain project stands in the way of a truly practicable, consent-based national strategy for repository development.

## About the Commission

The Nevada Legislature created the Commission on Nuclear Projects (Commission) in 1985 to assure that the health, safety, and welfare of Nevada's citizens and the State's unique environment and economy are adequately protected from development of the proposed geologic repository at Yucca Mountain. The seven-member Commission advises the Governor and Legislature on nuclear waste matters and oversees activities of the Agency for Nuclear Projects (Agency). The Agency administers the State's oversight duties as they relate to the proposed Yucca Mountain repository, the federal high-level radioactive waste management program, and other related federal programs.

In the preface to the Commission on Nuclear Projects' first report to the Governor and Legislature in 1986, then Chairman and former Governor Grant Sawyer highlighted the serious task facing DOE and the country as DOE sought to implement the Nuclear Waste Policy Act (NWPA):

> *"Few matters facing the State – or the nation – generate the level and intensity of concern that is elicited by the issue of nuclear waste disposal. Perhaps this is because the ramifications of decisions we make today about how to manage the nation's nuclear waste program have the potential to affect future generations and to impact ecosystems for thousands of years. It is difficult, I think, for any of us to fully grasp the long-term significance of a deep geologic repository for the disposal of highly radioactive materials. Such a repository, if one is built, will represent the first-time mankind has attempted to construct something that must remain functional for over 10,000 years. All of recorded history barely covers that span of time. The pyramids of Egypt, perhaps the longest surviving human engineering project, are 3,000 – 4,000 years old at most. Yet*

*DOE has selected Nevada as one of three potential sites to build something … that must not only remain intact for at least 10,000 years, but must retain the structural, geological and hydrological integrity to guarantee that thousands of tons of the most toxic and long-lived substances yet discovered will remain contained and isolated from the rest of the world for the entire time."*

Chairman Sawyer went on to set forth what would be the guiding principle underlying the State's approach to the federal high-level radioactive waste program and Yucca Mountain over the years, namely *"… that a nuclear waste repository should not be built until it can be shown, beyond the shadow of a doubt, that the facility can, in fact, do what its advocates claim – isolate radioactive waste from the biosphere for more than 10,000 years – and that the construction and operation of such a facility will be benign in its effects upon the people, the environment and the economy of the state or region within which it would be located.*"

DOE has failed to meet this standard, and the State of Nevada continues to oppose the project. In July 2004, Nevada succeeded in invalidating the 2001 Environmental Protection Agency (EPA) radiation standard for Yucca Mountain, finding it was inconsistent with the recommendations of the National Academy of Sciences (NAS). The D.C. Circuit of Appeals determined that portions of the 2001 standards concerning the 10,000-year time frame for which compliances must be demonstrated did not sufficiently protect and that 1 million years should be applicable period of protection. See, *Nuclear Energy Institute (NEI) v. U.S. EPA, 373 F.3d 1251 (DC Cir. 2004)*

## Status of the Yucca Mountain Project

Although no funding has been allocated for the Yucca Mountain Project since 2010, Yucca Mountain remains, by law, the only named location for disposal of the nation's nuclear HLW and SNF. There is no repository at the site. There are no waste disposal tunnels, and there are no receiving and handling facilities. The waste disposal container designs have not been approved. The original storage, transport and disposal canister concept, fundamental to DOE's license application, has been abandoned. There is no railroad to the site. The cost to build rail access would be $2.7 billion. Designation of the 2015 Basin and Range National Monument, over which the proposed rail route traverses, makes DOE's proposed rail route unworkable.

All that exists at Yucca Mountain is a single, 5-mile-long exploratory tunnel. The exploratory tunnel was constructed to permit access to the subsurface for the purpose of site characterization. The tunnel itself cannot be used for waste disposal. Constructing a repository at Yucca Mountain would require construction authorization from the Nuclear Regulatory Commission (NRC) and the physical construction of an additional 42 miles of tunnels to accommodate the statutory limit of 70,000 metric tons of heavy metal (MTHM) of SNF and HLW. To operate the repository, DOE also would need to construct extensive new surface facilities for waste receipt and handling.

DOE's Yucca Mountain, U. S. Bureau of Land Management (BLM) authorized public land order withdrawing the Yucca Mountain site from the public domain expired in 2010. Similarly, the 308,600-acre land withdrawals for the 300-plus mile-long Caliente rail corridor expired in 2015. Without congressional land withdrawals, any effort to restart the Yucca Mountain project or the Caliente rail alignment would require DOE to reinitiate BLM's

administrative land withdrawal processes. Additional National Environmental Policy Act (NEPA) analysis would also necessarily require costly and time-consuming analyses.

## Yucca Mountain Won't Work

For the reasons outlined above, Yucca Mountain is a deficient site for a geologic repository. DOE's repository design and operations plan, contained in its still pending NRC license application, cannot fix what is wrong with Yucca Mountain. Five key aspects remain unresolved:

1. DOE proposes a hot repository design which would keep underground temperatures above the boiling point of water for about 1,000 years. This design fails to prevent groundwater contamination and may, in fact, exacerbate contamination by altering groundwater flow pathways and chemistry. The hot waste needed for DOE's design concept also creates major problems for waste acceptance, and for safety during transportation, packaging, and emplacement.
2. DOE's proposes robotic installation of 11,500 titanium drip shields, one over each waste package 100 plus years after the waste has been emplaced. This design plan relies on unproven technologies. Even if the drip shields are perfectly installed, they cannot be guaranteed to prevent groundwater contamination. Moreover, the drip shield design places the burden on future generations to commit the substantial resources required to implement drip shield construction and emplacement.
3. DOE's proposed waste management system relies entirely on a hardware design - the transport, aging and disposal (TAD) canister - that was unfeasible when the license application was submitted in 2008 and is now completely obsolete. The inability of

DOE to develop and implement the TAD canister design makes every other aspect of DOE's repository operations plan an abject failure.

4. DOE's proposed Caliente rail corridor is exorbitantly expensive (over $2.7 billion), requires over 300 miles of new track, and would be the single largest rail project in the country. Even if the route could be adjusted to avoid the Basin and Range National Monument, nuclear waste trains would still travel through downtown Las Vegas and nuclear waste trucks would continue to travel along the Las Vegas Beltway. DOE's proposed transportation plan is of particular concern because it ignores the safety and security recommendations of the NAS and grossly underestimates routine radiation impacts, the consequences of severe accidents, and the risk of terrorist attacks that could release radioactive materials along the transportation routes.
5. DOE's proposed Yucca Mountain repository cannot solve the nation's nuclear waste disposal needs. SNF stored at U.S reactors presently exceeds 89,000 metric tons of uranium (MTU). By 2050, the amount of SNF and other high-level radioactive wastes requiring disposal will exceed 150,000 MTU. Current law imposes a 70,000 MTU limit on total waste emplacements at Yucca Mountain. If the law was amended to allow for additional waste emplaced in Yucca Mountain, the repository design in the DOE license application would need to be extensively revised and additional NEPA assessment would have to occur.

The federal government has estimated that about $14.5 billion has been spent since 1983 on the national high-level nuclear waste program, of which about $8.5 billion was spent directly on the Yucca Mountain project. DOE estimated in 2007, the total lifecycle cost of a Yucca

Mountain repository project to be approximately $97 billion. Extrapolating that figure to account for inflation, the current estimated cost to develop Yucca Mountain is $119 billion dollars. To begin actual construction, DOE would need NRC to approve the license application and grant construction authorization. The State of Nevada will continue to vigorously contest that application.

## Congressional Activity

Yucca Mountain remains the only high-level nuclear waste repository candidate site authorized by federal law. However, Congress has appropriated no new Yucca Mountain funding for over a decade, signaling a growing sentiment in Congress to end the program and find cost effective alternatives. While Nevada's congressional delegation has played key roles in defunding Yucca Mountain, there is also evidence that overall congressional support for the project has diminished over time.

The Trump Administration attempted to restart Yucca Mountain in 2017, but Congress again refused to fund it. In February 2020, President Trump, during a speech delivered in Las Vegas, indicated that he had given up on Yucca Mountain. T he Biden Administration, as directed by Congress, is focusing its attention on developing consent-based federal interim storage. Although Nevada remains concerned that DOE's current efforts should be instead focused on consent-based siting for a permanent repository in a geologically acceptable site, the Biden Administration unequivocally opposes the Yucca Mountain project. It is unclear which direction the incoming Trump administration will take.

Recognizing that some members of Congress, particularly those who represent states with significant inventories of HLW and SNF, influential nuclear industry trade associations and professional societies continue to support the Yucca Mountain project, there are undoubtedly some in Congress who may choose Yucca Mountain as a convenient "default" solution

especially if there appear to be no viable alternatives. While Yucca Mountain remains, the only site selected for a geologic repository, Nevada needs to simultaneously support amending the NWPA to remove the Yucca site selection and to prepare for licensing in the event the NRC licensing adjudication resumes.

In 2025, Nevada will urge Congress to consider new comprehensive authorizing legislation to restructure the federal high-level nuclear waste program. Over the last decade, there have been bills introduced to accomplish some of these objectives and other bills to allow Yucca to proceed to licensing. None have been successful. As recently as April 9th, 2024, there was a hearing by the House Subcommittee on Energy Climate, and Grid Security. At the hearing, witnesses and subcommittee members expressed support for Yucca Mountain and said that Nevada was the most significant obstacle to progress. Over recent years, legislative efforts were made to both fund and to kill Yucca Mountain in Congress. [1] Neither approach has been successful, and the policy deadlock continues.

## The NRC's Yucca Mountain Licensing Process

Congress has failed to appropriate any new funds for DOE's or NRC's Yucca Mountain programs since federal fiscal year 2011. Pursuant to court order, NRC must expend all available remaining Yucca Mountain funds appropriated in previous years, even though those funds are insufficient to complete the Yucca Mountain licensing proceeding.

[1] In May 2024, Senators Cortez Masto and Rosen introduced the Jobs Not Waste Act of 2024 seeking to ban any current or future consideration of a permanent nuclear waste repository at the Yucca Mountain site. In the last several sessions, members of Nevada's delegation have introduced the Nuclear Waste Informed Consent Act (NWICA) which would grant Nevada the right of consent presumably after going through an exhaustive and exorbitantly expensive NRC Licensing Adjudication.

Uncertainty over whether deadly high-level radioactive waste will be shipped through and entombed in Nevada, against its will, has loomed over its citizens and the economy for forty one years (Congress selected Yucca Mountain as the only potential repository site in 1987). Nevada believes strongly that the time has come to put this long dormant and unproven federal project out of its misery so that Nevada can devote its attention and resources to other matters, and the United States can move forward with scientifically sound, consent-based solutions for the disposal of high-level radioactive waste.

In September 2022, Nevada initiated a strategy to end the NRC licensing proceeding. There are at least three uncontested deficiencies in DOE's license application that Nevada believes provide grounds for NRC to summarily dismiss the license application. Because the licensing adjudication is currently suspended, on September 19, 2022, the State filed a motion to lift the current license proceeding suspension. If successful in its motion to reopen the licensing proceeding for the limited purpose of allowing the State to file its motions, Nevada will then file three motions for summary disposition. The State's motions for summary disposition are limited to straightforward legal issues that do not require discovery or fact finding. The topics of these three motions are as follows:

1. NRC regulations require that the Yucca Mountain repository operations area is located on land that is under the jurisdiction or control of DOE. It is undisputed that the operations area is not under DOE's control or on land permanently withdrawn for DOE's use as a repository.

2. The proposed above-ground facilities containing high-level radioactive waste must be designed to withstand aircraft crashes unless the crash probability is less than one in ten thousand before permanent closure. DOE determined that the crash probability would be sufficiently low only by relying on non-existent U.S. Air Force flight restrictions over and near Yucca Mountain. Until DOE has secured these protective flight restrictions, the license application (LA) cannot be granted.
3. NRC regulations require DOE to consider human-induced climate change. When DOE filed its application, DOE failed to consider human-induced climate change by instead relying on an NRC regulation that allowed it to exclude certain climatic changes from consideration. Subsequently, in a different case, an NRC licensing board ruled that this regulation does not apply to human-induced climate change. Thus, DOE must consider human-induced climate change in the Yucca Mountain LA. DOE has failed to meet this requirement.

Assuming at least one of these motions for summary disposition is granted, the State will move to have DOE's LA denied for failure to comply with NRC licensing requirements. Although Nevada is reasonably optimistic about its NRC motion strategy, the current motion to lift the licensing suspension remains pending.

# Recent Developments

## Consent Based Siting

The Yucca Mountain program is a failure on many counts. Perhaps its most profound deficiency can be found in the 1987 amendments to the NWPA. By succumbing to political pressure and abandoning the iterative, scientifically based comparative process contained in the 1982 NWPA, Congress singled out Yucca Mountain, thereby creating an irreconcilable conflict

between the federal government and Nevada. In what began as a populist sense of outrage, the State's opposition to Yucca Mountain has since been corroborated in Nevada's well-supported case against the repository. In 2010, following a finding of Yucca Mountain's intrinsic "unworkability," the Secretary of Energy empaneled the Blue-Ribbon Commission (BRC) on America's Nuclear Future. In 2012, the BRC released its final recommendations. Key to the BRC's findings is the concept of "consent-based siting." In response to the 2012 BRC Report to the Secretary of Energy, DOE, beginning in 2016, conducted a series of public meetings to gather input and begin to craft a consent-based siting program. This effort led to DOE publishing *Draft Consent-Based Siting Process for Consolidated Storage and Disposal Facilities for Spent Nuclear Fuel and High-Level Radioactive Waste* in January 2017.

DOE's work on consent-based siting was abandoned in 2018 after President Trump took office. It was not until President Biden assumed office, and Congress appropriated money for DOE in 2020 that DOE resumed its consent-based siting work. The objective of DOE's congressionally mandated CBS effort has shifted away from repository development and focused on siting a federal consolidated interim storage facility (CISF). DOE is managing a consent-based consortia to facilitate community engagement and elicit public feedback on consent-based siting, management of spent nuclear fuel, and consolidated interim storage.

## Interim Storage

In 2022, the NRC approved license applications for two private industry HLW and SNF CISFs to be located in New Mexico and Texas. In 2023, the U.S. Court of Appeals for the Fifth Circuit upheld a decision that the NRC lacked authority to issue licenses to private CISFs and invalidated the Texas license.[2] The Fifth Circuit then applied the same analysis to invalidate the

[2] *Texas v. Nuclear Regul. Comm'n*, 78 F.4th 827, 833–35 (5th Cir. 2023) *reh'g en banc denied*, 2024 WL 1108700 (5th Cir. Mar. 14, 2024)

New Mexico license.[3] The companies seeking to license these facilities (Interim Storage Partners (ISP) in Texas and Holtec International New Mexico) have petitioned the U.S. Supreme Court to reinstate NRC's grant of construction authorizations. On October 4, 2024, the Supreme Court agreed to hear the appeal in its 2024-2025 session. If developed, these facilities invite the prospect of a large-scale nuclear waste transportation program that would be operated by private entities rather than DOE.

The Agency has collaborated with the Western Interstate Energy Board High-Level Radioactive Waste Committee (WIEB HLRWC) to provide extensive comments on NRC's environmental impact statements produced for these two facilities' license applications. The Agency remains committed to working with the western partners to ensure that any HLW/SNF transportation program is run as safely as possible, regardless of the ultimate planning entity or the actual shipper. Should either of the two private interim sites proceed to development, the waste will be stored in relatively close proximity to Yucca Mountain. Without an alternative disposal program or other identified repository sites, there may be an incentive to revive the Yucca Mountain program.

## Agency Activities

The Agency's routine work, with legal support provided by the Nevada Attorney General and the State's outside legal team, focuses on preparations for adjudicatory hearings before the NRC on DOE's Yucca Mountain LA. Nevada's expert team has crafted and prioritized repository safety and environmental contentions which challenge, among other things, the likely release of radioactive contamination into groundwater and NEPA contentions regarding the impacts of thousands of rail and truck shipments traversing Nevada.

[3] *Fasken Land and Minerals v. NRC*, No. 23-60377 (5th Cir. 2024)

The Agency monitors DOE's activities across the entire spectrum of nuclear waste and nuclear materials management. There are often interrelated areas where the Agency's expertise has proved vital to the State of Nevada's interests. The Agency has produced a series of written articles, explanatory podcasts and YouTube videos describing the State of Nevada's position on Yucca Mountain. They are available at the agency's website, https://anp.nv.gov/ and at https://yuccamountainproject.com/.

## Advancing Technical Programs

Since 2019, the Agency has supported research at the University of Nevada, Reno (UNR) to analyze and evaluate seismic risk at the proposed Yucca Mountain repository site. Significant advances in paleo-seismology, geochronology, fault identification by remotely sensed methods, and the scientific community's general understanding of the regional tectonic architecture of the last two decades suggest that previous studies conducted at Yucca Mountain may not completely describe the seismic hazards in the region.[4] Additional studies are needed to fully understand the seismic risks at the Yucca Mountain repository site.

Although unavailable during Yucca site characterization, modern high-resolution topographic imagery (lidar) is the new industry standard for major infrastructure projects. Acquisition of lidar for the region surrounding Yucca Mountain will improve the accuracy of mapping and identifying seismic faults. The Agency assisted in requesting and securing federal funding for lidar data acquisition in Nevada. A new interlocal agreement between the Agency and UNR was entered into August of 2024 to further evaluate seismic risks at the proposed Yucca Mountain site and to evaluate lidar data.

[4] The complete report is available for download at https://pubs.nbmg.unr.edu/Review-of-Yucca-Mountain-p/r059.htm

The Agency continues to support research at the University of Nevada, Las Vegas (UNLV) on Yucca Mountain volcanism risks and related repository performance issues. Ongoing research is being conducted to demonstrate that explosive volcanism is a hazard for Yucca Mountain during the lifetime of the proposed repository and must be considered in risk assessment studies. There are two aspects of this ongoing research. First, the issue of explosive volcanism occurring in the vicinity of Yucca Mountain and whether it will cause a direct threat to the proposed Yucca Mountain repository. Second, the issue is whether ashfall at or near the proposed Yucca Mountain repository from distant explosive eruptions over southern Nevada will create a hazard to operations at Yucca Mountain and could affect transportation of nuclear waste to the site.

## Agency Planning Programs

Under DOE's proposed national plan for Yucca Mountain, transportation of HLW and SNF would likely, if implemented, affect much of the nation for a half-century or more. The details are enumerated in the final supplemental environmental impact statement (FSEIS) and are part of the license application DOE submitted to the NRC in 2008. Legally, the amount of HLW and SNF eligible for disposal at Yucca Mountain is limited to 70,000 metric tons of heavy metal (MTHM).[5] MTHM refers to the amount of uranium or plutonium in the fuel before use in a reactor, and this amount would constitute about half the expected national total by 2055 that would require geologic disposal. Proponents would like to amend the law to eliminate this limit, so that virtually all the nation's high-level waste would become eligible for disposal in Yucca Mountain.

[5] DOE, *Final Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada,* DOE/EIS-0250F-S1 (June 2008), pages S-7 to S-8. Available on-line at https://energy.gov/sites/prod/files/EIS-0250-S1-FEIS-01-2008.pdf

## The DOE Proposed Plan for Transportation to Yucca Mountain

DOE's FSEIS unrealistically assumes a "mostly rail" transportation scenario, with about 95 percent of the intended repository inventory shipped in dedicated trains - special trains "dedicated" to hauling only one type of freight, in this case, highly radioactive spent nuclear fuel, and high-level radioactive waste resulting from the reprocessing of spent nuclear fuel. These dedicated trains would consist of 2 to 4 locomotives and 3 to 5 cask cars, separated by an equal number of buffer cars, and a personnel car carrying armed guards. However, DOE's stated plan to use dedicated trains is not guaranteed, and federal rail regulations allow HLW and SNF to be shipped by rail in general freight service. Shipping SNF as general freight would significantly increase the number of shipments, result in increased risks of radiation exposures even in incident-free transport and heighten the risk of accidents or sabotage.

Because of developments in how utilities manage SNF in the 13 years since DOE submitted its license application to NRC in 2008, the use of legal weight trucks for transport of SNF to a repository has become less and less likely. Most utilities have, or are in the process of, moving SNF out of storage pools and into dry cask storage in independent spent fuel storage installations (ISFSI) at reactor sites. Such facilities utilize very large storage containers or dual-purpose storage-transport containers that cannot be shipped using legal weight trucks. This has significantly complicated the entire system for transporting SNF nationwide.

Under the NWPA limit of 70,000 MTHM, DOE would ship 9,500 rail casks in 2,800 trains, and 2,650 trucks hauling one cask each, to Yucca Mountain over 50 years. If the capacity limit were increased to 150,000 MTHM, DOE would ship about 21,900 rail casks in about 6,700 trains, and 5,025 truck casks, to Yucca Mountain.[6] Over the five decades required to ship the

[6] DOE, *Final Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada,* DOE/EIS-0250F-S1 (June 2008), pages 6-8, 8-41. Available on-line at https://energy.gov/sites/prod/files/EIS-0250-S1-FEIS-01-2008.pdf

waste, loaded casks will be en route to Yucca Mountain by rail or truck from one of 76 sites around the country. Nevada has challenged DOE's assumption that 95 percent of the SNF could be shipped by rail. If, instead, a more realistic 20 percent were to be shipped by truck, there could be one or more truck shipments daily or every other day.


Political jurisdictions, and communities totaling millions of Americans, would be impacted by shipments to Yucca Mountain under DOE's proposal. Most of the nation's HLW and SNF is currently stored at 76 sites in 34 states. The "representative routes" identified by DOE from these sites to Yucca Mountain are shown above. These routes would use 22,000 miles of railways and 7,000 miles of highways, traversing more than 40 states and the tribal lands of at least thirty Native American tribes, the District of Columbia, and 960 counties with a 2010 Census population of about 175 million.[7] Between 10 and 12 million people live within

[7] F. Dilger, *Counties Potentially Affected by High-level Nuclear Waste Shipments to Yucca Mountain, NV* (April 12, 2012), available on-line at http://www.state.nv.us/nucwaste/news2012/pdf/nv2012dilger_counties.pdf

the radiological region of influence for routine shipments, that is, within one-half mile (800 meters) of these rail and highway routes.[8]

The Agency works cooperatively with other western states on transportation safety through WIEB's HLRWC. In 2017-2020, the WIEB HLRWC published ten policy papers that set out the western states' expectations about what a large-scale HLW/SNF transportation program would require. Agency personnel were key co-authors and contributors on these policy papers, which have since been cited in numerous reports related to HLW/SNF transportation. The Agency continues to collaborate with the WIEB HLRWC by attending meetings, participating in National Transportation Stakeholder's Forum working groups, and adding Nevada's voice to western regional policy comments on all facets of HLW/SNF transportation.

## Findings and Recommendations of the Commission

*The next two years are critical.*

Both the science and the politics of DOE's Yucca Mountain project have been plagued by repeated mistakes. This Commission, the Agency for Nuclear Projects, and the Nevada Attorney General's office remain closely involved with the Yucca Mountain project and the federal high-level radioactive waste program. In the next two years, decisions made by the federal government may have profound implications not only for the Yucca Mountain project, but also for prospects for finding a successful solution of the nation's nuclear waste dilemma. Some key lessons learned are summarized below.

The Biden Administration openly states it does not support the Yucca Mountain project. However, without new legislation, the Yucca Mountain program remains the law, despite an over ten-year hiatus in funding. Without new legislation, Nevada remains the only site in the United

[8] R.J. HALSTEAD, F.C. DILGER, "Repository Transportation Planning, Risk Management, and Public Acceptance: Lessons Learned," *Proc. IHLRWMC*, Albuquerque, NM, Pp. 408-415 (2011), available on-line at http://www.state.nv.us/nucwaste/news2011/pdf/ANS2011halstead.pdf

States under consideration for spent fuel disposal. The "on and off" switch evidenced by Congress and DOE to address consent-based siting further exemplifies a lack of consistency and continuity in U.S. nuclear waste policy, especially with respect to commercial spent fuel disposal, and points to the need for legislation directing consent-based siting for geologic repositories, and as needed, for consolidated interim storage.

Because there remains support in Congress for the Yucca Mountain repository, over the next two years, the State of Nevada must closely follow developments in Washington. While continuing to resist any effort to fund or to move Yucca Mountain forward legislatively, Nevada must prepare for the possible reconstitution of DOE's Office of Civilian Radioactive Waste Management (OCRM) and the possible resumption of a multiple year NRC licensing proceedings.

*Recent developments regarding spent nuclear fuel storage have eliminated the argument that the Yucca Mountain repository is needed to continue nuclear power plant licensing.*

Over the past two decades, almost all operating (and shutdown) nuclear power plants in the United States have either begun storing spent nuclear fuel in dry storage systems or are currently planning to acquire or construct such systems. In 2014, NRC determined, through rulemaking, that spent nuclear fuel can be safely managed at reactors, in on-site dry storage systems, for up to 160 years. The NRC Continued Storage Rule and environmental findings were upheld by the U.S. Court of Appeals for the District of Columbia Circuit in 2016.[9] The NRC Rule eliminates the argument that licensing of Yucca Mountain is required to ensure the continued licensing of nuclear reactors. The future of Yucca Mountain and the future of nuclear power in the United States now have been separated.

[9] *New York v. USNRC, 824 F.3d 1012 (D.C. Cir. 2016)*

*The Blue-Ribbon Commission on America's Nuclear Future recommendations provide a sound basis for restructuring the U.S. nuclear waste program.*

Congress must act on legislation reforming the NWPA to end the stalemate on nuclear waste. Congress should act to implement the BRC recommendations, giving the highest priority to removing the federal nuclear waste program from DOE. In addition, Congress should consider reconstituting a new independent, presidentially appointed office of a Nuclear Waste Negotiator, creation of a consent-based process for siting high-level nuclear waste repositories and storage facilities, and adopting measures to enhance transportation safety and security. *Yucca Mountain failed for many reasons, but a critical element was unquestionably the forced nature of the siting process.*

In 1987, Congress selected Yucca Mountain to be the only repository site to be studied. DOE used that directive as the basis for pushing ahead with the project, even when the data showed serious flaws in the site and despite strong and determined opposition from the State of Nevada. Provisions of the NWPA, as amended in 1987, which allowed for state disapproval of the siting decision did not protect Nevada. As a small-population state, with four electoral votes at the time, Nevada could hardly expect to obtain support from two-thirds of the voting members in both the House and Senate needed to sustain the State's conditional veto. In the years leading up to the Secretary of Energy's 2002 Yucca Mountain Site Recommendation to the President and Congress, there was little incentive for DOE to work with or listen to Nevada's strong technical and safety concerns about the proposed repository. DOE staff may have believed all along that Congress would not sustain Nevada's veto. In retrospect, if DOE had been required to obtain the State's informed consent to continue with the project, Yucca Mountain would have been

disqualified years earlier, saving billions of dollars. Had that occurred, DOE would have been forced to identify a location that was technically and geographically sound.

*Transportation is the Achilles heel of the national nuclear waste management program; additional safety and security measures, recommended by the BRC, are required.*

After studying DOE's approach to Yucca Mountain transportation, and comments from Nevada and other affected parties, the NAS published an expert consensus report in 2006 on the radiological and social impacts of HLW and SNF transportation.[10] The NAS report recommended implementation of major safety and security enhancements before the commencement of any large-scale shipping campaigns under the NWPA, as amended. In the BRC's final 2012 report, twelve major NAS recommendations were incorporated. The BRC also added an overarching recommendation that all shipments to storage facilities or repositories under the NWPA should be fully regulated by NRC to eliminate DOS's self-regulation of shipments. [11] The recommended measures include shipping the oldest fuel first to reduce radiological impacts; full-scale testing of shipping packages as part of package performance evaluations; implementation of Section 180(c) of the NWPA to provide financial and technical assistance to corridor states and tribes; requiring DOE to maximize use of rail transportation and minimize truck shipments; and requiring DOE to identify and make public its suite of preferred shipping routes as soon as practicable to support state, tribal, and local planning and preparedness. The WIEB, comprised of Governors' appointees from ten major western states, has also recently approved policy papers calling for implementation of the NAS and BRC

[10] NAS Committee on Transportation of Nuclear Waste, *Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States*, Washington DC: The National Academies Press (2006)
[11] BRC, *Report to the Secretary of Energy* (January 2012), Pp 82-84, brc.gov/sites/default/files/documents/brc_finalreport_jan2012.pdf

recommendations before any large-scale shipping campaigns to nuclear waste storage or disposal facilities.

*While reprocessing, or recycling of used nuclear reactor fuel is authorized if solely financed by the private sector, no commercial reprocessing is taking place in the United States, and it is not a safe or environmentally sound activity for consideration at the Yucca Mountain site.*

Chemical reprocessing of used nuclear fuel was developed by the government to separate plutonium produced by the fission of uranium for use in production of nuclear weapons. The process also permits separation of unused uranium for fabrication into new power reactor fuel. Past efforts in the U.S. to use this process to support commercial power reactor fuel needs have failed for various reasons, including environmental contamination resulting from reprocessing and unfavorable economic factors. Yet, there have been suggestions to the Commission by Yucca Mountain proponents that co-locating a reprocessing facility and a nuclear power reactor along with a repository at Yucca Mountain could be financially advantageous for the State and reduce the volume of waste requiring disposal at Yucca Mountain.

We categorically reject this approval. Yucca Mountain is not an acceptable site for disposal of HLW and SNF. Adding a reprocessing facility and a nuclear reactor to the Yucca Mountain site would only add insult to injury. The liquid waste produced by reprocessing cannot be disposed of at the proposed Yucca Mountain repository and would require further treatment before it can be disposed. In fact, this liquid waste has caused extensive and long-lasting environmental contamination at other reprocessing facilities, including the reprocessing facility at West Vally, New York.[12] A reprocessing facility and/or a nuclear power reactor at the Yucca

[12] The West Valley Demonstration Project is a nuclear waste remediation effort in West Valley, New York. The cleanup and containment of radioactive waste continues to the present and the contamination caused a significant legacy of waste left behind after the abandonment of the commercial plant in 1980.

Mountain site would require vast quantities of process and cooling water that are unavailable in the already over-appropriated Amargosa groundwater basin. The site is in a high-risk earthquake zone and such "add-on" facilities would present exponential risks to human health, safety and the environment in the area. Finally, there is no domestic market for nuclear fuel from reprocessing because its production cost is a number of times more expensive than fuel made from available natural uranium sources.

*The current emphasis on developing micro, small modular, and advanced nuclear power reactors has not provided needed information to determine whether the used fuel would meet waste acceptance criteria proposed in the DOE's license application for a Yucca Mountain repository.*

The nuclear industry is seeking to deploy a new generation of nuclear reactors. Congress supports these efforts, and beginning in 2016, has passed legislation to facilitate their development. These "advanced" reactor concepts have been in existence for decades and some have been deployed as prototypes. Significant questions remain about these reactors' commercial viability, ultimate costs, and the fate of the used fuel produced by these reactors.

An NAS Committee has concluded that, of the many design concepts being explored, there is not currently sufficient information available to pick a "best of class" advanced reactor and fuel cycle technology option. DOE plans to narrow its support choices in the next few years. *Nuclear fusion as a source of energy offers the promise of a relatively clean (no high-level nuclear waste) source of energy. But it remains only a promise.*

A properly functioning nuclear fusion power reactor would not create significant contamination, as the process involves combining light atomic nuclei to release energy, with only trace amounts of radioactive materials produced. The fusion process is the reaction that

powers the sun. Current nuclear power reactors employ a fission process that splits heavy elements such as radioactive uranium isotopes which provide a large energy release while creating other radioactive elements that become high-level nuclear waste. Theoretically, fusion is a potentially attractive alternative to fission for generating energy because it does not produce long-lived radioactive waste or poses the same risks of contamination in the event of an accident. While fusion has not been developed at a utility scale, it is important to monitor rapidly advancing developments in the industry as fusion gets closer to reality.

The Commission believes that the next two years will be critical for the State of Nevada to prevent the resurrection of the Yucca Mountain repository program, and to protect the State's interests if the NRC licensing proceeding is restarted. Nevada experts continued and concerted efforts by Yucca Mountain supporters to restore the DOE repository program and restart the NRC licensing proceeding.

Instead of pursuing the fatally flawed repository at Yucca Mountain, now is the time for the nation to establish a new consent-based approach to site selection for nuclear waste disposal and storage. At this pivotal juncture, it is vital that Yucca Mountain lessons learned over the past three decades are not lost, and more significantly, are not repeated. To that end, the Commission offers the following recommendations:

**Recommendation 1:** For reasons described in this and the Commission's previous reports, Nevada's Governor should continue to communicate clearly and unambiguously to the Administration and to Congress that Nevada remains steadfast in its opposition to any attempt to resurrect the defunct Yucca Mountain project or otherwise bring HLW and SNF into Nevada.

**Recommendation 2:** The Governor, the Agency, General's office and the Legislature should continue to work with Nevada's congressional delegation to implement the

recommendations of the BRC, especially those provisions requiring consent-based siting for nuclear waste disposal and storage facilities, and the need for measures to enhance transportation safety and security. The legislation designating Yucca Mountain for the development of a repository should be repealed because Yucca Mountain is, in fact, the single greatest impediment to solving the waste problem and moving the country forward with sound and workable solutions like those recommended by the BRC.

**Recommendation 3:** In the event that Congress appropriates new funds for DOE and NRC Yucca Mountain licensing activities and/or enacts legislation to resurrect the Yucca Mountain program, the Agency for Nuclear Projects, the Attorney General and the Governor should develop plans for a major public information program on the radiological and social impacts of transporting HLW and SNF to Yucca Mountain, including the 2006 findings and recommendations of NAS regarding transportation safety and security.

## Conclusion

The Governor and Legislature should reject appeals to support the proposed, but dangerous and ill-considered, geologic repository at Yucca Mountain, interim storage facilities anywhere in Nevada, and embrace the recommendations of the BRC for consent-based selection of sites for nuclear waste storage and disposal. The Commission rejects proposals for reprocessing, waste storage, and other activities in combination with or co-located at Yucca Mountain which would allow for the importation of HLW and SNF into Nevada. Any such proposals would circumvent the State's long-standing, soundly based opposition to the Yucca Mountain project.

There are substantial technical and administrative obstacles to restarting the Yucca Mountain Project. Yet, Yucca Mountain remains an impediment to resolving the nation's

ultimate need for nuclear waste disposal. Congress has left the NWPA, as amended in 1987, intact, and has not passed much needed legislation providing for an integrated nuclear waste program. Because Congress has failed to enact alternatives to failed Yucca Mountain repository, the possibility remains that the Yucca Mountain program could be revived. The Yucca Mountain site is not now and never has been an appropriate site for the geologic disposal of high-level nuclear waste.

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