# *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 ACRONYMS/ABREVIATIONS

ADAMS – Agency-Wide Documents Access and Management System

AMFM – Alternative Means of Financing and Managing panel

BLM – Bureau of Land Management

BPC – Bipartisan Policy Center

BRC – Blue Ribbon Commission on America's Nuclear Future

CAB – NRC's Construction Authorization Board responsible for the Yucca Mountain licensing hearings

CADC – US Court of Appeals for the District of Columbia Circuit

DOE – U.S. Department of Energy

EIS – Environmental Impact Statement

EPA – U.S. Environmental Protection Agency

FEIS – Final Yucca Mountain Environmental Impact Statement

GAO – U.S. Government Accountability Office (formerly the U.S. General Accounting Office)

HLW – High-Level Radioactive Waste

IPC – Invitation for Public Comment

LA – DOE's Yucca Mountain License Application pending before the Nuclear Regulatory Commission

LSN – Licensing Support Network

MTHM – Metric Tons of Heavy Metal

NAS – National Academy of Sciences

NEPA – National Environmental Policy Act

NOI – Notice of Intent

NRC – U.S. Nuclear Regulatory Commission

NWA – Nuclear Waste Administration

NWPA – Nuclear Waste Policy Act of 1982 – the 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

OCRWM – Office of Civilian Radioactive Waste Management

SEIS – Supplemental Environmental Impact Statement

SER – Safety Evaluation Report

SRGs – State regional groups

## LIST OF FIGURES AND TABLES

# Introduction – Current Yucca Mountain Developments

In its last report to the Governor and Legislature in December 2014, the Nevada Commission on Nuclear Projects provided a comprehensive review of the status of the U.S. Department of Energy's (DOE) Yucca Mountain high-level radioactive waste repository project, the U.S. Nuclear Regulatory Commission's (NRC) Yucca Mountain licensing proceeding, and DOE's failed attempt to withdraw the license application and formally terminate the program. In the intervening two years, little has changed. The Yucca Mountain project remains suspended, but advocates in Congress and the nuclear industry are keeping the program on life support and looking for ways to restart it. The retirement of Senator Harry Reid, whose leadership position in the U.S. Senate and strong opposition to Yucca Mountain have effectively shut down funding for the program, and the onset of a new Congress and a new Administration in January 2017, have created opportunities for proponents to attempt to resurrect the project.

## *The NRC's Yucca Mountain Licensing Process*

Following DOE's decision to terminate the Yucca Mountain program in 2010 and NRC's subsequent suspension of the licensing proceeding in 2011, the States of South Carolina and Washington, one South Carolina County (Aiken County), the National Association of Regulatory Utility Commissioners, several individuals from Washington State, and eventually Nye County, Nevada (in direct opposition to the position of the State of Nevada) filed suit in 2011 before the U.S. Court of Appeals for the District of Columbia Circuit (CADC) asking for a writ of mandamus (i.e., a court order) to require the NRC to restart the Yucca Mountain licensing proceeding. [*In re* Aiken County, 725 F.3d 255 (D.C. Cir. 2013), *pet, for reh'g en banc den.* (Oct. 28, 2013)(Aiken case)]

On August 13, 2013, the CADC issued a decision in the Aiken case, granting a writ of mandamus that ordered NRC to restart the Yucca Mountain licensing proceeding using the available funds appropriated in previous years, even though the court acknowledged that those funds were insufficient to complete the proceeding. The ruling was a split decision. Two members of the three-judge panel voted to grant mandamus, while Chief Judge Merrick Garland asserted in a strongly-worded dissent that NRC was being ordered to do a "useless thing," i.e., restart a proceeding everyone agreed could not be sustained, let alone completed, without substantial new congressional appropriations.[1]

[1] Following DOE's decision to terminate the Yucca Mountain program, Congress has failed to appropriate any new funds for DOE or NRC licensing activities since federal fiscal year 2010.

Following the court's ruling, NRC reported that it had slightly over $13 million in funds remaining from prior appropriations that could be used for a restarted licensing proceeding.[2] On November 18, 2013, NRC ordered the licensing proceeding restarted and directed its staff to undertake four specific tasks:

1. Complete work on the Safety Evaluation Report (SER)[3] that contains the staff's review of the DOE license application and its compliance with NRC licensing regulations.
2. Prepare a Supplement to DOE's 2008 Environmental Impact Statement (EIS Supplement) to address the impacts of the proposed repository on groundwater.[4] NRC initially asked DOE, as the project applicant, to complete the EIS Supplement. DOE declined and only provided NRC with an updated technical report on groundwater issues. NRC subsequently completed the EIS Supplement on its own.
3. Arrange for all of the documents formerly contained in the NRC's dedicated licensing database (the licensing support network or LSN) to be incorporated into NRC's overall information database (the Agency-wide Documents Access and Management System – ADAMS).
4. Produce a lessons-learned report documenting the NRC's experience in the licensing process thus far.

As of the date of this report, NRC staff has completed all of the tasks assigned in the November 2013 order, although it is not yet clear whether NRC's ADAMS document system will be an adequate and accessible replacement for the defunct LSN. NRC is expected to have at least $1 million remaining in available nuclear waste funds, once all costs for those four tasks have been tallied. It is possible that NRC would direct that these remaining funds be used to restart the suspended adjudicatory proceeding. However, without an infusion of new funding from Congress, little could be accomplished other than possibly convening the parties for a case management conference and some preliminary procedural and process-related activities. Nevertheless, the lifting of the suspension and restart of the adjudicatory portion of the licensing proceeding would start the clock on crucial deadlines the State of Nevada must be prepared to respond to on very short notice. For example, upon resumption of the licensing proceeding,

[2] Prior to the suspension of the proceeding in 2010, NRC had estimated that the total costs of a full-scale licensing proceeding would be in excess of $100 million.

[3] The Safety Evaluation Report is a 5-volume document prepared by NRC staff that represents the staff's evaluation of DOE's license application in relation to NRC's licensing guidelines and regulations. The SER is a document required to be prepared by NRC staff for all facility license applications that go to hearing before a NRC licensing board. It essentially documents the staff's review of the application prior to the formal licensing hearings.

[4] Before the licensing proceeding was suspended in 2010, NRC staff had determined that the groundwater analysis contained in the EIS DOE prepared as part of its license application did not adequately address certain groundwater impacts resulting from repository activities. NRC decided that a supplemental environmental analysis would be required. However, the proceeding was suspended before such analysis could be undertaken.

there would be a very short deadline for submitting new contentions[5] and for filing important procedural motions. The Agency for Nuclear Projects and the Attorney General's Office, together with the State's licensing attorneys and technical experts, have been working diligently over the past two years to lay the groundwork for expeditiously re-engaging in a full licensing proceeding and preparing for an early resumption of discovery and hearings.

An in-depth discussion of NRC's Yucca Mountain licensing requirements and the anticipated licensing proceeding are contained in the attached white paper, "The U.S. Nuclear Regulatory Commission's Yucca Mountain Licensing Proceeding" (Attachment I).

## *Status of Nevada's Intervention in NRC's Yucca Mountain Licensing Proceeding*

In response to DOE's Yucca Mountain License Application (LA), Nevada submitted 229 contentions to the NRC licensing board in December 2008. The majority of the contentions are technical in nature and address serious deficiencies in the LA, ranging from flaws in the overall performance assessment model and calculations to specific geotechnical issues, such as the potential for renewed volcanic activity at the Yucca Mountain site, corrosion of the waste disposal packages, the implications of DOE's proposed use of drip shields to shelter waste packages from water in the tunnels, and other key safety and site suitability issues. The State's contentions also challenged the adequacy of DOE's repository and transportation environmental impact assessments.

In May 2009, the NRC licensing boards[6] accepted an unprecedented 222 out of the 229 originally filed contentions by the State. Nevada's 1,566 page petition containing all 229 contentions can be found at: http://www.state.nv.us/nucwaste/licensing/Contentions_NV.pdf.[7]

Upon subsequent appeal of the Boards' ruling by the NRC staff[8], the full Nuclear Regulatory Commission upheld all but two of Nevada's contentions, allowing 220 to go forward to be adjudicated. Subsequently, six (6) additional contentions were submitted by Nevada in response to new information that came to light after the initial license submittal by DOE. Four (4) of those new contentions were also admitted for adjudication by the licensing boards. Due to consolidation of several Nevada contentions, the total number of the State's admitted contentions

[5] Nevada currently has 218 admitted contentions pending before the NRC's suspended Yucca Mountain licensing proceeding. As a result of new information that has become available since the suspension of the proceeding in 2011, Nevada's legal team and technical experts have identified 30 new contentions, with another 20 in process.

[6] Due to the complexity of the Yucca Mountain licensing proceeding, NRC, before the proceeding was suspended, had initially established three licensing boards, called Construction Authorization Boards (CABs), that would have operated concurrently in adjudicating the unprecedented number of contentions and theoretically allow the proceedings to be completed in the statutorily specified four year time-frame.

[7] The Agency maintains a comprehensive web page containing all pertinent licensing materials, petitions, orders, etc. This web page can be found at: http://www.state.nv.us/nucwaste/licensing.htm .

[8] DOE originally challenged all of Nevada's contentions, while the NRC staff recommended that only 19 of the original 229 State contentions should be admitted for adjudication in the licensing hearing.

currently stands at 218. A total of 299 contentions from all parties to the licensing proceeding have been accepted by the NRC licensing boards to date.

Following the court-mandated restart of NRC's licensing activities, the Agency for Nuclear Projects and the Nevada Attorney General's Office have carefully reviewed and provided extensive comments on the NRC staff's SER and NRC's Supplement to DOE's Yucca Mountain Environmental Impact Statement on groundwater impacts of the proposed repository. As a result of these reviews and from information that has come to light since the suspension of the licensing proceeding in 2011, the State's licensing attorneys and technical experts have so far identified 30 new contentions and are working on as many as 20 additional ones. Since the formal NRC proceeding remains suspended, these new contentions cannot be submitted unless and until the adjudicatory hearing resumes.

Nevada's licensing team of technical experts and attorneys are preparing extensive contingency plans in anticipation of a restart of NRC's adjudicatory proceeding. Preparation for hearings would place a considerable burden on the State, requiring expeditious action on filing new contentions, submitting procedural and substantive motions and filings, depositions and discovery, and carrying out other licensing tasks under what are likely to be tight timeframes and deadlines imposed by the licensing board.

## *DOE's Initiative for a Consent-Based Process for Siting Nuclear Waste Facilities*

DOE, under the leadership of Secretary Ernest Moniz, has remained steadfast in its position that the Yucca Mountain program is unworkable. DOE has shown no inclination towards resurrecting the defunct program. Following the 2010 decision to halt the program, DOE dismantled the Office of Civilian Radioactive Waste Management, the DOE organizational entity that had implemented the Yucca Mountain program. In March 2013, DOE published a strategy for implementing the recommendations of the Blue Ribbon Commission (BRC) on America's Nuclear Future.[9] In December 2015, the DOE Office of Nuclear Energy issued a Invitation for Public Comment (IPC) Notice in the *Federal Register* requesting public input on plans to develop a new, "consent-based" process for siting facilities for nuclear waste storage and disposal based on the BRC recommendations. This new initiative seeks to incorporate lessons learned from failed past attempts to site nuclear waste repositories, including Yucca Mountain.

Between March and July 2016, DOE held eight public meetings around the country "to engage communities and discuss the development of a consent-based approach to managing the

[9] The BRC was comprised of 15 highly regarded individuals from diverse backgrounds who were appointed by President Obama to review the federal government's high-level nuclear waste program and make recommendations regarding the future of the program. The BRC was co-chaired by former U.S. Congressman Lee Hamilton and former presidential advisor Brent Scowcroft. The BRC held a series of meeting and information gathering activities around the country over a two-year period and issued a comprehensive report in January 2012. The final BRC report recommended, among other things, that any future nuclear waste facility siting efforts be consent-base and have the approval of the host state and community.

nation's nuclear waste." The Agency's executive director attended the April 26, 2016 meeting in Sacramento, California. In the *Federal Register* Notice announcing the initiative, the Department "concurred with the recommendation from the Blue Ribbon Commission on America's Nuclear Future that a phased, adaptive, consent-based siting process is the best approach to gain the public trust and confidence needed to site nuclear waste facilities." Five specific questions were listed in the IPC Notice for public comment and feedback: (1) How can the Department of Energy ensure that the process for selecting a site is fair; (2) What models and experience should the Department of Energy use in designing the process; (3) Who should be involved in the process for selecting a site, and what is their role; (4) What information and resources do you think would facilitate your participation; and (5) What else should be considered?

In comments made on behalf of the State of Nevada, the Agency for Nuclear Projects restated Nevada Governor Brian Sandoval's opposition to Yucca Mountain:

> "DOE's new interest in consent-based siting does not change Nevada's opposition to Yucca Mountain. Governor Brian Sandoval has clearly stated that Nevada will not consent to storage or disposal of spent nuclear fuel or high-level nuclear waste at Yucca Mountain. This site is unsafe for commercial and defense high-level nuclear wastes, whether combined in one repository, or disposed separately."

The Agency's July 29, 2016 letter to DOE emphasized the need to acknowledge the failure of forced siting at Yucca Mountain:

> "If Yucca Mountain has taught us anything, it is that trying to force a repository on an unwilling state only gets the nation further away from a workable and safe solution to nuclear waste disposal. Nevada supports the development of a consent-based siting process for nuclear waste storage and disposal facilities to find workable alternatives to Yucca Mountain."

The Agency's comments also responded in detail to DOE's fifth question:

> "The implementation of a consent-based siting process for nuclear waste facilities will require new federal legislation to replace or amend the Nuclear Waste Policy Act, as amended (NWPA, 42 U.S.C. 10101 *et seq.).*We believe that new federal legislation must at a minimum incorporate the 2012 recommendations of the BRC in three crucial areas.
>
> "First, new legislation must provide a statutory basis for binding written agreements between DOE (or any other program-managing entity) and state, local and tribal governments that consent to host nuclear waste storage and disposal facilities. In preparing its report on this IPC, DOE should consider the legislation introduced in the

114th Congress by Senator Harry Reid and Senator Dean Heller, S.1825, The Nuclear Waste Informed Consent Act. S.1825 would require the Secretary of Energy to obtain written consent from any potential host state and county, adjacent county impacted by transportation, and affected Indian tribe, before expending any funds from the Nuclear Waste Fund for repository construction.

"Second, new legislation must affirm the regulatory basis for the siting, licensing, operation, and closure of nuclear waste storage and disposal facilities. Both the final report of the *Blue Ribbon Commission on America's Nuclear Future* (2012) and the Administration's *Strategy for Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste* (2013) state that an important early step in the siting process is establishment of generic repository safety standards. In preparing its report on this IPC, as part of its "implementing a consent-based siting process" DOE should consult formally with the Nuclear Regulatory Commission and Environmental Protection Agency on the urgent need for safety standards and regulations to support a new repository siting process that relies on early public confidence to make informed consent possible from potential host jurisdictions and communities.

"Third, new legislation must address the radiological impacts and social impacts of transporting spent nuclear fuel and high-level radioactive waste. The National Academy of Sciences (NAS) Committee on Transportation of Radioactive Waste documented these radiological and social impacts, and recommended comprehensive transportation safety and security measures to address these impacts, in their report *Going the Distance? The Safe Transportation of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States* (2006). The NAS findings and recommendations were adopted and endorsed by the BRC in 2012. In preparing its report on this IPC, DOE should consider requiring implementation of the transportation safety and security measures recommended by the NAS and the BRC before the commencement of any shipments of spent nuclear fuel or high-level radioactive waste to consolidated interim storage or disposal facilities."

In September 2016, DOE released a draft report[10] summarizing the comments and information collected during the public hearings and public comment process. That report contains no conclusions or DOE answers to the questions posed. Rather it represents an overview of what DOE has gleaned from the public input process and summarizes fairly

[10] "Designing a Consent-Based Siting Process: Summary of Public Input, Draft Report", U.S. Department of Energy (September 15, 2016) http://energy.gov/sites/prod/files/2016/09/f33/09%2015%2016%20Draft%20Summary%20of%20Public%20Input%20Report.pdf

accurately the major themes that emerged from the public meetings and other responses to DOE's solicitation of public comments.

The Agency for Nuclear Projects submitted comments on the draft report to DOE on October 27, 2016, reiterating that DOE's consent-based siting process must provide for written consent agreements with host states and other affected governments, develop new repository safety standards, and address stakeholder concerns about transportation. In particular, attendees at DOE's meetings across the country challenged DOE on transportation safety and security. Accordingly, Nevada strengthened its recommendations to DOE on transportation:

> "Public input since December 2015 has clearly identified nuclear waste transportation impacts as a major area of stakeholder concern in facility siting. Transportation impacts should be addressed in both the draft consent-based siting process and in the draft report on siting considerations. We believe that new federal legislation will be needed to address the radiological impacts and social impacts of transporting spent nuclear fuel and high-level radioactive waste. The National Academy of Sciences (NAS) Committee on Transportation of Radioactive Waste documented these radiological and social impacts and recommended comprehensive transportation safety and security measures to address these impacts in their report: *Going the Distance? The Safe Transportation of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States* (2006). The NAS findings and recommendations were adopted and endorsed by the BRC in 2012. With or without new statutory requirements, DOE should make a clear commitment to implement the transportation safety and security measures recommended by the NAS and the BRC before the commencement of any shipments of spent nuclear fuel or high-level radioactive waste to consolidated interim storage or disposal facilities."

On December 29, 2016, DOE published "Designing a Consent-Based Siting Process: Summary of Public Input, Final Report"[11]. A number of Nevada's comments are included in the DOE siting process report. The DOE siting report refers to other ongoing spent nuclear fuel (SNF) and high-level radioactive waste (HLW) management studies that have addressed the BRC recommendations, including the Bipartisan Policy Center (BPC) Nuclear Waste Initiative[12] and the Stanford Center for International Security and Cooperation Reset of U.S. Nuclear Waste Management Strategy and Policy Initiative.[13] Agency representatives have participated in both the BPC and Stanford meetings.

[11] https://energy.gov/sites/prod/files/2016/12/f34/Summary%20of%20Public%20Input%20Report%20FINAL.pdf
[12] An overview of BPC activities, including the report, *Moving Forward with Consent-Based Siting for Nuclear Waste Facilities* (September 2016), is available at http://bipartisanpolicy.org/nuclear-waste/ .
[13] The agendas and resource materials for the five Stanford Center-George Washington University meetings held so far are available at http://cisac.fsi.stanford.edu/research/nuclear-waste-reset-initiative .

Other DOE activities related to consent-based siting include development of a plan for a possible defense-waste-only repository and ongoing meetings with, and DOE financial support for, organizations representing transportation-affected state and tribal governments, and other potential transportation stakeholders. On December 16, 2016, DOE issued for public comment a *Draft Plan for a Defense Waste Repository*, which would implement President Obama's March 2015 finding that a separate repository "is required" for high-level radioactive waste resulting from atomic energy defense activities.[14] The Agency and the Attorney General's Office will submit comments to DOE on or before the March 16, 2017 deadline for public input.

DOE provides financial and technical support to four regional transportation planning groups (usually referred to as state regional groups or SRGs). The Agency represents Nevada on the Western Interstate Energy Board High-Level Waste Committee, one of the four SRGs supported by DOE. Representatives of the Agency, Nevada Highway Patrol, and other Nevada state agencies participate in DOE's National Transportation Stakeholder Group. Nevada Native American tribe representatives participate in the DOE Tribal Working Group. During 2016, all of these groups were actively involved with DOE's consent-based siting program.

## *NRC's Continued Storage Rulemaking – Implications for Yucca Mountain*

On August 26, 2014, NRC issued a final rule on continued at-reactor storage of spent nuclear fuel and terminated a two-year suspension of final licensing actions for new nuclear power plants and license renewals of existing plants. The 2014 "Continued Storage" rule is good news for opponents of Yucca Mountain. First, the NRC determination that spent nuclear fuel can be safely managed on-site in dry casks for up to 160 years eliminates the argument that the successful licensing of Yucca Mountain is required to assure the continued licensing of nuclear reactors. The future of Yucca Mountain and the future of nuclear power are now separate. Second, the NRC generic environmental impact statement prepared in support of the Continued Storage Rule defines the "no action" alternative required under the National Environmental Policy Act (NEPA) in a manner that negates the key "no action" alternative in the U.S. Department of Energy's (DOE's) 2008 Supplemental Environmental Impact Statement (EIS) for Yucca Mountain, which was submitted to NRC as part of the license application. DOE's 2008 conclusion that constructing and operating a repository at Yucca Mountain is the preferred alternative under NEPA is no longer supported by DOE's and NRC's own NEPA analyses. The attached white paper (Attachment II) reviews the developments that led up to the NRC's new "Continued Storage of Spent Nuclear Fuel" Rule, beginning with the adoption in 1980 of the former "Waste Confidence Rule" and the subsequent unsuccessful legal challenges to the NRC rule, which concluded in 2016.

[14] https://energy.gov/ne/defense-waste-repository

# Developments in Congress with Implications for Yucca Mountain

It is apparent to the Commission that influential members of Congress and key actors within the nuclear industry and nuclear industry advocacy groups have not given up on finding a way to resurrect the failed Yucca Mountain program. Representative John Shimkus (R-IL), perhaps the most vocal of Yucca Mountain proponents in Congress, has repeatedly articulated his intention to move ahead with renewed efforts to fund NRC and DOE licensing efforts after the new Congress begins in January 2017. Rep. Shimkus is the chair of the House Subcommittee on Environment and the Economy and is a senior member of the House Committee on Energy and Commerce.

## *Recent Congressional Actions that have Implications for Yucca Mountain*

In April 2015, Rep. Shimkus and the Subcommittee on Environment and the Economy staged a visit to the Yucca Mountain site in an effort to advance the erroneous notion that the project could be readily restarted (see the discussion on page 14 of this report that addresses what actually exists at the Yucca Mountain site and what would be required to develop a repository there). In July 2016, Rep. Shimkus' subcommittee held a hearing in Washington to promote "Federal, state and local agreements and associated benefits for spent nuclear fuel disposal." While neither the Governor nor any other state officials participated in the hearing, Governor Sandoval made clear Nevada's position in a July 7, 2016 letter sent to Chairman Shimkus:

> "My position, and that of the State of Nevada, remains unchanged from my previous letters to this committee in May 2015 and January 2016: the State of Nevada opposes the [Yucca Mountain] project based on scientific, technical and legal merits."

Because the subcommittee hearing was clearly aimed at encouraging support for the project from Yucca Mountain proponents in Nye County, Governor Sandoval reminded the subcommittee that "as set forth in the Nuclear Waste Policy Act of 1982, only the Governor is empowered to consult on matters related to the siting of a nuclear waste repository." The Governor went on to call for support for "bipartisan efforts in Congress to pursuing a long-term solution for the nation's nuclear waste through a consent-based process. If such a process had been embraced when my predecessor, Governor Kenny Guinn, vetoed the selection of Yucca Mountain 14 years ago, we might today be closer to a long-term solution for the nation's spent nuclear fuel." A copy of Governor Sandoval's letter is appended to this report as Attachment III.

In early 2017, the U.S. Government Accountability Office (GAO) is expected to release a detailed report on Yucca Mountain licensing restart issues and costs requested by Rep. Shimkus

and Rep. Fred Upton, Chairman of the House Committee on Energy and Commerce.[15] GAO was asked to address the following:

1. Does DOE have a restart plan to complete the review of the Yucca Mountain LA? If so, does the plan comply with all aspects of the NWPA? If not, what are the gaps? What is the current status and availability of contracts and contractors to support the licensing and program restart?
2. What specific contracting and DOE personnel remain to assist in the completion of the LA?
3. Do the contractor(s) have sufficient funding available for timely restart of their needed functions? If so, are funds available to enable completion of the LA review process? If not, what funding is needed and what are the cost and schedule estimates for funding?
4. What plans or instructions are in place to find, and use, the Yucca Mountain records which were archived during the shutdown process?
5. Does the NRC have the necessary expertise and organization in place to complete its review of the Yucca Mountain LA?

GAO staff, as part of their research, interviewed Agency for Nuclear Projects and Office of the Attorney General staff and consultants in September 2016. Nevada staff and consultants provided a detailed account of the State of Nevada's objections to DOE's Yucca Mountain license application, emphasizing that the site is unsuitable because of its complex geology and hydrology; that the proposed repository cannot meet EPA and NRC requirements for post-closure safety over the required 1 million year performance period; and that if the titanium drip shields are not installed, the 10,000-year allowable dose limit to individuals (15 mrem/yr) could be exceeded before 900 years, and the million-year standard (100 mrem/yr) could be exceeded at 2,000 years. The NRC staff SER also acknowledges that key criteria for pre-closure safety, control of the site by land withdrawal and securing of water rights necessary for repository construction and operation have not been met.

Nevada staff and consultants also stated that the national interest would be much better served by terminating the current Yucca Mountain license application as DOE proposed in its 2010 motion to withdraw its license application. However, if the adjudication was restarted, it is very important to have the hearing venue located in Nevada. NRC's original provisions for a hearing facility in Las Vegas were appropriate and should be reinstituted. Nevada believes it is imperative that sufficient funds are provided not only to the State of Nevada but also to each of the affected counties, independently of the funds that might be provided to Nye County as the host county. Sufficient resources also need to be provided to the Timbisha Shoshone Tribe and to

[15] Fred Upton and John Shimkus, Letter to the Honorable Gene Dodaro, Comptroller General, U.S. GAO, February 29, 2016.

the Native Community Action Council, both of which are parties admitted to the licensing proceeding by the Nuclear Regulatory Commission.

## *Pending Legislation that has Implications for Yucca Mountain*

The 115th Congress, which convened on January 3, 2017, is expected to consider new legislation dealing with high-level nuclear waste management. Since 2013, several bills have been introduced in Congress aimed at restarting the federal high-level radioactive waste program and implementing key provisions contained in the BRC recommendations.[16] The most comprehensive approach so far is that proposed in S.854, the Nuclear Waste Administration Act of 2015. (see https://www.congress.gov/bill/114th-congress/senate-bill/854/) S.854 was introduced in March 2015 by Senator Lamar Alexander (R-TN), with co-sponsors Senators Lisa Murkowski (R-AK), Dianne Feinstein (D-CA), and Maria Cantwell (D-WA).[17] S.854 was referred to the Senate Committee on Energy and Natural Resources, where no further action was taken. A new bill based on S.854 is expected to be the basis for discussion in the Senate in 2017.

S.854 would create a new Nuclear Waste Administration (NWA) to assume DOE's responsibility for siting and operating a geologic repository for spent nuclear fuel and high-level radioactive waste and would direct the NWA to site and operate a pilot spent fuel storage facility and one or more consolidated storage facilities. S. 854 would require consent of affected states, including written consent of the governor, communities, and Indian tribes (if applicable), before developing facilities for storage and disposal of spent fuel and high-level waste. The bill would also change how future siting, characterization, licensing, and construction activities would be funded.

To be acceptable to Nevada, S.854 would need to be amended to apply the requirement for a written consent agreement to Nevada and to the Yucca Mountain project. In July 2015, Nevada's U.S. Senators Harry Reid and Dean Heller introduced S.1825, the Nuclear Waste Informed Consent Act (https://www.congress.gov/bill/114th-congress/senate-bill/1825). S.1825 would require a binding written consent agreement with the host state governor, affected units of local government (including contiguous counties impacted by transportation), and any affected Indian tribe before the Secretary of Energy made any expenditures from the Nuclear Waste Fund

[16] Legislative efforts to implement the BRC recommendations are examined in R.J. Halstead, A. Mushkatel, and K. Thomas, "Remaking the U.S. Nuclear Waste Program: A Window of Opportunity for Change?" Waste Management 2015, Proceedings of the Conference, Phoenix, AZ (March 15-19, 2015), available at http://www.state.nv.us/nucwaste/news2016/pdf/WM2015_RemakingWasteProgram.pdf

[17] S.854, like S.1240 (2013), has its origin in a bill introduced in August 2012 by the retiring U.S. Senator from New Mexico, Jeff Bingaman, with the goal of starting a discussion on the BRC report. Bingaman's bill, S.3469 (2012) died in committee. In April 2013, the Committee on Energy and Natural Resources issued a "discussion draft" of legislation "intended to implement the recommendations" of the BRC. Over the next month, the Committee received more than 2,500 public comments on the discussion draft bill. In June 2013, S.1240 was introduced and referred back to the Committee. S.1240 represented the collaborative work of the Committee's Chairman (Ron Wyden, D-OR) and Ranking Member (Lisa Murkowski, R-AK) and the Chairman (Dianne Feinstein, D-CA) and Ranking Member (Lamar Alexander, R-TN) of the Senate Appropriations Subcommittee on Energy and Water Development. It was originally scheduled for amendments and debate in early 2014.

for construction and operation of a geologic repository. This approach would both extend consent to Nevada regarding the proposed Yucca Mountain repository and protect the interests of other potential host states and local governments by allowing completion of the full legally-mandated NRC licensing proceeding before requiring a binding written agreement with DOE.[18] No further action was taken on either of these bills during the 114th Congress.

As part of seeking to revive the federal high-level nuclear waste program, Yucca Mountain congressional supporters, with encouragement from the nuclear industry, will likely make a concerted effort in 2017 to appropriate new funds for DOE and NRC licensing activities. Congress has not provided any new appropriations for DOE or NRC Yucca Mountain activities for the past six years.

Congress did not pass an appropriations act for Fiscal Year 2017, which began on October 1, 2016, and the Federal Government is currently operating under a continuing resolution that expires in April 2017. The current continuing resolution provided no new funding for Yucca Mountain activities by DOE or NRC. The Congress could provide funding to restart the Yucca Mountain program in 2017 either through a continuing resolution or through an energy and water development appropriations bill.

In early 2017, the House of Representatives could follow the approach taken in April 2016, when the House Appropriations Committee adopted by voice vote an FY 2017 energy and water development appropriations bill that, in the words of the words of the committee, "continues congressional efforts to support the Yucca Mountain nuclear repository, providing $150 million for the Nuclear Waste Disposal program and $20 million for the Nuclear Regulatory Commission to continue the adjudication of DOE's Yucca Mountain License application." That bill was defeated in a floor vote for reasons unrelated to Yucca Mountain.

It is unclear what might happen in the Senate in 2017. The Senate Appropriations Committee unanimously approved S.2804, the FY 2017 Energy and Water Development Appropriations Act in April 2016, which contained no Yucca Mountain funding. That bill included a pilot program for consolidated nuclear waste storage and allowed DOE to store nuclear waste at private facilities that are licensed by the Nuclear Regulatory Commission. However, Nevada Sen. Harry Reid was the Senate minority leader at the time when the Senate

[18] An earlier approach was taken in March 2015, when Sen. Harry Reid (D-NV) and Sen. Dean Heller (R-NV) introduced the Nuclear Waste Informed Consent Act (S.691). Rep. Dina Titus (D-NV) and Rep. Joe Heck (R-NV) introduced an identical bill (H.R. 1364) in the House of Representatives. These bills would require a binding written consent agreement with the host state governor, affected units of local government (including contiguous counties impacted by transportation), and any affected Indian tribe before the NRC authorized construction of any repository. This would allow the repository consent agreement to be informed by completion of the safety evaluations required by NRC regulations and by the environmental evaluations required under NEPA. This timing change for the required agreement would extend consent to Nevada regarding the proposed Yucca Mountain repository.

voted to pass that appropriations bill and was instrumental in keeping funds for Yucca Mountain out of the bill. The bill was never enacted.

Completion of the legally-mandated licensing process for Yucca Mountain could cost $2 billion or more. In a 2008 report, DOE estimated new funding requirements for Yucca Mountain licensing at $1.66 billion for a 10-year period beginning in 2007, in addition to $670 million spent on licensing between 2003 and 2006.[19] The NRC Chairman recently stated that it would cost "about $330 million" over "multiple years" to complete the Yucca Mountain licensing process.[20] The last congressional action that appropriated funds to DOE and NRC for licensing activities in Fiscal Year 2010 also included funding for the State of Nevada ($2.5 million), affected units of local government ($4.5 million), and affected federally-recognized Indian Tribes ($246,000).[21]

[19] DOE, *Analysis of the Total System Life Cycle Cost of the Civilian Radioactive Waste Management Program, Fiscal Year 2007*, DOE/RW-0591, Washington, DC (July 2008). All values were stated in 2007 dollars; see pages 8, 17 - 19.
[20] NRC Chairman Burns' response to questions during testimony before the House Appropriations Committee, Subcommittee on Energy and Water Development, February 10, 2016.
[21] PL 111-85 (for FY 2010), October 28, 2009, 123 STAT. 2864-2865, percentage allocations of total $98.4 million appropriated from the Nuclear Waste Fund, "to remain available until expended."

# Lessons Learned from Past Yucca Mountain Experience

As Nevada once again faces the likelihood of a resurgent push by Yucca Mountain proponents in Congress and elsewhere, it is instructive and useful to revisit the compelling reasons why Yucca Mountain is a scientifically and technically unsuitable repository site, how DOE's engineering 'fixes' over the years were designed to mask the site's fundamental deficiencies, and what lessons can be gleaned from the Yucca Mountain experience.

## *What Actually Exists at Yucca Mountain?*

Proponents advocating restart of the Yucca Mountain project continually misrepresent what would be involved with the development of a repository at the site. When DOE abandoned the Yucca Mountain site and announced that it was terminating the project in 2010, all that existed, and all that continues to exist, at the project's location is a single 5-mile-long, horseshoe-shaped tunnel constructed to permit access to the subsurface for the purpose of studying geologic and hydrologic conditions underground (site characterization). DOE's proposed subsurface layout would incorporate the existing access tunnel, but that tunnel itself cannot be used for waste storage or disposal. At a minimum, a repository at Yucca Mountain would require the construction of 42 miles of additional tunnels to accommodate the emplacement limit of 70,000 metric tons of heavy metal (MTHM) of SNF and HLW. Yet another 45 miles of new tunnels would be required if the capacity were increased to 150,000 MTHM.[22] To operate the repository, DOE also would need to construct extensive new surface facilities for waste receipt and handling and more than 300 miles of new railroad, the country's longest new rail construction project in the past 100 years.

In 2010, DOE reported that it had spent $6.6 billion on the Yucca Mountain project between 1983 and 2009.[23] DOE later recalculated and estimated it spent about $14.5 billion on Yucca Mountain and related costs, when the costs were expressed in 2008 dollars. Including the $14.5 billion already spent, DOE estimated in December 2012 that going forward with Yucca Mountain would require another $82.5 billion for construction, operation, and closure, for a total cost just under $97 billion.[24] To begin actual construction, DOE would need the approval of the license application and the granting of a construction authorization from NRC– something that is being – and will continue to be – vigorously contested by Nevada.

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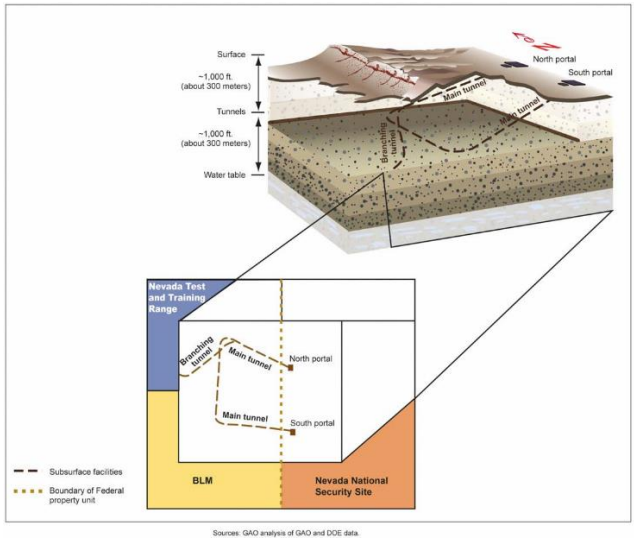
[22] DOE, *Final Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*, DOE/EIS-0250F-S1 (June 2008), pages S-7, 2-24, 2-28, 8-6, 8-17.
[23] DOE, Office of Civilian Radioactive Waste Management, Office of Business Management, Summary of Program Financial and Budget Information, As of January 31, 2010. Those costs are expressed in actual year of expenditure dollars, with no adjustment for inflation.
[24] J.T. Carter, Back End Fuel Cycle Cost Comparison, Prepared for U.S. DOE, Nuclear Fuel Storage and Transportation Planning Project, Dec. 21, 2012, FCRD-UFD-2013-000063, Rev 1, page B-22; See also DOE, *Analysis of the Total System Life Cycle Cost of the Civilian Radioactive Waste Management Program, Fiscal Year 2007*, DOE/RW-0591, Washington, DC (July 2008), wherein costs are estimated in 2007$. The estimated cost for the Caliente rail line found on pages 27-28 is $2.69 billion in 2007$, including $40 million spent in 2004-2006.

The site has been mothballed since 2010. 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 that is 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 or more, and the designation of the new Basin and Range National Monument makes DOE's proposed rail route unworkable. As shown in Figure 1, all that exists at Yucca Mountain is a single, 5-mile long exploratory tunnel.

*Figure 1. What Exists Today at Yucca Mountain*




- *No waste disposal tunnels (Over 40 miles needed beyond current 5 miles)*
- *No waste handling facilities*
- *No state water permit*
- *No construction authorization*
- *No railroad*
- *Expired BLM land withdrawal*

DOE's Yucca Mountain public land order, granted by the Bureau of Land Management (BLM) for use of the proposed site area, expired in 2010. DOE's BLM 308,600 acre land withdrawal for the 300-plus mile-long Caliente rail corridor expired in 2015. BLM has informed the Nevada Office of Attorney General that any effort to restart the Yucca Mountain project or the Caliente rail alignment would require DOE to restart the administrative process for land withdrawal:

> "… a new land withdrawal application would need to be filed with the BLM. There would be at least one public meeting no sooner than 30 days after the Notice of Intent

(NOI) for Withdrawal is published in the Federal Register. The NOI would segregate the lands for a period of 2 years while the studies and reports are prepared (NEPA, cultural, historic, mineral potential report, etc.) The NEPA and other statues and regulations would dictate the public involvement. In addition, if the agency applying for use of the lands has any acquisition requirements/restrictions, those would also need to be met. The withdrawal may only be made after all requirements are met."

## *What Is Wrong with Yucca Mountain?*

The concept known as deep geologic disposal is relatively simple and straight-forward: Find a location within the earth's crust that, through an understanding of its geologic composition and history, can be determined to have remained stable and undisturbed for millions of years. Put the highly radioactive waste into that formation, seal it up, and allow the geology to assure that the material would be kept out of the environment for the time required. Human-built components to this geologic isolation system were NOT to be relied on for assuring waste isolation, only to provide redundancy and "defense-in-depth."

In the preface to the Commission on Nuclear Projects' very 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 original Nuclear Waste Policy Act:

> *"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.*"

In the years since Governor Sawyer's cautionary words, Yucca Mountain has been shown not to possess the characteristics required for long-term waste isolation. Yucca Mountain is located in an active geologic environment; there is an oxidizing, corrosive subsurface environment where the waste would be emplaced; the site is in an area of high seismic activity and relatively young volcanic activity; and there are fast groundwater pathways for rapid groundwater movement from the ground surface through the repository horizon to the regional aquifer below. The site is far from an ideal location for "geologic disposal".

To compensate for the inadequate geology, DOE has turned the concept of geologic disposal on its head, proposing an engineered facility that relies almost exclusively on human-built components to keep wastes isolated from people and the environment for hundreds of thousands of years. DOE has studied the Yucca Mountain site for over 30 years, and as each new failing of the site was uncovered, DOE put forward an engineering fix intended to substitute for the shortcomings of the geologic setting. These engineering fixes include a repository design that requires the waste heat to raise the temperature of the emplacement drifts and surrounding rock above the boiling point of water for a thousand years; yet-to-be developed waste disposal packages that would need to remain intact for thousands of years; and 11,500 or more titanium drip shields emplaced over each waste package to keep water from contacting the disposal containers (drip shields that DOE does not propose to install for 80 to 100 years after waste emplacement begins).

In addition, DOE's performance assessment for Yucca Mountain relies on the dilution of radioactive waste escaping from Yucca Mountain in the aquifer beneath the site as a waste management tool in order to make the site appear to meet EPA radiation exposure limits. EPA's radiation protection standards, written specifically for Yucca Mountain, allow DOE to gerrymander the site's boundaries to encompass miles of the underground aquifer far from the actual site itself for dilution of escaping radionuclides in order to make the performance calculations work.

Using DOE's own data, the contribution of Yucca Mountain's geology to the overall waste isolation capacity of the system is insignificant, while the waste disposal packages, drip shields, and thermal loading account for almost all of the system's isolation capability. Ironically, DOE is not required to expose this calculation in the NRC's Yucca Mountain licensing proceeding. NRC rejected an early Nevada legal contention that DOE should be

required to demonstrate the relative contributions of the component barriers of the waste isolation system. Instead, NRC ruled that DOE need only use the aggregated performance of the overall system (the "Total System Performance Assessment") to demonstrate compliance with EPA's radiation protection regulations.

## *Volcanism*

Given the extraordinarily long time frame required for waste isolation, the probability of volcanic eruption near or into a repository at Yucca Mountain is not farfetched. While this may not be important to some, given the time frame, the basic premise of the original Nuclear Waste Policy Act was that generations after us should not be exposed to any higher radiation limits than those that are in effect today. Figure 2 shows some of the past volcanic activity near Yucca Mountain.

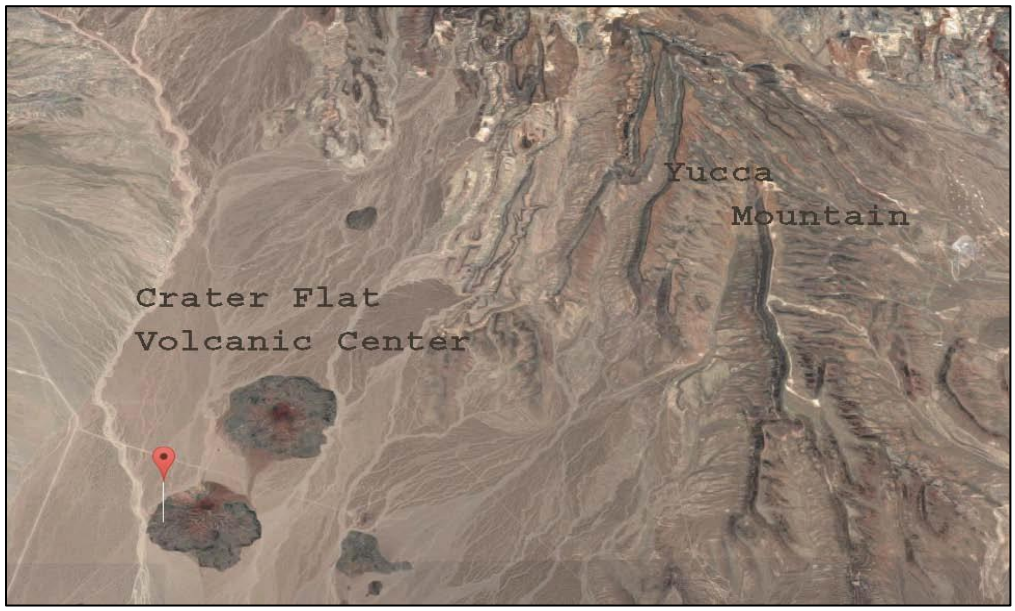



*Figure 2 – Some of the Past Volcanic Activity Near Yucca Mountain*

Attachment IV is a paper on volcanism at and in the vicinity of Yucca Mountain, written by the Agency's technical experts at Geoscience Consultants of Henderson, Nevada and the Department of Geoscience at the University of Nevada Las Vegas. This paper describes the history of the volcanism program for the State and its interactions with DOE and NRC over the last 30 years, discusses the differences between the approach taken by the State's volcanism experts and those of DOE and NRC, and describes ongoing work on new research and licensing contentions.

There are 5 basic assumptions made by DOE regarding volcanism in and around Yucca Mountain. These assumptions are: 1) understanding the process of volcanism is not important for calculating the probability of future volcanism; 2) melting to produce volcanoes near Yucca Mountain occurred shallow in the lithospheric mantle. This model infers that volcanism will die out over the next 10,000 to 1,000,000 years and that the probability of future volcanism is very low; 3) the volcanic field used to calculate probability is restricted to the immediate area around Yucca Mountain; 4) looking at volcanism near Yucca Mountain, it is permissible to use only the last five million years of activity. It is not necessary to look at the entire 11-million-year record; and 5) relatively non-explosive and low-volume basaltic volcanism will characterize future activity around Yucca Mountain. Explosive felsic (rhyolitic) volcanism will not occur.

The State experts believe that: 1) understanding the processes involved with the volcanism in the area of Yucca Mountain is very important to determine the probability of future events; 2) there are strong indications that melting to produce volcanoes near Yucca Mountain occurred deeper in the mantle than believed by DOE; 3) the extent of the volcanic field upon which DOE based the probability of volcanic events is much too restricted; 4) the geologic record of volcanic events in and around Yucca Mountain covers much more than the last 5 million years (in fact, the record covers more than 11 million years); and 5) there are indications that more explosive, therefore more impacting, types of volcanic eruptions are possible at and around Yucca Mountain.

Nine contentions already admitted into the licensing proceeding have been based on these 5 differences. New contentions are being developed based on the ongoing work by the State's technical experts.

## *Yucca Mountain Transportation Issues*

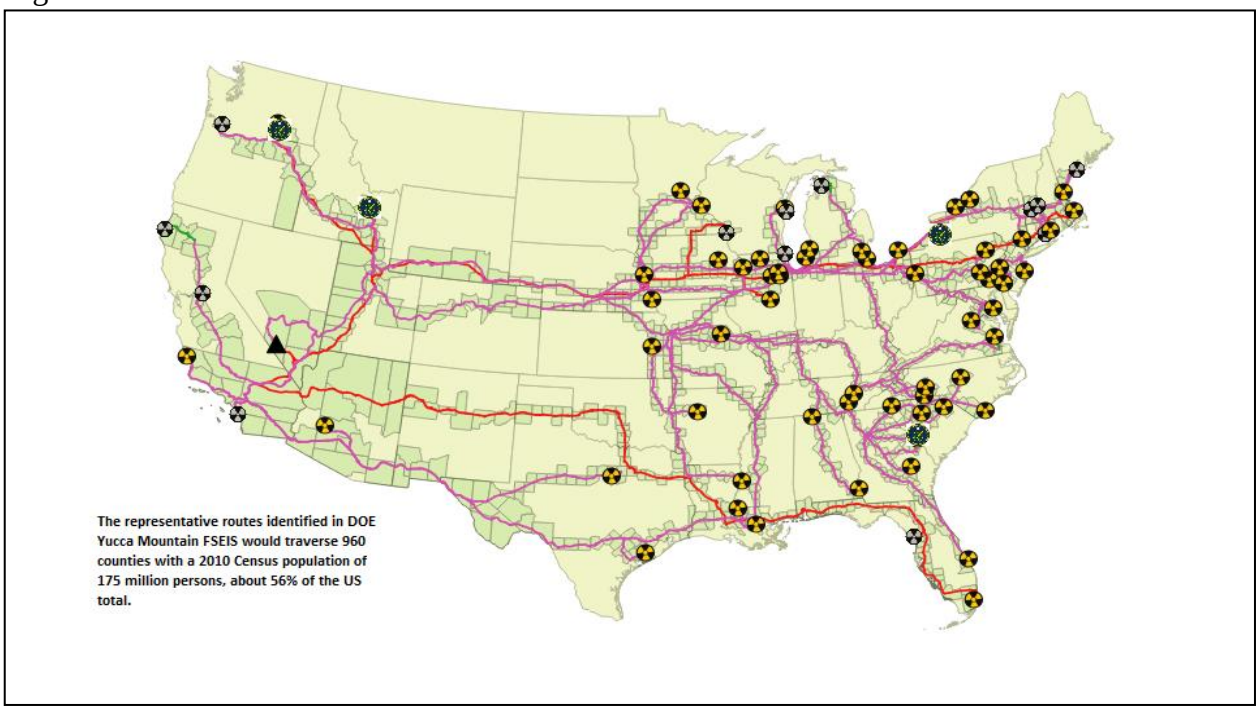
Under DOE's proposed plan for Yucca Mountain, transportation of spent nuclear fuel (SNF) and high-level radioactive waste (HLW) would affect much of the nation for a half-century or more. The details are spelled out in the Final Supplemental Environmental Impact Statement (FSEIS), part of the License Application DOE submitted to the NRC in 2008.

DOE optimistically assumed a "mostly rail" transportation scenario, with 95 percent of the commercial SNF and all of the HLW shipped in special trains. Under the Nuclear Waste Policy Act 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.[25] Almost every day, for five decades or more, one or more loaded casks would be traveling to Yucca Mountain by rail or truck from one of 76 sites around the country. Nevada has challenged the DOE 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 every other day, or even every day, for 5 decades or more.

Many political jurisdictions and communities totaling millions of Americans would be impacted by shipments to Yucca Mountain under the DOE proposal. Most of the nation's SNF and HLW is currently stored at 76 sites in 34 states. The "representative routes" identified by DOE, from these sites to Yucca Mountain, are shown in Figure 3. These routes would use 22,000 miles of railways and 7,000 miles of highways, traversing 44 states and the tribal lands of at least 30 Native American Tribes, the District of Columbia, and 960 counties with a 2010 Census population of about 175 million. Between 10 and 12 million people live within the radiological region of influence for routine shipments, that is, within one-half mile (800 meters) of these rail and highway routes. These rail and highway routes would affect most of the nation's congressional districts (331 districts in the 114th Congress).[26]

Figure 3. DOE Rail and Truck Routes to Yucca Mountain[27]




[25] FSEIS, pages 6-8, 8-41.
[26] 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
[27] The representative routes identified in DOE's Yucca Mountain Final EIS would traverse 960 counties with a 2010 Census population of 175 million people or about 56% of the total U.S population.
[28] NRC, U.S. Nuclear Regulatory Commission Staff's Adoption Determination Report for the U.S. Department of Energy's Environmental Impact Statements for the Proposed Geologic Repository at Yucca Mountain, Pp. 3-13, 3-15, 5-1 (September 5, 2008).

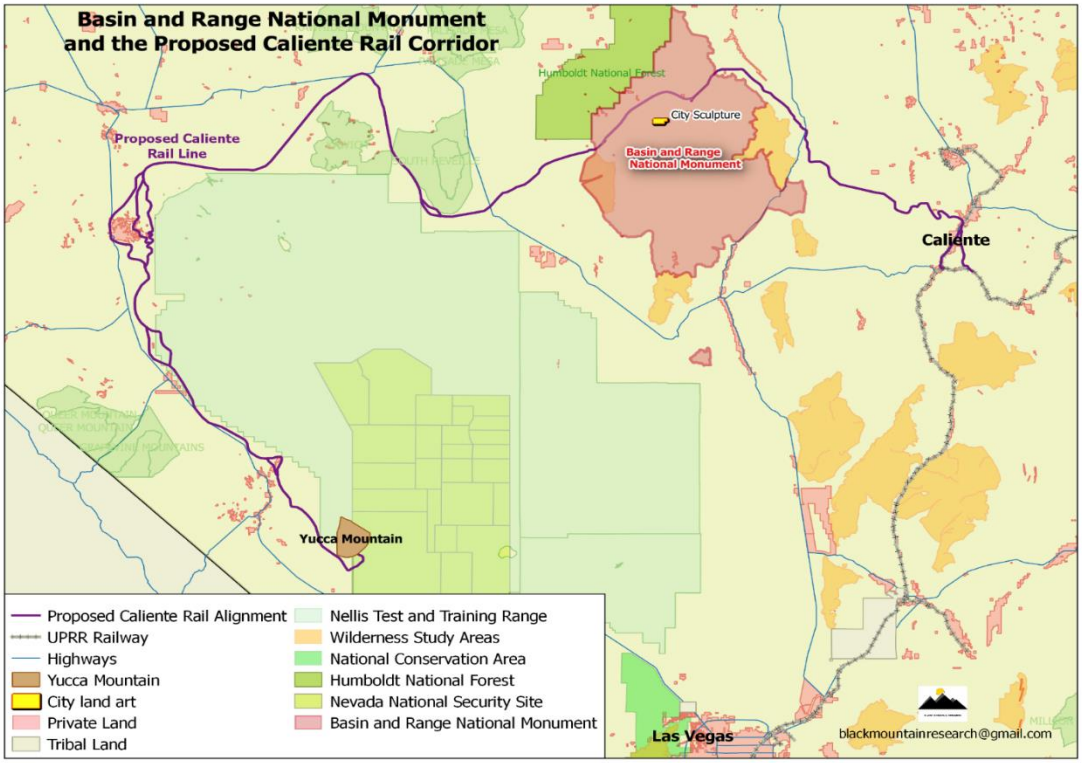
As part of the Yucca Mountain licensing process, NRC staff reviewed and adopted the DOE FSEIS, including the transportation mode and routing assumptions and radiological impact evaluations.[29] DOE evaluated transportation radiological impacts in four categories: (1) "incident-free" exposures to members of the public; (2) "incident-free" exposures to transportation workers such as escorts, truck drivers, and inspectors; (3) release of radioactive material as a result of the maximum reasonably foreseeable transportation accident; and (4) release of radioactive material following a successful act of sabotage or terrorism. Nevada and other parties submitted contentions challenging the sufficiency of DOE's transportation impact evaluations under the National Environmental Policy Act (NEPA).

In May 2009, the NRC Atomic and Safety Licensing Boards admitted 46 NEPA transportation, or transportation-related, contentions for adjudication: 16 submitted by the State of Nevada, 17 submitted by the State of California, 8 submitted by California and Nevada Counties, 3 submitted by the Nuclear Energy Institute, and 2 submitted by the Timbisha Shoshone Tribe. These admitted contentions address virtually every aspect of repository transportation, including radiological impacts, social and economic impacts, and construction and operation of the proposed Caliente railroad to Yucca Mountain. If the NRC licensing proceeding should resume, the details of these impacts would be further evaluated.

The license application submitted to NRC in 2008 assumes that DOE could construct a railroad to Yucca Mountain. DOE selected the Caliente rail alignment as its preferred option for rail access. Figure 4 shows the proposed Caliente rail alignment. At 300-plus miles, the Caliente railroad would be longer than the distance between Washington DC and New York City, cross 8 mountain ranges, and cost $2.7 billion or more. Even if built, the Caliente rail line to Yucca Mountain would not eliminate rail shipments of SNF through downtown Las Vegas. Nevada has four contentions that challenge DOE's impact evaluation of the Caliente rail alignment in the NRC licensing proceeding and has challenged DOE's application for a Certificate of Public Convenience and Necessity from the U.S. Surface Transportation Board. The BLM public land withdrawal granted to DOE for the Caliente corridor has expired. DOE has withdrawn its applications for more than 100 state permits for water wells needed for rail construction. The recent designation of the Basin and Range National Monument, shown in Figure 4, and the related conservation easement for the area around the "City" land sculpture installation in Garden Valley, would make future consideration of the Caliente route extremely difficult.

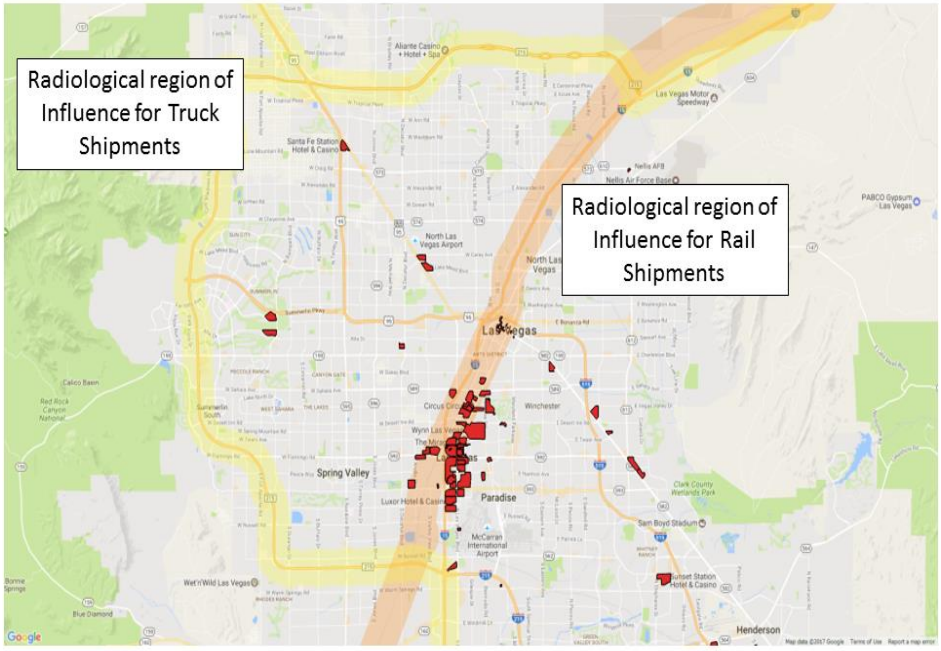
[29] NRC, U.S. Nuclear Regulatory Commission Staff's Adoption Determination Report for the U.S. Department of Energy's Environmental Impact Statements for the Proposed Geologic Repository at Yucca Mountain, Pp. 3-13, 3-15, 5-1 (September 5, 2008).

Figure 4. Proposed Caliente Rail Alignment




DOE's proposed plan for Yucca Mountain transportation includes use of rail and highway routes through the City of Las Vegas and Clark County. Figure 5 shows these routes, which include both the eastern and western segments of the I-215 beltway and the Union Pacific Railroad mainline through downtown Las Vegas. More than 220,000 Nevadans, or about one in every 12 Nevada residents, live within one-half mile of the rail and highway routes identified by DOE. A large portion of the world-famous Las Vegas Strip and more than 34 hotels with 49,000 hotel rooms are located within the one-half mile region of influence of the rail route. Nevada estimates at least 40,000 nonresident visitors and workers in Clark County would be located within one-half mile of the highway and rail routes at any hour of any given day.

Figure 5. Yucca Mountain Transportation Routes through Las Vegas




Agency staff and contractors are currently working on a white paper that will provide: (1) an overview of DOE's transportation impact analysis in the FSEIS and the NRC staff adoption of DOE's transportation impact analysis as part of the license application; (2) an overview of Nevada's 16 transportation contentions admitted for adjudication in the licensing proceeding; (3) a discussion of the National Academy of Sciences 2006 report on transportation of SNF and HLW[30], their findings regarding the radiological and social impacts of SNF and HLW transportation, and their recommendations for enhanced security and safety, which were all adopted by the BRC in 2012; and (4) a discussion of issues and impacts related to DOE's proposed Caliente rail alignment.

## *The Business Case against Trying to Resurrect Yucca Mountain*

Apart from the technical and scientific issues that make Yucca Mountain so unsuitable as a high-level nuclear waste repository location, recent analyses conducted by the Agency for Nuclear Projects demonstrate that there are substantial economic benefits to be realized by

[30] 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)

developing a repository at other, less complex and problematic sites – sites that do not require the extraordinary, exotic, and expensive engineered barriers needed at Yucca Mountain to compensate for the lack of geologic waste isolation. Agency staff and contractors are currently working on a white paper that will document the business case against Yucca Mountain. Part of that work is a review of DOE cost analyses prepared between 2006 and 2012 that examined the cost of a Yucca Mountain repository compared with newly developed costs for equivalent repositories in salt and crystalline rock. Additional work is needed to make sure that the cost components are comparable and the constant dollar costs are accurately expressed, but the preliminary findings, summarized below in Table 1, strongly indicate that development of a repository at a new site in salt would be significantly less expensive than going forward with Yucca Mountain, and that even a new crystalline repository site would be less costly than Yucca Mountain.[31]

**Table 1. Repository Costs (in millions constant $2007) for 83,000 MTHM of high-level radioactive waste in various geologic media.**

| *Cost Component* | *volcanic tuff* | *massive salt* | *crystalline* |
|---|---|---|---|
| Development and Characterization | 9,488 | 800 | 11,006 |
| Surface and Subsurface Facilities | 24,053 | 7,187 | 27,901 |
| Waste Package and Barriers/Shields | 19,164 | 1,250 | 8,700 |
| Performance Confirmation | 3,273 | 926 | 3,797 |
| Regulatory, Infrastructure, Mgmt. Support | 4,687 | 2,030 | 5,436 |
| Program Integration QA/QC, NRC, other | 6,821 | 3,708 | 7,912 |
| Transportation | 9,434 | 7,000 | 6,500 |
| Institutional Costs and Financial Assistance | 6,604 | 6,604 | 6,604 |
| TOTAL | $83,524[32] | $29,505 | $77,856 |

[31] "Nuclear Waste – The Cost of Uncertainty," James L. Conca, Ph.D., Draft Report (June 2016).
[32] This figure reflects new costs for constructing and operating a repository at Yucca Mountain and does not account for the approximately $13 billion DOE has spent on the program to date. DOE's last estimate of the total cost for a Yucca Mountain repository was more than $96 billion, including costs already incurred.

# Findings of the Commission

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

**The coming year (2017) will likely present a major new political battlefield for the State of Nevada's struggle against the Yucca Mountain high-level nuclear waste repository.**

The retirement of Nevada's long-time U.S. Senator Harry Reid, coupled with the results of the 2016 election, have created a new political environment in our nation's capital and a likelihood that Yucca Mountain proponents will attempt to resurrect the DOE repository program and provide funding for the restarted NRC licensing proceeding. For the first time in a decade, Senator Reid will not be Senate Majority Leader, or Minority Leader. Senator Reid's retirement after six terms has emboldened Yucca Mountain proponents since it was announced last year.

The November 2016 congressional elections have returned to power United States Representatives and Senators who are longtime proponents of the Yucca Mountain repository program. In the 115$^{th}$ Congress, these proponents will hold leadership positions on the committees of jurisdiction and on the appropriations committees in the House of Representatives and in the Senate. Even prior to the November elections, key committee and subcommittee chairpersons in both house indicated their intent to push Yucca Mountain forward after Senator Reid's retirement.

The November 2016 presidential election will bring to power a new Administration whose position on Yucca Mountain is not known. Under the outgoing Administration, DOE had abandoned the Yucca Mountain project as unworkable, refused to participate in the restarted NRC licensing proceeding, and appointed a bipartisan Blue Ribbon Commission (BRC) on America's Nuclear Future to develop a plan for restructuring the nuclear waste program. In 2015 DOE began a concerted effort to implement a consent-based siting process that followed the BRC recommendations. At the end of 2016, DOE published a promising report, summarizing input on consent-based siting received from the public and officials.

Meanwhile, influential nuclear industry trade associations and professional societies have joined congressional supporters in urging the new Administration and Congress to resurrect the DOE

repository program and provide new funding for DOE and NRC Yucca Mountain licensing activities as soon as possible. They have, to varying degrees, opposed or supported DOE's consent-based siting efforts, generally qualifying any support for consent-based siting of storage facilities by conditioning it on the resurrection of the Yucca Mountain repository program.

Congress is expected to consider new funding for DOE and NRC Yucca Mountain licensing activities in early 2017. Longtime proponents of Yucca Mountain are known to be advising the new Administration's transition team and have been publicly identified as potential appointees for important positions in the Department of Energy, other executive branch agencies, and at the Nuclear Regulatory Commission. Major programmatic, budgetary and personnel decisions relating to Yucca Mountain will become apparent by mid-2017, or earlier. Over the next two years, and especially over the next six months, the State of Nevada must closely follow developments in Washington and prepare for the possible resumption of a multiple year NRC licensing proceeding, accompanied by a potential reversal in DOE policy regarding Yucca Mountain.

**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 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 by rulemaking that spent nuclear fuel can be safely managed at reactors, in on-site dry storage systems, for up to 160 years. The NRC rule and environmental findings were upheld by the U.S. Court of Appeals for the District of Columbia Circuit in 2016. The NRC Continued Storage Rule eliminates the argument that the licensing of Yucca Mountain is required to ensure the continued licensing of nuclear reactors. The future of Yucca Mountain and the future nuclear power in the United States now have been separated.

Over the past two years, there have been positive developments regarding joint public-private efforts to provide consolidated interim storage for spent nuclear fuel in states that have indicated their willingness to consider consenting to host such facilities. NRC has received a license application for an interim storage facility that would be located in Andrews County, Texas. Another entity has notified NRC that it intends to submit an application for a similar facility in Eddy and Lea Counties, New Mexico. These proposed facilities would store spent nuclear fuel from commercial nuclear power plants for 40 years or more in dry storage systems similar to, and in some cases the same as, those being used for storage at reactor sites. Important details about such facilities are still unresolved, especially regarding formal host state consent arrangements, use of the Nuclear Waste Fund to pay the cost of interim storage, and transportation impacts.

In December 2016, DOE published a draft report on options for designing a consent-based siting process for nuclear waste storage and disposal facilities and also issued a draft report on development of a separate geologic repository for disposal of defense high-level nuclear waste to be sited using a consent-based process. Other organizations, including the Bipartisan Policy Center and the Stanford University Center for International Security and Cooperation, have developed initiatives in support of consent-based siting and are expected to continue work in 2017.

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

In the past two Congresses, the Senate Energy and Natural Resources Committee has drafted comprehensive legislation, entitled the Nuclear Waste Administration Act, to restructure the nation's nuclear waste program following the BRC recommendations. This legislation is not acceptable to the State of Nevada because it would continue the status quo regarding Yucca Mountain. It would need to be amended along the lines of the Nuclear Waste Informed Consent Act, introduced by the Nevada congressional delegation. After extending the consent process to Nevada, the 115th Congress should resume action to implement the BRC recommendations, giving the highest priority to taking the federal nuclear waste program out of DOE, creation of a consent based process for siting high-level nuclear waste storage and disposal facilities, and adoption of measures to enhance transportation safety and security. The following findings of the Commission, based on past experience with Yucca Mountain, support these priorities for congressional action.

**The U.S. Department of Energy was probably the wrong entity to implement the federal high-level radioactive waste program, and placing the program within DOE may have doomed it from the start**.

The original Nuclear Waste Policy Act of 1982 was a complex piece of legislation that sought to balance numerous competing interests and constituencies. The very character of DOE, with its culture of secrecy, its 'we know best' decision-making, its schedule-driven approach, and its inability to work in a cooperative manner with states and communities, made DOE a poor choice to implement a program that required achieving the difficult compromises embodied by the Act.

In Nevada, DOE created a hostile atmosphere almost from the beginning by interfering with the State's Yucca Mountain oversight program and activities. The State was forced to go to court in 1984 to secure its independent oversight role. In 1985, the court strongly admonished DOE,

finding that allowing DOE to approve or disapprove the state's oversight work would be akin to "permitting the fox to guard the chicken coop."[33]

Even after the court ruling, DOE continued to interfere with Nevada's oversight by restricting use of funds, hampering personnel access to the site, and withholding needed data and information.

DOE rejected the advice of its Alternative Means of Financing and Managing (AMFM) Panel, which recommended in 1984 that the program be moved from DOE to a quasi-governmental corporation to insulate it from political influences and to provide the program with stability and continuity over the long period of time that would be required to site, construct and operate one or more repositories.[34]

The heavy-handed manner by which DOE has implemented the Yucca Mountain program, and the DOE history of organizational and institutional problems over the years, will make it extremely difficult for DOE to obtain the level of trust and confidence necessary to manage a successful program in the future.

**The Nuclear Waste Policy Act of 1982, as amended in 1987, institutionalized an adversarial relationship between DOE and the State of Nevada.**

The 1987 amendments to the original Nuclear Waste Policy Act fundamentally altered the already contentious relationship between DOE and the State of Nevada. DOE viewed the amended act, which designated Yucca Mountain as the sole candidate site for the first repository, as a directive to do whatever it took to make Yucca Mountain work regardless of known geotechnical problems. DOE went from asking, "Is Yucca Mountain a suitable site", to "What do we need to do to make the site work?" That quickly evolved to, *what regulations and standards have to be changed* and *how do we engineer the facility so as to overcome its deficiencies*?[35]

The technical objectivity of the DOE investigations at Yucca Mountain deteriorated as time went on and more and more unfavorable findings surfaced. DOE's site characterization program appeared to be designed so as to NOT identify anything that might disqualify the site. Despite

[33] State of Nevada, Ex Rel., Robert R. Loux, Director of the Nevada Nuclear Waste Project Office v. John Herrington, Secretary of the United States Department of Energy, 777 F.2d 529 (9th Cir. 1985).

[34] Section 303 of the Nuclear Waste Policy Act of 1982 required the Secretary of Energy "to undertake a study with respect to alternative approaches to managing the construction and operation of all civilian radioactive waste management facilities, including the feasibility of establishing a private corporation for such purposes." The section was in response to concerns, even as early as 1982, that housing the waste program in a federal agency would doom it to failure due to the undue influence of politics and the vagaries of changing administrations. The AMFM Panel released its report, "Managing Nuclear Waste – A Better Idea," in December 1984, which concluded that "[t]he Panel's preferred long-term alternative to the Office of Civilian Radioactive Waste Management (OCRWM) for managing the nation's high-level radioactive waste program is a public corporation chartered by Congress."

[35] This led to a series of ever-more-exotic engineering fixes. For example, the current license application includes covering all the waste canisters with 11,500 titanium drip shields to protect them from rock fall and highly corrosive groundwater. But there is no guarantee that the billions of dollars needed for the drip shields will be appropriated, and the drip shields themselves are only proposed to be installed 80 to 100 years AFTER the waste is put into the mountain. Since the site is physically and radiologically too hot for humans, sophisticated, not-yet-developed robotics would be needed to install the shields inside of the tunnels with no margin for error.

this, potentially disqualifying conditions were revealed at the site (i.e., fast groundwater pathways, unacceptable levels of radioactive gas releases, recent volcanism, potential seismicity, etc.). To get around this, DOE scrapped its own site evaluation guidelines[36] altogether and replaced them with a performance assessment approach that allowed unfavorable attributes of the site to be minimized. These unfavorable technical findings and subsequent DOE actions led the State to conclude that Yucca Mountain was an unsuitable and unsafe site, which in turn, made it impossible for Nevada to even consider cooperating with DOE.

Safety was, and remains, the major reason that Nevada has not sought economic benefits under the provisions of the amended NWPA. The statutory benefit language itself[37] makes it impossible for Nevada to consider cooperating with DOE, given the safety and environmental concerns already documented. Because the State of Nevada is duty bound to protect the public health and safety of its citizens, successive Nevada Attorneys General have agreed that Nevada would forfeit its rights to participate in critical safety and environmental issues during NRC licensing if it even began to negotiate with DOE for a benefits package. Moreover, the act limits economic benefits to only $10 million a year after license approval and $20 million a year once waste was shipped to Yucca Mountain.

**Yucca Mountain failed for many reasons, but a critical element was unquestionably the forced nature of the siting process.**

In 1987, Congress directed that Yucca Mountain be the only 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. Provisions of the amended act allowing state disapproval of siting decisions did not protect Nevada. 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 veto. The Administration was determined to force the site on Nevada in 2002, and members of Congress from other states were anxious to protect themselves from a new repository siting effort. In the years leading up to 2002, there was little incentive for DOE to work with or listen to Nevada. DOE believed all along that Congress would not sustain Nevada's veto. 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, and DOE would have had to move on to identify a location that was technically suitable.

[36] The original Nuclear Waste Policy Act of 1982 required DOE to promulgate guidelines for the evaluation of potential repository sites that contained specific qualifying and disqualifying conditions. DOE issued its siting guidelines in 1984. However, DOE subsequently scrapped those guidelines and replaced them with a Total System Performance Assessment approach in the Yucca Mountain license application that involves a collective assessment of risk rather that an examination of specific geologic, hydrologic, and related conditions occurring at the site.
[37] "The State or Indian tribe that is party to such [benefits] agreement waive its rights under title I to disapprove the recommendation of a site for a repository." NWPAA, Subtitle F – Benefits Agreements Section, 171(b)(2).

**Congress shares a large portion of the blame for the failure of the federal high-level radioactive waste program**.

The original NWPA was a complex and cumbersome law that sought to balance a variety of competing and often conflicting interests. It was not perfect, but the Act represented an unprecedented set of compromises agreed to by diverse affected parties and might have succeeded if politics had not intervened in the siting process in 1986, resulting in the 1987 amendments act. Congress failed to hold DOE's feet to the fire and allowed DOE to subvert the technically-based site selection process intended by the original act.[38] While the process of selecting a site for a geologic repository cannot be completely insulated from politics, ways must be found to minimize political influence and increase the likelihood that a sound, scientifically-based, credible, and publically acceptable process can go forward.

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

After studying DOE's approach to Yucca Mountain transportation, and after receiving comments from Nevada and other affected parties, the National Academy of Sciences (NAS) published an expert consensus report in 2006 on the radiological and social impacts of spent nuclear fuel and high-level radioactive waste transportation.[39] 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. The BRC also received comments from Nevada and other parties and, in its final 2012 report, endorsed 12 major NAS recommendations. The BRC added an overarching recommendation that all shipments to storage facilities or repositories under the NWPA should be fully regulated by the NRC to eliminate DOE self-regulation of shipments.[40] The recommended measures include shipping oldest fuel first to reduce radiological impacts; full-scale testing of shipping packages, as part of package performance evaluations; immediate implementation of Section 180(c) of the NWPA to provide financial and technical assistance to corridor states and tribes; and DOE maximizing use of rail transportation,

[38] During the election cycle of 1986, the Reagan Administration, responding to political pressure from eastern states that had potential sites being examined for a second repository, directed DOE to suspend the second repository program, an important component in the Act to insure regional equity. In 1987, powerful states with potential first repository sites (especially Louisiana, Texas and Washington) successfully managed to gut the carefully crafted selection process for the first repository, get their states off the hook, and single out Nevada's Yucca Mountain based on political considerations [i.e., Nevada's political weakness vs. the clout of Senate Energy Committee Chairman J. Bennett Johnston (LA), House Speaker Jim Wright (TX) and House Majority Leader Tom Foley (WA)]. A detailed history of nuclear waste politics between 1982 and 1987 is provided in R.J. Halstead, A. Mushkatel, and K. Thomas, "Remaking the U.S. Nuclear Waste Program: A Window of Opportunity for Change?" Waste Management 2015, Proceedings of the Conference, Phoenix, AZ (March 15-19, 2015), available at http://www.state.nv.us/nucwaste/news2016/pdf/WM2015_RemakingWasteProgram.pdf

[39] 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)

[40] BRC, *Report to the Secretary of Energy* (January 2012), Pp. 82-84, brc.gov/sites/default/files/documents/brc_finalreport_jan2012.pdf

minimizing truck shipments, and identifying and making public its suite of preferred shipping routes as soon as practicable to support state, tribal, and local planning and preparedness.

# Recommendations of the Commission on Nuclear Projects

The Commission believes that the next two years will be critical for the State of Nevada in preventing the resurrection of the now-terminated Yucca Mountain repository program, and in protecting the State's interests if the NRC licensing proceeding is restarted. Senator Harry Reid, as Majority Leader and later as Minority Leader in the U.S Senate, was able to restrict funding for Yucca Mountain over the past decade. Senator Reid's retirement, coupled with other changes in Congress and the Executive Branch, are likely to result in concerted efforts by Yucca Mountain supporters to restore the DOE repository program and restart the NRC licensing proceeding.

It will also be a critical time for the Nation, providing an opportunity to proceed with a new consent-based approach to selecting sites for nuclear waste storage and disposal. The Commission considers DOE's recent efforts to implement a consent-based siting approach for nuclear waste storage and disposal facilities to be a very promising development, which should be carried forward by the new Administration and supported by the new Congress.

At this critical juncture, it is extremely important that the lessons of the failed Yucca Mountain project over the past three decades are not lost and, more importantly, are not repeated. To that end, the Commission offers the following recommendations:

**Recommendation: Governor Sandoval should communicate clearly and unambiguously to the new Administration and to the new Congress, Nevada's continuing steadfast opposition to any attempt to resurrect the defunct Yucca Mountain project or otherwise bring spent nuclear fuel and high-level radioactive waste into Nevada.**

Discussion

It is critical that the Governor continue to communicate, as he has done so effectively and consistently for the past 6 years, Nevada's steadfast opposition to Yucca Mountain. There must be no misunderstanding of Nevada's position with regard to the Yucca Mountain project on the part of the new Administration and the new Congress. Yucca Mountain is an unsafe site for a geologic repository, and transportation of high-level nuclear waste to Yucca Mountain would pose unacceptable risks to Nevada's people, environment, and economy. Making the State's position unambiguously clear is especially important in light of Nye County's continuing misguided advocacy of the project.

**Recommendation: The Governor and Legislature must assure that the Attorney General and the Agency for Nuclear Projects have sufficient funds to effectively represent Nevada in NRC's Yucca Mountain licensing proceeding.**

Discussion

NRC's first-of-a-kind proceeding for licensing a high-level radioactive waste repository is legally and procedurally complex, technically demanding, highly specialized, and will likely be lengthy. In order for the State of Nevada to protect its interests and assure that the 218 already admitted[41] serious safety and environmental contentions are adequately addressed and adjudicated, the Agency and the Attorney General must have adequate resources for necessary legal and technical expertise. Depending on how NRC's proceeding is structured and how the process is scheduled, it is estimated that the State could need $8 million to $10 million per year over the course of four to five years. While this is a significant amount of money, it pales in comparison to the $330 million NRC estimates it will need over 3-5 years, and the $1.66 billion DOE has said it would need if licensing is resumed. In the past, Congress has provided some federal funding for state participation and also for participation by affected local and tribal governments. Given the uncertainties surrounding Yucca Mountain in the new Congress, however, Nevada cannot be assured of any specific level of federal financial support.

**Recommendation: In the likely 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 and the Governor should develop plans for a major public information program on the radiological and social impacts of transporting spent nuclear fuel and high-level radioactive waste to Yucca Mountain, including the 2006 findings and recommendations of the National Academy of Sciences regarding transportation safety and security.**

Discussion

The Commission believes that the State of Nevada has technically sound and valid objections related to the safety and suitability of the proposed Yucca Mountain repository site and is positioned to make a compelling case in any restarted NRC licensing proceeding. However, Nevada must also be prepared to address the fact that Yucca Mountain is not just a Nevada issue but will affect the entire country through the unprecedented nuclear waste shipping campaign that would be necessary to bring spent nuclear fuel and high-level radioactive waste to a Nevada repository.

[41] As noted earlier in this report, the State currently has 218 contentions already admitted to the proceeding. Another 30 - 50 new contentions are currently being prepared for submission when and if the licensing's adjudicatory proceeding resumes.

DOE and the commercial nuclear industry have gone to great lengths to downplay the transportation impacts of the repository program and to obscure the risks faced by thousands of communities in the 44 states that would be traversed by nuclear waste shipments to Yucca Mountain. DOE, the Nuclear Energy Institute, and the nuclear industry, have so far failed to acknowledge the radiological and social impact findings of the 2006 National Academy of Sciences report, and failed to implement the safety and security measures recommended by the NAS, which were all adopted by the BRC in 2012. A national information campaign to inform states and cities of the significant radiological and social impacts of transporting spent nuclear fuel and high-level radioactive waste would mitigate the support for further forced-siting approaches that may be considered in Congress.

Such a campaign would require adequate resources to be effective. A similar effort was undertaken leading up to the vote in Congress to override Governor Guinn's veto of the presidential site recommendation decision in 2002. While Congress did not ultimately sustain Nevada's notice of disapproval, the public information initiative was successful in raising awareness of the transportation risks associated with Yucca Mountain and made the override vote much closer than expected. The Commission continues to believe that such an effort is essential to a successful strategy for opposing the Yucca Mountain project, and we urge the Governor and legislature to support funding for a national information initiative in the event the project is restarted.

**Recommendation: The Commission should formally commend the U.S. Department of Energy for its recent efforts to develop a consent-based process for siting nuclear waste facilities. The Governor and Nevada's congressional delegation should work with the new Administration and the new Congress to support and encourage the work DOE has started and to assure that the same consent-based provisions are extended to the State of Nevada and the Yucca Mountain project.**

Discussion

Beginning with the passage of the 1987 amendments to the original NWPA, the relationship between DOE and the State of Nevada was increasingly confrontational, as evidence mounted about Yucca Mountain's serious shortcomings and as DOE sought to mask those shortcomings in order to avoid having to disqualify the site. It took DOE 23 years to finally acknowledge that Yucca Mountain was, in fact, unworkable as a high-level nuclear waste repository. But in 2010, after decades of increasingly adversarial interactions, DOE and Nevada found themselves in agreement not only regarding the failure of Yucca Mountain as a repository location, but also with respect to the approach needed to achieve a successful solution to the nation's nuclear waste problem. DOE is to be commended for acknowledging the Yucca Mountain site is unworkable. DOE's embrace of the BRC recommendation for a consent-based approach to siting nuclear

waste facilities represents a dramatic departure from the forced siting tactics used in relation to Yucca Mountain.

With Yucca Mountain still being advocated by some in Congress and in the industry, however, it is extremely important that DOE's commitment to consent-based, voluntary facility siting also be applied to Yucca Mountain and Nevada, if the DOE repository program is restarted. Nevada's congressional delegation should work with others in Congress to provide Nevada with the same right to consent as is afforded other states that may be potential hosts for nuclear waste storage or disposal facilities.

As discussed elsewhere in this report, the Commission believes that the recommendations of the Blue Ribbon Commission on America's Nuclear Future provide a constructive and effective roadmap for redirecting national nuclear waste policy and program implementation and achieving sound and acceptable solutions for the nuclear waste issue. Communicating the BRC-recommended approaches to the new Congress and new Administration will be especially important if the debate over Yucca Mountain continues.[42]

[42] The Agency has been communicating Nevada's position at professional meetings and conferences. Attachment 5 provides the presentation slides used by the Executive Director during a panel discussion on Yucca Mountain at the American Nuclear Society Winter Meeting in Las Vegas, NV on November 7, 2016.

# ATTACHMENT I

# WHITE PAPER: THE U.S. NUCLEAR REGULATORY COMMISSION'S YUCCA MOUNTAIN LICENSING PROCEEDING

# THE U.S. NUCLEAR REGULATORY COMMISSION'S YUCCA MOUNTAIN LICENSING PROCEEDING

**Prepared by**

**The Nevada Agency for Nuclear Projects**

**November 2016**

## THE U.S. NUCLEAR REGULATORY COMMISSION'S YUCCA MOUNTAIN LICENSING PROCEEDING

The Nuclear Waste Policy Act of 1982, as amended (NWPA), requires the U.S. Department of Energy (DOE) to obtain a license from the U.S. Nuclear Regulatory Commission (NRC) before it is authorized to construct and operate a repository at the Yucca Mountain site. DOE formally submitted its License Application (LA) to construct and operate a Yucca Mountain high-level radioactive waste repository to NRC in June 2008, six months after it had certified (for the second time) its Licensing Support Network (LSN) documents database[1]. In support of its LA, DOE submitted three new environmental documents[2] including a:

- Final Supplemental Environmental Impact Statement for a Geologic Repository for Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada (Yucca Mountain FSEIS);

- Final Supplemental Environmental Impact Statement for a Geologic Repository for Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada – Nevada Rail Transportation Corridor (Rail Corridor FSEIS); and

- Final Environmental Impact Statement for a Rail Alignment for the Construction and Operation of a Railroad in Nevada to a Geologic Repository at Yucca Mountain, Nye County, Nevada (Rail Alignment FEIS).

In addition to the State of Nevada, other entities (apart from NRC and DOE) that were originally admitted to participate in the licensing proceeding include: Clark County, Nye County, the State of California, Inyo County (California), the Timbisha Shoshone, Eureka County, Lincoln County[3], White Pine County, the four counties of Esmeralda, Churchill, Mineral, and Lander (admitted as a collective), and the Nuclear Energy Institute.

In response to DOE's Yucca Mountain LA, Nevada initially submitted 229 contentions (challenges) to the NRC licensing board in December 2008. The majority of those contentions were technical in nature and addressed deficiencies in the LA ranging from flaws in the overall performance assessment model and calculations to specific geotechnical issues, such as the potential for renewed volcanic activity at the Yucca Mountain site, corrosion of the waste disposal packages, the implications of DOE's proposed use of drip shields to shelter waste packages from water in the tunnels, and other key site suitability issues.

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[1] The Licensing Support Network (LSN) is a comprehensive web-based, searchable database maintained by NRC containing documentary materials from all parties to the Yucca Mountain licensing proceeding.

[2] These documents, required under the National Environmental Policy Act (NEPA), were in addition to the Final Yucca Mountain Environmental Impact Statement that had been issued with the DOE site recommendation in 2001.

[3] Lincoln County sought and was admitted as an "Interested Governmental Participant" rather than as a full party to the proceeding.

In May 2009, the NRC licensing boards[4] accepted an unprecedented 222 out of the 229 originally-filed contentions submitted by the State. Nevada's 1,566 page petition containing the 229 contentions can be found at: http://www.state.nv.us/nucwaste/licensing/Contentions_NV.pdf .[5]

Upon subsequent appeal of the Boards' ruling by NRC Staff[6], the full Nuclear Regulatory Commission upheld all but two of Nevada's contentions, allowing 220 to proceed to adjudication. Subsequently, six (6) additional contentions were submitted by Nevada in response to new information that came to light after the initial license submittal by DOE.[7] Four (4) of those new contentions were also admitted for adjudication by the licensing boards. There are currently 218 admitted Nevada contentions awaiting adjudication.

Originally, the licensing board or Construction Authorization Board (CAB) segmented the hearing process into two phases. This was done to accommodate NRC Staff's schedule for completing the Safety Evaluation Report (SER) which is NRC's review of DOE's LA in relation to NRC's regulations governing the Yucca Mountain application. Phase One of the proceeding would address the long-term performance of the proposed repository (post-closure). Phase Two would involve adjudication of matters relating to pre-closure issues.

Based on a joint proposal developed by Nevada that set out a plan for grouping all the admitted contentions from all parties, the Discovery Phase[8] for Phase One of the licensing hearings had actually begun October 1, 2009, prior to DOE's announcement that it intended to withdraw the LA - and the licensing board's subsequent suspension of the licensing proceeding. The State of Nevada was actively engaged in intense activities associated with discovery and for eventual expert testimony in support of the State's contentions when the proceeding was suspended.

*DOE's Decision to Withdraw the Yucca Mountain License Application*

In 2010, acknowledging that the Yucca Mountain project had become "unworkable," DOE formally moved to withdraw its application for a license to construct a repository at the site. The NRC's licensing board denied that motion later in 2010, ruling that under current law (the NWPA, as amended), DOE did not have the authority to withdraw the application. Nevertheless, the NRC licensing board subsequently suspended the proceeding on September 30,

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[4] Due to the complexity of the Yucca Mountain licensing proceeding, NRC established three licensing boards, called Construction Authorization Boards (CABs), that would operate concurrently in adjudicating the unprecedented number of contentions or objections and allow the proceedings to be completed in the statutorily-specified four-year time-frame.

[5] The Agency maintains a comprehensive web page containing all pertinent licensing materials, petitions, orders, etc. This web page can be found at: http://www.state.nv.us/nucwaste/licensing.htm .

[6] DOE originally challenged all of Nevada's contentions, while the NRC staff recommended that only 19 of the 229 State contentions should be admitted for adjudication in the licensing hearing.

[7] After consolidation of several Nevada contentions, there are currently 218 admitted Nevada contentions awaiting adjudication, with at least 30 new ones to be filed in the event the licensing proceeding should resume. A total of 296 contentions from all parties were initially accepted by the NRC licensing boards.

[8] A more detailed description of "Discovery" as it pertains to the NRC licensing proceeding is contained on page 12 of this paper.

2011 (the last day of the federal fiscal year) due to Congress' refusal over consecutive fiscal years to appropriate new funds for completing the licensing process and the fact that the President's Fiscal Year 2012 budget request contained no funds for Yucca Mountain activities.

On June 29, 2010, in an unprecedented move, the CAB issued a ruling formally granting the petitions of five new intervenors to participate in the licensing proceeding. Those parties' sole objective in intervening in the proceeding was to oppose DOE's attempt to withdraw the LA and force NRC to continue the licensing process.

In 2011, those same intervenors, the States of South Carolina and Washington, one South Carolina County (Aiken County), the National Association of Regulatory Utility Commissioners, several individuals from Washington State, and eventually Nye County, Nevada (which joined the others in litigation in direct opposition to the position of the State of Nevada), filed suit in the U.S. Court of Appeals for the District of Columbia Circuit (CADC) asking for a writ of mandamus requiring NRC to restart the then-suspended Yucca Mountain licensing proceeding using what little carry-forward funds remained available to NRC for Yucca Mountain licensing activities.

On August 13, 2013, the CADC issued a decision in the case, ordering NRC to restart the Yucca Mountain licensing proceeding using the available carry-over appropriated funds, even though the court acknowledged that those funds were insufficient to complete the proceeding. The ruling was a split decision, with two members of the three-judge panel voting to grant mandamus and one judge (Chief Judge Garland), in a strongly-worded and compelling dissent, opined that NRC was being ordered to do a "useless thing" by forcing it to restart a proceeding everyone agreed could not be finished without new congressional appropriations.

Following the court's ruling, NRC reported that it had slightly over $13 million in funds remaining from prior appropriations that could be used for a restarted licensing proceeding.[9] On November 18, 2013, NRC ordered the licensing proceeding restarted and directed its staff to complete work on the SER, containing NRC Staff's review of the DOE license application and its compliance with NRC licensing regulations. NRC also requested that DOE prepare an Environmental Impact Statement Supplement (EIS Supplement) to address the impacts of the proposed repository on groundwater.[10] DOE advised NRC that it would not prepare the requested EIS Supplement and, instead, promised to provide NRC with an updated report on groundwater issues. NRC Staff subsequently completed a draft EIS Supplement on its own. The Commission also directed NRC Staff to create a substitute for the defunct licensing support network (LSN) within NRC's computerized document database (known as Agency-wide Documents Access and Management System or ADAMS).

[9] Prior to the suspension of the proceeding in 2010, NRC had estimated that the total costs of a full-scale licensing proceeding would be in excess of $100 million.

[10] Before the licensing proceeding was suspended in 2010, NRC Staff had determined that the groundwater analysis contained in the EIS DOE prepared as part of its license application did not adequately address certain groundwater impacts resulting from repository activities. NRC decided that a supplemental environmental analysis would be required. However, the proceeding was suspended before such analysis could be undertaken.

NRC Staff completed the five-volume SER in January 2015 and issued the draft EIS Supplement on groundwater impacts for public comment in August 2015. The final EIS Supplement was completed in May 2016.

*The role of NRC Staff in the Licensing Proceeding*

The role of NRC Staff in NRC's licensing process requires explanation. Once an applicant has submitted a formal application, that application is referred to professional staff employed by NRC. It becomes NRC Staff's responsibility to review the application for procedural adequacy and to then "docket" the application – meaning that it then becomes the subject of a formal NRC adjudicatory proceeding to determine if a license to construct the facility should be granted. Once docketed, the same staff is then charged with preparing a SER that evaluates the application in relation to NRC safety regulations for licensing such a facility. Upon completion of the SER, the NRC Staff is an actual party in the adjudicatory proceeding. Unlike the NRC licensing board members and the Commissioners (all of whom are presumed to be neutral and impartial on contested factual issues), the staff team, which is a party in the adjudicatory proceeding, can be partial, and in this case certainly is partial, in favor of the DOE LA. In effect, NRC Staff joins with the applicant in defending the LA.

With regard to the proposed Yucca Mountain high-level nuclear waste repository and the decades-long effort by DOE to compile information and prepare the LA for submittal to NRC, the roles of NRC Staff with respect to the project applicant (DOE) are blurred. As early as 1987, with the passage of the Nuclear Waste Policy Amendments Act that singled out Yucca Mountain as the only site to be characterized as a potential repository location, NRC Staff had been working closely with DOE management and technical experts with the goal of assisting DOE to develop an "acceptable" license application that could be successfully submitted to NRC, docketed, and adjudicated. In doing so, NRC Staff became so closely involved with DOE's Yucca Mountain project and the intricacies of the work that went into developing the LA that the final LA can only be viewed as a cooperative effort on the part of NRC Staff and DOE.

The State of Nevada has long been aware of and concerned about inappropriate DOE/NRC activities and interactions. Over the years, a trail of correspondence between the Nevada Agency for Nuclear Projects, the Nevada Attorney General, the state's congressional delegation, and NRC and DOE reflects an escalating level of concern on the part of the State and a consistent pattern of denial and avoidance on the part of both federal agencies.

After passage of the 1987 amendments to the NWPA (the so-called "Screw Nevada Bill"), both DOE's and NRC's approach to the federal repository program changed dramatically. Prior to 1987, DOE approached the effort as one to determine which three of nine possible sites were suitable for further study. After 1987, the focus became one of how to make Yucca Mountain work (i.e., appear safe and suitable) despite all of the serious problems and fundamental flaws DOE already knew existed at the site.

On NRC's part, the change was slightly more subtle, but no less dramatic in its effect. Prior to 1987, NRC Staff viewed its role as overseeing DOE's site investigation efforts to assure that adequate quality control processes and procedures were in place and that staff remained

cognizant of what DOE was doing in assessing candidate repository sites against the various site selection criteria. After 1987, NRC Staff began to view its role as that of partner with DOE in the Yucca Mountain program and its function as one of assisting DOE to develop a "high quality" LA for a Yucca Mountain repository facility.

*Distinguishing Between Roles of Various NRC Actors in the Licensing Proceeding*

It is very important, in viewing the component parts of NRC's Yucca Mountain Licensing Proceeding, to distinguish between the role of the Commission proper and the several different roles played by different groups within NRC Staff.

The Commission is headed by five Commissioners appointed by the President and confirmed by the Senate for staggered five-year terms (or for the remainders of five-year terms if vacated early). A quorum of three is required for the conduct of Commission business. The Commission, as a collegial body, formulates policies, develops regulations governing nuclear reactor and nuclear material safety, issues orders to licensees, and has final decision-making authority regarding licensing and other adjudicatory decisions.

Commission members cannot be removed from office except for inefficiency, neglect of duty, or malfeasance in office. One of them is designated by the President to be the Chairman and, as Chairman, serves at the pleasure of the President. Therefore, when a new President takes office, he or she may appoint a new Chairman from among Commission members or nominate a new person to fill a Commission vacancy with the intent to designate the new person as Chairman following confirmation. The Chairman is the principal executive officer of and the official spokesperson for the NRC. As principal executive officer, the Chairman is responsible for conducting the administrative, organizational, long-range planning, budgetary, and certain personnel functions of the NRC. The Chairman also has ultimate authority for certain NRC functions pertaining to an emergency. However, the Chairman's actions are governed by the general policies of the Commission and, on matters requiring a Commission vote, the Chairman's vote has no special weight.

The Commission's Staff is headed by an Executive Director for Operations, who is typically a career federal employee. On adjudicatory matters, such as contested licensing proceedings, the Staff participates as a party along with the licensee or applicant and other interested persons. However, the Staff enjoys no special status as a party and, as a party, operates without day-to-day supervision from the Commission. Private communications between the Staff and Commission regarding issues in a licensing hearing are severely restricted.

The Commission itself ultimately decides the question of whether to grant or deny the LA filed by DOE in June 2008, in accordance with its assignment to do so in Section 114 of the (NWPA. While the NWPA provides that the Commission will make that decision in three years (with an option for a fourth year), that schedule has obviously undergone substantial delay. Indeed, the proceeding was already about three years old when its adjudicatory portion was suspended on September 30, 2011. It currently remains suspended, and is likely to remain so until and unless Congress appropriates additional funding for its continuation, something it has not done in the last six fiscal years.

In August 2013, CADC entered a mandamus order requiring NRC to continue with the licensing proceeding as far as its limited remaining funds would allow, while granting the Commission the discretion to prioritize the remaining tasks. The Commission utilizes various teams of its Staff to carry out its required licensing functions and entered an order in November 2013 specifying the implementation of those tasks. The Commission's order required Staff to undertake a number of sequential tasks:

- Preparation of the SER;
- Preparation of the EIS Supplement;
- Preparation of "Lessons Learned" from its SER work; and
- Preparation of a complete public database on its ADAMS document website containing all the documents which had (prior to the suspension of the adjudicatory portion of the licensing proceeding) been publicly available on NRC's LSN that contained all the documentary material relevant to the licensing proceeding.

NRC's CAB is composed of a three-judge panel from NRC'S Atomic Safety and Licensing Board Panel (ASLB), and is assigned NRC Staff responsibility for the conduct of the Yucca Mountain adjudicatory proceeding and, after its completion, for making a recommendation to the full Commission regarding the grant or denial of the LA. (The NRC Staff group which prepares the SER likewise makes a recommendation to the Commission, which considers both of these recommendations in reaching its preliminary and final decisions.)

As far as the makeup of the CAB panel in any restarted proceeding, there exists considerable uncertainty. On the one hand, the three current judges accumulated a substantial amount of knowledge about the case prior to the proceeding's suspension in 2011. However, it will have been more than five years since they participated in the case if it proceeds, and one or more of the judges may be unable to continue due to health concerns or other reasons. The final decision on the make-up of the CAB for a resumed adjudicatory proceeding would be up to the Chairman of the ASLB Panel or possibly the full Commission.

A separate NRC Staff group is an actual party in the adjudicatory proceeding. Unlike the CAB judges and the NRC Commissioners (all of whom are assumed to be neutral and impartial, at least on contested factual issues) the Staff team can be partial, and in this case certainly is partial, in favor of the applicant - DOE. In theory at least, NRC Staff's viewpoint carries no more weight than that of any of the other 17 parties to the adjudicatory proceeding. However, as noted above, in the case of Yucca Mountain – unlike other NRC licensing proceedings – there has been a long and unprecedentedly close working relationship between DOE and NRC Staff during site characterization and preparation of the Yucca Mountain LA.

*Issues Impacting Any Future Resumption of the Adjudicatory Hearing*

It is likely that NRC will have at least $1 million remaining after completing the four tasks listed above. NRC could generate additional tasks (currently unanticipated) to utilize those funds, but we believe it is possible NRC will briefly lift the existing suspension and order the CAB to conduct at least one Case Management Conference, requiring the participation of all parties to the licensing proceeding, to solicit input as to how to proceed in the event that

subsequent substantial appropriations signal the full-on resumption and completion of the proceeding.

Likewise, the venue of a restarted proceeding would be an issue due to NRC's relinquishment of its hearing facility in Las Vegas. While not legally required, Nevada would prefer that any resumed hearing take place in Las Vegas, in accord with long-standing Commission policy to conduct licensing hearings in proximity to the affected communities. Because NRC hearing facilities at its headquarters in Rockville, Maryland are not sufficient for a licensing proceeding with the number of parties in the Yucca Mountain proceeding, an appropriate facility would likely have to be acquired or developed there as well.

The NRC Chairman recently stated that it would cost "about $330 million" over "multiple years" to complete the Yucca Mountain licensing process.[11] The cost to DOE would be many times this amount, perhaps more than a billion and a half dollars.[12] In order for the proceeding to be completed, it is obviously a prerequisite that Congress appropriate substantial sums of new funds to both agencies. The last congressional action appropriating funds to DOE and NRC for licensing activities in Fiscal Year 2010 also included funding for the State of Nevada ($2.5 million), affected units of local government ($4.5 million), and affected federally-recognized Indian Tribes ($246,000).[13]

*Potential Duration of the Adjudicatory Proceeding (If It Resumes)*

Historically, in past NRC licensing hearings, it took an average of 1.6 days to hear a specific (narrow in scope) contention, with an average duration (start to finish of hearing on all contentions being heard in the hearing segment[14] divided by the number of contentions) of 2.6 calendar days. These numbers suggest that 400 days of evidentiary hearings will be required to address 250 contentions,[15] with a total duration (start to finish of hearings) of 650 calendar days. If we ignore historic duration times and unrealistically assume that hearings would be held five days a week without any breaks until all contentions are heard, the total duration (start to finish of hearings) would be a minimum of 560 calendar days.

These figures contrast sharply with the 90 days allotted from start to finish of hearings in NRC's regulation applicable to a Yucca Mountain proceeding (Appendix D of 10 C.F.R. Part 2). The Commission or CAB might attempt to shorten the length of the hearing by imposing artificial constraints, such as insisting that all hearings be completed in six months or possibly

[11]NRC Chairman Burns' response to questions during testimony before the House Appropriations Committee, Subcommittee on Energy and Water Development, February 10, 2016.

[12] DOE estimated in 2008 that it would need $1.660 billion dollars for all activities associated with the licensing process, over the period 2007-2017. That amount was in addition to $670 million spent between 2003 and 2006. All values were stated in 2007 dollars as part of the DOE Total System Life-Cycle Cost Report (2008), pages 8, 17 - 19.

[13] PL 111-85 (for FY 2010), October 28, 2009, 123 STAT. 2864-2865, percentage allocations of total $98.4 million appropriated from the Nuclear Waste Fund," to remain available until expended."

[14] Hearing segment refers to the NRC practice of conducting hearings in segments covering subsets of contested issues, for example, all safety issues or all NEPA issues.

[15] We used the number 250 to account for separate admitted contentions that are sufficiently similar that they would be heard together, contentions that would likely be mooted before the hearing, and legal issue contentions that need no evidentiary hearing.

even the ninety days as provided in Appendix D of 10 C.F.R. Part 2. This information will be important in estimating the resources that will be needed if the Yucca Mountain adjudicatory hearing is restarted.

**A Detailed Explanation of NRC's Licensing Proceeding Hearing Process**

DOE is required under the NWPA, as amended, to submit a LA to NRC for development of a high-level radioactive waste repository at Yucca Mountain. Title 10 of the Code of Federal Regulations (C.F.R.) Part 63, *Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada*, contains NRC regulatory requirements for the Yucca Mountain repository. Part 63 specifies that DOE shall not receive or possess spent nuclear fuel or high-level radioactive waste except as authorized by a license issued by NRC; nor shall DOE begin construction of a geologic repository unless it has filed an application with NRC and has obtained a construction authorization.

DOE's LA for the Yucca Mountain repository, filed in June 2008, contained "General Information" and a "Safety Analysis Report," and was accompanied by DOE's 2002 final environmental impact statement ("FEIS") for the repository. Two supplemental FEISs and another FEIS (on rail alignment) were submitted to NRC later in 2008. In accordance with the NWPA, NRC Staff prepared an FSEIS adoption report, listing some areas to be supplemented with additional environmental impact analysis. That process was completed by NRC Staff in the spring of 2016.

Four outcomes are possible to NRC at the conclusion of the licensing proceeding. NRC can grant the construction authorization or license. NRC can grant the construction authorization or license subject to conditions. NRC can deny the construction authorization or license. Or NRC can remand some issues back to the CAB for further proceedings, possibly including more hearings, with or without staying the issuance of the authorization or license. The major steps in the Yucca Mountain licensing proceeding include, in chronological order:

(1) Establishment and population of the Yucca Mountain Licensing Support Network (LSN);

(2) DOE submittal of the Yucca Mountain LA;
(3) NRC conduct of an acceptance (completeness) review of the LA;

(4) If acceptable, NRC docketing the LA and issuance of a notice of the evidentiary hearing required by 10 C.F.R. Part 2;

(5) Requests to Intervene and proposed contentions are required to be submitted by interested parties within 30 days of the notice of the hearing; changed to sixty days for this proceeding;

(6) The discovery process proceeds in parallel with NRC Staff compliance review (SER) of the LA; this proceeding was halted early in the discovery process;

(7) At the completion of its review, NRC Staff issues a SER (in this proceeding, the SER was completed in January 2015);

(8) The evidentiary hearing(s) are conducted by the Atomic Safety and Licensing Board (in this proceeding, denominated the CAB);

(9) The CAB issues an initial Decision; if favorable to DOE, the Commission may allow it to become effective so as to authorize construction pending final Commission review;

(10) The NRC Commissioners issue a final Decision on the construction authorization after deciding appeals from the initial decision and reviewing uncontested issues;

(11) Midway through construction, DOE will update its LA, supplement its FEIS, and request a license to receive and possess high-level nuclear waste and spent nuclear fuel;

(12) NRC will then conduct a second proceeding to review this license amendment request;

(13) Once DOE's updated LA is accepted for compliance review, a notice of the hearing for the license to receive and possess high-level waste and spent nuclear fuel will be issued;

(14) Petitions from potential intervenors will be considered;

(15) At the completion of NRC Staff compliance review, NRC Staff will issue a second SER based in part on its construction inspections; NRC Staff will also issue a supplemental adoption decision relating to DOE's FEIS supplement;

(16) A hearing will be conducted by an atomic safety and licensing board, assuming the issuance of the license is contested and a new round of contentions is admitted;

(17) The board will issue an initial decision on the license to receive and possess high-level nuclear waste and spent nuclear fuel; as before, if the decision is favorable, the license may be issued pending review;

(18) The NRC Commissioners will issue a final decision based on the findings in the SER and by the CAB; and

(19) If NRC approves, DOE may begin waste receipt at the repository.

*Yucca Mountain Licensing Support Network (LSN)*

DOE is required to make available, no later than six months in advance of submitting the Yucca Mountain LA, an electronic file, including a bibliographic header, for all Documentary Material as defined in 10 C.F.R. 2.1001. NRC is required to make its Documentary Material available no later than thirty days after DOE certifies its information is complete. Each potential party, interested governmental participant or party is required to make its Documentary Material available no later than ninety days after the DOE certification. (This process was completed by all parties; the LSN "went dark" when the proceeding was suspended; NRC Staff made all LSN documents publicly available on its ADAMS website in September 2016.)

*Requests for Additional Information*

Following the submittal of the LA, DOE responded to NRC Staff requests for additional information (RAIs). DOE bears the burden of proof to show that the design and performance of the repository is safe, to demonstrate that regulations are met, and to ensure continued compliance with the regulations. Its RAI responses are not deemed to be included in DOE's LA until the application is amended to include them; however, NRC Staff considered them in preparing its SER.

*Safety Evaluation Report*

The purpose of the SER is to describe the information NRC Staff reviewed, provide the technical basis for the staff conclusion regarding compliance with the applicable regulations, and state findings at the conclusion of each section. NRC Staff may recommend license conditions be incorporated into the construction authorization. License conditions may sometimes be used by NRC to ensure that specific requirements are met. NRC Staff has specified license conditions in Volume V of its SER in this proceeding.

NRC Staff was expected to issue the SER one and a half years following docketing of the LA but, in this case, completed the SER some 76 months after docketing the LA. NRC Staff will defend its SER and address admitted contentions at the evidentiary hearings, if they resume. However NRC Staff is, with limited exceptions, treated the same as the other parties in the proceeding.

*Role of Intervenors*

Throughout the course of the licensing proceedings, the intervenors will observe and review NRC and DOE interactions and information; formulate and file proposed contentions; conduct and defend discovery requests; and eventually litigate contentions at the Yucca Mountain evidentiary hearing.

Any person whose interest may be affected by a proceeding on DOE's application for a license to construct a high-level radioactive waste repository at Yucca Mountain, and who desires to participate as a party, is required by 10 C.F.R. 2.1014 to file a written petition for leave to intervene, together with contentions it seeks to have admitted and adjudicated. Petitions for

intervention, and any request to participate as an interested governmental agency, must be filed within thirty (but, in this case, sixty) days after the publication of the notice of hearing in the Federal Register. There are currently 18 parties. Late filings will not be considered except under extraordinary circumstances.

One of the primary criteria for later filed contentions is that they be based upon "new information." In this case, where the adjudicatory proceeding has been on hold for more than six years, any new contentions cannot be tendered until the suspension is lifted.

The CAB provides representatives of an interested State (e.g. California), county, municipality, and Indian Tribes, an opportunity to participate in the Yucca Mountain proceeding and to introduce evidence, cross examine witnesses, and file proposed findings without requiring them to take a position with respect to any admitted contention. They may also file petitions for review by the NRC Commissioners and file briefs "*amicus curiae*" on any matter taken up by the Commission for review. Currently, the admitted parties to the proceeding are:

(1) U.S. Nuclear Regulatory Commission Staff;
(2) U.S. Department Of Energy;
(3) State of Nevada;
(4) State of South Carolina;
(5) State of Washington;
(6) California Energy Commission;
(7) Churchill, Esmeralda, Mineral and Lander Counties ("Four Nevada Counties")
(8) Clark County, Nevada;
(9) Eureka County, Nevada;
(10) Inyo County, Nevada;
(11) Lincoln County, Nevada
(12) Nye County, Nevada;
(13) White Pine County, Nevada;
(14) Aiken County, South Carolina;
(15) Native Community Action Council;
(16) Joint Timbisha Shoshone Tribal Group;
(17) Prairie Island Indian Community;
(18) Nuclear Energy Institute; and
(19) National Association of Regulatory Utility Commissioners.

*Presiding Officer(s) Role*

The CAB currently consists of one three-person panel of administrative judges headed by a Chairman who is a lawyer and qualified in the conduct of proceedings, with the remaining members chosen for technical expertise on the issues being adjudicated. The CAB rules on the admission of intervenor contentions, subject to Commission review, and conducts trial-type hearings on the issues. The CAB drafts findings of fact and conclusions of law and issues an initial decision regarding issuance of the construction authorization. The initial decision may be appealed to the NRC Commissioners. The CAB's role includes: supervising the population and use of the LSN; issuing decisions on motions regarding intervention petitions, discovery, and

summary disposition; presiding at the evidentiary hearings; and issuing the Initial Decision on the construction authorization. The NRC Commissioners review decisions and actions of the CAB; conduct supervisory review of contested and uncontested issues in the proceeding; and issue the Final Decision on the construction authorization and DOE's subsequent license amendment request to receive and possess high-level waste.

*Phases of the Yucca Mountain Licensing Proceeding*

There are three primary remaining phases of the Yucca Mountain licensing proceeding: discovery, the evidentiary hearings, and the decisions. The overall schedule for these activities is set out in Appendix D to 10 C.F.R. Part 2. Pre-license application discovery began six months before the LA was submitted with the certification of the LSN by DOE. Post-license application discovery was scheduled to run for 23 months (690 days) after the LA was docketed. The evidentiary hearings were scheduled to begin 24 months (day 720) after the LA was docketed and were scheduled to end three months later (day 810). The Final Decision was scheduled to be issued by the Commission three years (day 1125) after the LA was docketed. Obviously, none of these schedules were met in this proceeding. It has been over eight years since the LA was filed, and post-LA discovery had barely begun before the proceeding was stopped when DOE moved to withdraw its LA in early 2010. Under the NWPA, the proceeding was supposed to be completed within a maximum of four years. That is now impossible and it remains to be seen what new deadline may be set by the Commission if the hearing is resumed.

*Discovery*

Parties and interested governmental participants in the Yucca Mountain licensing proceedings are authorized to obtain discovery regarding any matter, not privileged, which is relevant to the licensing of the Yucca Mountain repository, whether it relates to the claim or defense of the person seeking discovery or to the claim or defense of any other person.

Discovery principally takes the form of document requests, interrogatories, and depositions. The types of discovery permitted, and its duration, are at the discretion of the CAB. The LSN was developed to facilitate timely pre-LA document discovery, and to be the primary documentary tool available to the parties during post-LA discovery.

Non-parties may be subpoenaed for document production. (This is important here, where the LA's authors may no longer be with DOE after the lengthy hiatus.)

The post-LA discovery will consist mainly of depositions. Depositions involve the questioning of potential witnesses or other interested persons. Deponents are required to provide any additional Documentary Material (e.g., drafts, personal records) in their possession relevant to the subject matter of the deposition. Deponents provide answers under oath.

NRC Staff is required to make available one or more witnesses designated by NRC Staff's Executive Director for Operations, for oral examination at the hearing or on deposition regarding any matter, not privileged, which is relevant to the issues in the proceeding. The attendance and testimony of the Commissioners and named NRC personnel at a hearing or on

deposition cannot be ordered by the Presiding Officer, by subpoena or otherwise, except under unusual circumstances.

*Evidentiary Hearings*

The purpose of the Yucca Mountain evidentiary hearings is to allow affected parties to present and defend evidence in support of their position(s) on contested issues. Testimony and documentary evidence constitute the official record on which the CAB will make its decision and recommendation to the Commission regarding issuance of a construction authorization. Parties submit, in advance, written, direct and rebuttal testimony of their witnesses. Parties identify, in advance, documents they intend to submit in support of their position. The rules of evidence are otherwise similar to those of a civil court. Witnesses are subject to cross examination by the other parties although the party cross examining may need to submit in advance a written cross examination plan to the CAB. The Presiding Officer's Initial Decision is based on the preponderance of evidence (a "more probable than not" standard). NRC could, if it chooses, constitute multiple, possibly simultaneous Atomic Safety and Licensing Boards and hearings, using multiple CABs, to expedite hearing the evidence on what is expected to be over 300 pending contentions. In any case, the hearings may be conducted in phases followed by partial initial decisions, each of which is separately appealable to the Commission. Appeals to the Commission from CAB rulings, other than partial or full initial decisions, are severely limited.

*The Commission's Final Decision*

The CAB will issue an initial decision regarding the construction authorization, and NRC Staff will have delivered its SER, with the Commission making a final licensing decision based on these two inputs.

Within fifteen (15) days after the date of the CAB's full or partial initial decision, a party may file a petition for review with the NRC Commissioners on the grounds specified in 10 C.F.R. 2.1015. The filing of a petition for review is mandatory for a party to exhaust its administrative remedies before seeking judicial review.

Any other party to the proceeding may, within ten days after service of a petition for review, file an answer supporting or opposing Commission review. This answer should also address the matters in the original petition to the extent appropriate. The petitioning party shall have no right to reply, except as permitted by the Commission.

A petition for review will not be granted if it relies on matters that could have been, but were not, raised before the CAB. If the Commission does not act on a petition to review within thirty (30) days, the petition shall be considered denied. If a petition for review is granted, the Commission will issue an order specifying the issues to be reviewed and designating the parties to the review proceeding and direct that appropriate briefs be filed, whether there will be oral argument, or both. A petition for reconsideration of a Commission decision after review may be filed within ten (10) days. If a petition for reconsideration is filed, the Commission decision is not final until the petition is decided.

Neither the filing nor the granting of a petition for review will stay the effect of the decision of the CAB, unless otherwise ordered by the NRC Commissioners. In other words, the CAB's decision stands pending review and, if favorable to DOE, may be used to issue the construction authorization or license pending Commission review. The Commissioners issue the final decision which, under NRC rules, also constitutes the National Environmental Policy Act (NEPA) Record of Decision. The Commission's decision is subject to appeal to federal appellate courts once it is considered a final agency action of NRC.

# ATTACHMENT II

# THE U.S. NUCLEAR REGULATORY COMMISSION'S

# CONTINUED STORAGE RULE: A WHITE PAPER

# THE NUCLEAR REGULATORY COMMISSION'S CONTINUED STORAGE RULE: THE LATEST CHAPTER IN A REGULATORY SAGA

***Prepared By***

**The Nevada Agency for Nuclear Projects**

**November 2016**

**THE NUCLEAR REGULATORY COMMISSION'S CONTINUED STORAGE RULE: THE LATEST CHAPTER IN A REGULATORY SAGA**

ABSTRACT

*On August 26, 2014, the United States Nuclear Regulatory Commission (NRC) issued a final rule on continued at-reactor storage of spent nuclear fuel and terminated a two-year suspension of final licensing actions for new nuclear power plants and license renewals of existing plants. The 2014 "Continued Storage" rule is good news for opponents of Yucca Mountain. First, the NRC determination that spent nuclear fuel can be safely managed in dry casks for up to 160 years eliminates the argument that the successful licensing of Yucca Mountain is required to assure the continued licensing of nuclear reactors. The future of Yucca Mountain and the future of nuclear power are now separate. Second, the NRC environmental impact statement (EIS) prepared in support of the Continued Storage Rule defines the "no action" alternative required under the National Environmental Policy Act (NEPA) in a manner that negates the key "no action" alternative in the U.S. Department of Energy's (DOE's) 2008 Supplemental EIS for Yucca Mountain, which was submitted to NRC as part of the license application. DOE's conclusion that constructing and operating a repository at Yucca Mountain is the preferred alternative under NEPA is no longer supported by DOE's and NRC's own NEPA analyses. This paper reviews the developments that led up to the NRC's new "Continued Storage of Spent Nuclear Fuel" Rule, beginning with the adoption in 1980 of the former "Waste Confidence Rule".*

## I. Introduction and Background

### A. Introduction

Spent (or used) nuclear power reactor fuel is highly radioactive and will remain so for many thousands of years after it is removed from the reactor. It must be managed safely for a very long time. About four decades ago, on November 8, 1976, the Natural Resources Defense Council (NRDC) petitioned NRC to suspend its licensing of nuclear power reactors until NRC made a definitive finding that the radioactive wastes in the spent fuel the reactors generated could be disposed of safely. NRDC argued that the radioactive wastes in spent reactor fuel

must eventually be disposed of and, if those wastes cannot be disposed of safely, it logically follows that the finding required by the Atomic Energy Act of 1954 as a prerequisite to reactor licensing – that operation will not be "inimical to the health and safety of the public" – cannot be made. Thus began a nuclear regulatory saga that finally, in August 2016, appears to have reached a conclusion.

NRC denied the NRDC petition in 1977 on the grounds: (1) it had "reasonable confidence" these materials could and would be disposed of safely in a geologic repository and, indeed, as a policy matter, it would not license reactors if it thought otherwise; but (2) the safety finding sought by NRDC was not legally required because, by putting reactor licensing into a statutory category separate from waste disposal, the Atomic Energy Act of 1954 effectively carved out waste disposal safety from the scope of the safety findings required as a prerequisite to reactor licensing.[1] NRC's stated belief that it had "reasonable confidence" these materials could and would be disposed of in a geologic repository (what became known as a 'Waste Confidence" finding) likely reflected NRC's concern that NRDC's position might be correct. NRC probably hoped that its Waste Confidence finding here would tend to moot the issue NRDC raised and thereby enable NRC to continue licensing reactors even if NRDC was correct about what the Atomic Energy Act required.

In a major (and somewhat surprising) victory for NRC, its denial of NRDC's petition was upheld by the U.S. Court of Appeals for the Second Circuit in *NRDC v. NRC*, 582 F. 2d 166 (2nd Cir. 1978). In upholding the denial, the Second Circuit appeared to agree with NRC's interpretation of the Atomic Energy Act that no finding of disposal safety was required as a prerequisite to reactor licensing, but the Court's opinion was somewhat unclear. The opinion could be read to uphold NRC's denial because NRC stated it had "reasonable confidence" the wastes could and would be disposed of safely in a geologic repository and NRDC had gone too far in insisting that all power reactor licensing be suspended pending a more "definitive" disposal safety finding.

B. The Minnesota Case

The same spent fuel disposal issue resurfaced in a different legal context shortly thereafter. Power reactor operators stored their radioactive spent fuel in pools near the reactor. These pools began to fill up when the commercial program to reprocess spent fuel off site foundered and the Government's program to develop a disposal facility was delayed. Various power

[1] 42 Fed. Reg. 34,391 (July 5, 1977)

reactor licensees sought permission from NRC (in the form of operating license amendments) to expand the storage capacity in their on-site spent fuel pools. Reactors could then continue to operate by allowing newly-generated spent fuel to be moved into pools with the new expanded capacity, and refueling with fresh fuel could occur.

NEPA requires NRC to evaluate the environmental impacts of its licensing actions but NRC Staff's NEPA evaluations supporting these licensing actions only included consideration of the environmental impacts of storing the additional spent fuel up until the time the reactor licenses expired. Opponents argued that NRC Staff's NEPA reviews need to address the environmental effects of storage of spent fuel beyond the license terms, including indefinitely long storage. Similar arguments were made by opponents of initial licensing of new power reactors. All the opponents argued that the delays and uncertainties in the Government's disposal program made indefinite storage a reasonably foreseeable event that had to be considered under NEPA.

NRC rejected the opponents' arguments in all the cases. According to NRC, it was unreasonable to presume there would be extended on-site storage on any reactor site because it had already found, in response to NRDC's petition, that there was reasonable confidence spent fuel could and would be disposed of safely in a geologic repository before extended storage became necessary.

On judicial review, the U.S. Court of Appeals for the D.C. Circuit (D.C. Circuit) remanded the affected licensing cases back to NRC for further consideration.[2] The Court had no problem with NRC's basic approach of eliminating consideration of disposal safety and extended and indefinite storage from individual reactor NEPA reviews on the basis of a generic finding in a rule, with that generic finding then automatically incorporated into every individual reactor's NEPA review. Indeed, this general NRC approach of making generic NEPA findings had been approved by the U.S. Supreme Court.[3] However, the Court remanded the cases back to NRC because the generic waste confidence finding NRC relied on to reject the opponents' arguments (NRC's findings in response to NRDC's petition) was not the product of a public rulemaking proceeding. NRC had denied NRDC's petition without conducting any such proceeding.

[2] *Minnesota v. NRC*, 602 F. 2d 412 (D.C. Cir. 1979)

[3] *Vermont Yankee Nuclear Power Corp. v. NRDC*, 435 U.S. 519, 535 note 13 (1978). *See*, also *Baltimore Gas & Electric Co. v. NRDC*, 462 U.S. 87, 101-102 (1983)

The Court's opinion appeared to endorse NRDC's view that reactor licensing requires a finding under the Atomic Energy Act that the wastes in spent fuel can and will be disposed of safely, but the Court apparently thought that a suitable generic safety finding could be made on remand. In this regard, the D.C. Circuit read the Second Circuit's opinion in *NRDC v. NRC* to be based on NRC's stated assurance to Congress and the public that there would be safe disposal, but the Court observed that Congress would have wanted NRC to consider relevant new information. However, like the Second Circuit's opinion, the D.C. Circuit's opinion is not a model of clarity.

**II. Early NRC Waste Confidence Reviews**

In 1979, following the Court's remand in *Minnesota v. NRC*, NRC initiated its first Waste Confidence public rulemaking proceeding inviting public comments on prospects for safe disposal of spent reactor fuel. Because NRC also wanted to use the results of the Waste Confidence proceeding to avoid having to consider, on a case basis, the environmental impacts of extended storage of spent fuel, the Waste Confidence proceeding also included a proposed rule that reached generic conclusions about the environmental impacts of storage of spent fuel on nuclear power reactor sites or, possibly, on independent spent fuel storage installation sites (ISFSIs).

In its 1984 Waste Confidence Decision (and rule), 49 Fed. Reg. 34658 (August 31, 1984), NRC considered public comments and essentially confirmed (no surprise) what it had said in its response to NRDC's petition: that it had reasonable assurance a safe geologic repository for the disposal of spent reactor fuel is technically feasible. The final generic environmental impact evaluation is somewhat more complicated. NRC faced the choice to either evaluate the environmental impacts of storage of spent fuel for an indefinite time (on reactor sites and possibly later on ISFSI sites) or to truncate the evaluation by choosing a date when the spent fuel would be moved to a repository for disposal (the environmental impacts of disposal are addressed in a separate rule not in contention). NRC chose the latter. The timeframe chosen for the availability of a repository was 2007-2009. NRC found that extended storage of spent reactor fuel until then would not cause any significant environmental impact. This "no significant impact finding" was then to be used in each relevant reactor licensing NEPA evaluation.

In its 1984 decision, NRC promised to re-examine the relevant issues about every five years. This promise led to a second Waste Confidence public rulemaking and NRC's 1990 Waste

Confidence decision (and rule[4]). NRC affirmed still again its finding that safe disposal of spent reactor fuel in a geologic repository is technically feasible and that storage of spent reactor fuel until disposal would not cause any significant environmental impacts, but the date for repository availability (and for truncation of the storage environmental impact evaluation) is adjusted to 2000-2025. In its 1990 decision, NRC promised to re-examine the issues in ten years. However, in 1999, NRC decided not to commence another Waste Confidence rulemaking proceeding, indicating instead that it would re-examine the 1990 decision only if "significant and pertinent unexpected events occur, raising substantial doubt about the continuing validity of the Waste Confidence findings."[5]

The 1984 and 1990 Waste Confidence Rules were not judicially challenged.

**III. The 2005 Nevada Petition**

As noted above, the 1990 Waste Confidence decision included a finding that a repository for the disposal of spent reactor fuel would be available in 2000-2025. By 2005, it had become apparent that the 2000-2025 prediction could not be met unless NRC licensed the proposed Yucca Mountain repository which, since enactment of the 1987 amendments to the Nuclear Waste Policy Act (NWPA), had been and still is the only repository site under consideration. In 2005, the State of Nevada petitioned NRC to amend the 1990 Waste Confidence decision to remove the 2000-2025 prediction on the ground that it effectively prejudged the results of a future Yucca Mountain licensing proceeding. NRC denied any prejudgment and rejected Nevada's petition.[6] The D.C. Circuit dismissed Nevada's petition for judicial review of NRC's decision on standing grounds, reasoning that Nevada was not injured because the Waste Confidence Rule could not have any legal effect on a future Yucca Mountain licensing proceeding and could be amended if the Yucca Mountain application is ultimately denied.[7] The effect of NRC's denial and the Court's judgment is that the 1990 prediction that a repository would be available in 2000-2025 could not be used in any way by NRC to prejudge or unduly expedite any future Yucca Mountain licensing proceeding.

**IV. The Ill-Fated Third Waste Confidence Decision**

[4] 55 Fed. Reg. 38474 (September 18, 1990)
[5] 64 Fed. Reg. 68005 (December 6, 1999)
[6] 70 Fed. Reg. 48329 (August 17, 2005)
[7] *Nevada v. NRC*, No. 05-1350 (Judgment September 22, 2006) (unpublished).

A. The 2010 Waste Confidence Decision

The essential logic of the 2005 Nevada petition - that the 2000-2025 repository availability date in the 1990 Waste Confidence decision presumes that Yucca Mountain would be available for disposal by at least 2025 - apparently struck a raw nerve in NRC and the nuclear industry. In September 2007, at the urging of the nuclear industry, NRC agreed to revisit the 1990 Waste Confidence decision because the 2000-2025 dates for repository availability were obviously unrealistic, especially if Yucca Mountain is rejected.[8] In effect, NRC agreed to do what the nuclear industry asked even though it had refused to do the same thing just two years before when Nevada did the asking.

After another extensive rulemaking proceeding, NRC issued its third Waste Confidence decision (and rule) in 2010.[9] The 2010 Waste Confidence decision let stand the finding that there is reasonable assurance a geologic repository for the disposal of spent reactor fuel is technically feasible, but provides no specific date or dates for repository availability. Instead, the Commission found that a repository would be available for disposal of spent reactor fuel "when necessary," that is, when the safety of temporary on-site storage can no longer be assured. The previous generic conclusion that storage of spent reactor fuel until disposal, either on-site or in ISFSIs, would not pose any significant environmental impact was also essentially reaffirmed, but the evaluation period of on-site reactor storage was extended from thirty to sixty years beyond the licensed life of the reactors.

B. The *State of New York et al. v. NRC* case

Unlike the previous two Waste Confidence decisions and rules, the third decision and rule was judicially challenged. Moreover, circumstances had changed since 1990 – the Administration (including the Department of Energy, the applicant for the Yucca Mountain repository license) no longer supports the Yucca Mountain repository, and it is unclear what is the path forward to disposal. In *State of New York et al. v. NRC*, 681 F.3d 471 (D.C. Cir 2012), the Court vacated and remanded the 2010 decision and rule on multiple grounds.

First, the Court agreed with petitioners that the combined decision and rule is a major federal action under NEPA. As the Court saw it, an effect of the 2010 decision and rule is to enable reactor licensing. Consequently, NEPA requires NRC to do an assessment and make a finding of

[8] (Commission Staff Requirements Memoranda, ADAMS Accession Number ML072530192)
[9] 75 Fed. Reg. 81,037 (December 23, 2010)

no significant impact or prepare a full environmental impact statement supporting the decision and rule. There was no environmental impact statement but NRC argued in the alternative that, if the decision and rule are not purely administrative in nature, then the decision, rule, and supporting technical evaluations constitute, in effect, an environmental assessment and finding of no significant impact, thus eliminating the need for a full environmental impact statement. This led to the Court's second holding that the decision, rule, and supporting evaluations do not constitute an adequate assessment. Three reasons were given:

First, given current circumstances, it could not be maintained that a failure to ever establish a repository is a remote and speculative possibility and, in fact, NRC merely found that there was "reasonable assurance" a repository would be developed. Therefore, indefinite storage of spent reactor fuel with no disposal is not a remote and speculative possibility and its impacts must be considered under NEPA, something NRC had declined to do.

Second, the Court found that NRC had not adequately considered the risks of leaks in spent fuel storage pools in a forward-looking fashion.

Third, the Court held that NRC had not examined the consequences of spent fuel pool fires. While NRC has maintained that the fire risk is very low, it did not say that the fire probability is effectively zero and, given this, the fire consequences have to be specifically evaluated and examined in proportion to the probability.

Unlike the decision in *Minnesota v. NRC*, the Court in *State of New York et al. v. NRC* did not merely remand back to NRC for additional consideration in accordance with the Court's opinion, leaving NRC's licensing actions still effective, but went a critical step further and vacated (judicially invalidated) NRC's 2010 decision and rule. This had nearly immediate consequences. Because the now-vacated decision and rule underpinned all licensing decisions that could result in the generation of additional spent fuel, including all new power reactor license renewals and new combined licenses, NRC was forced to suspend all such licensing.[10] However, the effect of the suspension was largely symbolic because no licensing proceedings were suspended and no actual licensing decisions in those proceedings were expected for a year or more.

[10] E.g., Calvert Cliffs Nuclear Project, LLC (Calvert Cliffs Nuclear Power Project, Unit 3) et al., CLI-12-16, 76 NRC 63 (2012).

NRC embarked on a crash rulemaking project to correct the deficiencies found by the Court. Unlike the 2010 decision and rule, this new action included an environmental impact statement that considered the environmental impacts of indefinite spent fuel storage.

**V. The 2014 Continued Storage Rule**

The results of the rulemaking conducted in response to *State of New York et al. v. NRC* were published on September 19, 2014.[11] The supporting generic environmental impact statement (GEIS) was published as NUREG-2157 (September 2014) and the licensing moratorium was lifted.

A. Summary of the Rule

The main part of the rule is contained in a revised section of the Code of Federal Regulations 10 C.F.R. § 51.23. This revised section states that the Commission has generically determined that the environmental impacts of continued storage of spent nuclear fuel beyond the licensed life for operation of any reactor are limited to those impacts identified in NUREG–2157, "Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel," and summarized in the preamble to the rule. The generic environmental evaluation in NUREG-2157 applies to all NRC licensing actions subject to NEPA that would result in continued storage of spent nuclear fuel beyond the licensed life for operation of a reactor, including new reactor construction permits, operating licenses, combined licenses, and early site permits. Under the new rule, NRC deems the impact determinations in NUREG–2157 to be incorporated into all relevant environmental impact statements and environmental assessments.

The environmental analysis in the GEIS and the rule covers low and high burn-up spent fuel generated in light water nuclear power reactors. It also covers mixed oxide ("MOX") fuel, since NRC believes MOX fuel is substantially similar to light-water reactor fuel. It also covers spent fuel from small pressurized modular light-water reactors. NRC states that these modular light-water reactors being developed will use fuel very similar in form and materials to the existing operating reactors and will not, therefore, introduce new technical challenges to the storage of spent fuel. The environmental analysis in the GEIS also covers the spent fuel from one high temperature gas-cooled reactor built and commercially operated – Fort Saint Vrain in Colorado. The GEIS does not address foreign spent fuel or non-power reactor spent fuel (e.g.,

[11] 79 Fed. Reg. 56238

fuel from research and test reactors). Finally, the GEIS and rule do not cover the storage of spent fuel during the licensed life for operation of a power reactor or ISFSI.

Whether storage of spent reactor fuel during the licensed life of a reactor (or ISFSI) will be unsafe or give rise to unacceptable environmental impacts may (with some exceptions) be raised as issues in the relevant individual licensing reviews and proceedings. The same would be true for storage incident to disposal, such as spent fuel aging or above-ground storage at a repository. The rule does not authorize the storage of spent fuel at any site. The rule reflects only the generic environmental analysis for the period of spent fuel storage beyond a reactor's licensed life for operation, assumed to be up to eighty years. The GEIS and rule are not a substitute for licensing actions that typically include site-specific NEPA analysis and site- specific safety analyses. In addition, NRC's GEIS and final rule do not pre-approve any particular waste storage or disposal site technology or require that a specific cask design be used for storage.

The GEIS evaluates three scenarios for the length of continued storage that may be needed. The first timeframe is for short-term storage, which analyzes 60 years of continued storage after the end of a reactor's licensed operational life (140 years total). NRC considers the short-term timeframe to be the most likely scenario for continued storage, and the GEIS therefore assumes that a repository would become available by the end of the short-term timeframe. However the GEIS also analyzes two additional timeframes. A long-term timeframe considers the environmental impacts of continued storage for 160 years after the end of a reactor's licensed life for operation (240 years total), and an indefinite timeframe considers the environmental impacts that would arise assuming that no repository for disposal ever becomes available.

The GEIS includes a number of key assumptions. The most important and controversial assumption is that institutional controls (such as human surveillance and government regulation of spent fuel storage) will continue forever if necessary. NRC explains that a strong regulatory framework that involves regulatory oversight, continuous improvement based on research and operating experience, and licensee compliance with regulatory requirements is important to the continued safe storage of spent fuel until repository capacity is available. The GEIS and rule also assume that: (1) spent fuel canisters and casks will be replaced approximately once every 100 years; (2) a dry transfer facility would be built at each ISFSI location for fuel repackaging and the ISFSIs and dry transfer facility would be replaced approximately once every 100 years; (3) all spent fuel would be removed from spent fuel pools to dry storage by the end of the short-term timeframe (60 years after licensed life); and (4) an

ISFSI of sufficient size to hold all spent fuel generated during licensed life for operation will be constructed before the end of the reactor's licensed life for operation. These ISFSIs would be located either on the former reactor site or elsewhere.

In accordance with standard NRC practice, the extended storage environmental impacts described in the GEIS are categorized as "SMALL," "MODERATE," or "LARGE," using standard definitions of the three terms (capitalization is also standard NRC practice). To be SMALL, the environmental effects must not be detectable or be so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. Radiological impacts that do not exceed permissible levels in the Commission's regulations are always considered small. For MODERATE, the environmental effects must be sufficient to alter noticeably, but not destabilize, important attributes of the resource. An effect is considered LARGE if the environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource. NRC acknowledges that there are inherent uncertainties in predicting effects over long and indefinite timeframes.

For at-reactor extended storage, the GEIS concludes that the unavoidable adverse environmental impacts for each resource area are SMALL for all timeframes with the exception of waste management impacts, which are SMALL to MODERATE for the indefinite storage timeframe, and historic and cultural resource impacts, which are SMALL to LARGE for the long-term and indefinite storage timeframes. The MODERATE waste-management impacts are associated with the volume of nonhazardous solid waste generated by assumed facility replacement activities for the indefinite timeframe.

The effects of away-from-reactor extended storage are more complicated. Here, the unavoidable adverse environmental impacts for each resource area are SMALL except for air quality, terrestrial ecology, aesthetics, waste management, transportation, history and culture. The potential MODERATE impacts on air quality, terrestrial wildlife, and transportation are based on potential construction-related fugitive dust emissions, terrestrial wildlife direct and indirect mortalities, terrestrial habitat loss, and temporary construction traffic impacts. The potential MODERATE impacts on aesthetics and waste management are based on noticeable changes to the view from constructing a new away-from-reactor ISFSI and the volume of nonhazardous solid waste generated by assumed ISFSI and replacement activities for the indefinite timeframe.

The potential LARGE (beneficial) impacts on socioeconomics are due to local economic tax revenue increases from an away-from-reactor ISFSI. The potential impacts to historic and cultural resources during the short-term storage timeframe would range from SMALL to LARGE. The potential impacts to historic and cultural resources during the long-term and indefinite storage timeframes would also range from SMALL to LARGE.

The GEIS (and related references) discuss in some detail the two technical issues that led to remand and invalidation of the 2010 rule – spent fuel pool fires and leaks. NRC again decided that there is a low risk of a spent fuel pool fire. NRC states that it is not aware of any study that would cause it to question the low risk of spent fuel pool accidents and thereby question the technical feasibility of continued safe storage of spent fuel in spent fuel pools for the short-term timeframe considered in the GEIS. Further, NRC decided again that the public health impact from potential spent fuel pool leaks is SMALL.

The radiological impacts from extended storage on either reactor sites or independent ISFSI sites are considered to be SMALL in all three timing scenarios. The GEIS acknowledges that if spent fuel storage facilities are not cared for (no institutional controls), they could release radioactivity into the environment in a period as short as decades and that the consequences of such releases could be catastrophic, but provides no further impact information other than to state, in response to public comments, that the impacts would be similar to those evaluated for the no-action alternative in the Yucca Mountain environmental impact statement.

Questions have been raised (in comments and later in the litigation discussed below) whether NRC's generic evaluation of these radiological risks is sufficiently conservative (impacts maximized) to embrace all of the nuclear facilities to which it applies, including nuclear facilities located in high population density areas. Also questions have been raised whether NRC's assumptions about such things as continued institutional controls and periodic refurbishment and replacement of storage facilities are so unimpeachable that alternative assumptions need not be fully evaluated.

B. Offsite Disposal of Spent Fuel

The continued storage GEIS is not the only NRC generic environmental impact statement. NRC frequently simplifies and expedites NEPA reviews and hearings by preparing generic environmental impact statements. Another such statement generically evaluated most (but not all) environmental impacts from power reactor license renewals (extensions of power reactor

operating license terms for twenty or possibly more years). The long-term environmental impacts from power reactor operation, including operation under a renewed license, obviously include the radiological impacts from any later off-site disposal of the spent fuel. In the 2013 update of that other generic environmental impact statement and related rule, NRC committed to update these off-site impacts later as part of a Waste Confidence rulemaking. As explained below, NRC fulfilled this promise in the continued storage GEIS and rulemaking.

This task required NRC to evaluate prospects for safe spent fuel disposal, somewhat like it had to do in 1984, 1990, and 2010. In the GEIS, NRC once again determined that safe disposal of reactor spent fuel in a geologic repository is technically feasible. NRC explained that activities of European countries, experience in reviewing DOE's Yucca Mountain license application, and DOE's defense-related activities at the Waste Isolation Pilot Plant, all support the technical feasibility of a deep geologic repository. How NRC's experience in reviewing DOE's Yucca Mountain license application supports the technical feasibility finding is not clear given that the Commission never resolved any of the many safety issues that were raised about the proposed repository.

As for repository timing, the GEIS notes that international and domestic experience clearly demonstrates that technical knowledge and experience alone are not sufficient to bring about the broad social and political acceptance needed to construct a repository. The time needed to develop a societal and political consensus supporting a repository could add significant time to site and license a repository or overlap it to some degree. Given this uncertainty, the GEIS evaluates a range of scenarios for the timeframe required to develop a repository. The GEIS includes NRC's stated belief that the United States will open a repository within the short-term timeframe but as noted, to account for all possibilities, includes a second, longer timeframe as well as the scenario in which no repository ever becomes available.

The actual entry for offsite disposal impacts in the generic environmental impact statement for license renewal, as prescribed in the continued storage GEIS and rule, is interesting. There is no categorization of this impact as SMALL, MODERATE, or LARGE. Instead, the Commission summarized the Environmental Protection Agency's (EPA) post-closure dose standards for Yucca Mountain and concluded that the radiological impacts from disposal would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation should be eliminated under NEPA. A similar NRC generic finding was upheld in *Baltimore Gas & Electric Company v. NRDC*, 462 U.S. 87 (1983)). NRC explained that although the status of any particular repository, including a repository at Yucca Mountain, is uncertain

and outside the scope of the GEIS, it nevertheless believes that it is appropriate to refer to the radiation standard for Yucca Mountain because it is the current standard. Nevada has filed a judicial challenge to the EPA standard.

**VI. Uncertainties and Litigation**

The NRC final rule did not resolve previously identified uncertainties, and quickly resulted in a new legal challenge. In October 2014, the States of New York, Vermont, and Connecticut, along with NRDC and other environmental groups, and a Native American community petitioned for review of NRC's 2014 rule and GEIS in the D.C. Circuit (the Court that invalidated the 2010 rule). Petitioners argued that the Continued Storage Rule is a major federal action requiring NEPA compliance. Specifically, petitioners contended that NRC: (1) failed to consider alternatives to and mitigation measures for the continued storage of spent nuclear fuel; (2) miscalculated the impacts of continued storage; and (3) relied on unreasonable assumptions, including the likelihood of failure to site a permanent repository, in its EIS. Petitioners further took issue with NRC's failure to employ conservative bounding estimates, its insufficient assessment of cumulative impacts and that NRC unjustifiably dismissed the risks of short-term, high-volume pool leaks.

On June 3, 2016, the Court rejected the argument that NRC was arbitrary and capricious and upheld the Continued Storage Rule. Notably, the Court agreed with NRC that while the Continued Storage Rule is indeed a "major federal action" under NEPA, NRC met its NEPA obligations by preparing the GEIS. The Court held that the rule itself is not a licensing action and does not trigger the necessity to address alternatives to licensing. The Court rejected petitioners' claims concerning mitigation measures for pool fires and pool leaks, finding that the GEIS sufficiently discusses mitigation measures for these events. To the extent the Court considered additional mitigation measures, it held that NRC can defer consideration of such measures until it addresses site-specific review in particular licensing cases. In considering the State petitioners' argument that NRC failed to use "conservative bounding assumptions" in the GEIS, particularly concerning NRC's estimates of risks from pool fires and leaks, the Court found sufficient NEPA compliance, particularly in light of its deference to NRC's technical judgments.

NRDC argued that NRC failed to quantify the probability of failure to site a repository. Again, the Court determined that NRC had adequately considered both the probability and consequences of failure to site a repository, finding NRC had provided sufficient NEPA analysis.

The Court methodically rejected arguments concerning cumulative impacts of continued storage, NRC's treatment of short-term, high-volume leaks, and NRC's waiver process for exempting license applicants from certain requirements. Ultimately, the D.C. Circuit, while acknowledging the political discord surrounding the country's nuclear energy policy, found its role circumscribed by the narrow "arbitrary and capricious" standard of review. The Court directed the petitioners to take their concerns to Congress.

On August 8, 2016, the full Court denied a rehearing en banc, thus concluding the litigation and affirming NRC's Continued Storage Rule.[12] The D.C. Circuit's refusal to grant a rehearing en banc effectively closes the chapter on this litigation.

**VII. Implications for Yucca Mountain**

The 2014 Continued Storage Rule is good news for opponents of Yucca Mountain. Until the 2014 rule, NRC policy had clearly been that operation of nuclear power plants could not continue unless there is reasonable assurance (or confidence) that the spent fuel they generate could and would be disposed of (not just stored) on a timely basis. After 1987, the United States' efforts to develop a disposal facility focused exclusively on Yucca Mountain and, as a result, the successful and timely licensing of Yucca Mountain could be seen as important, if not critical, to the existence and future of nuclear power in the United States. Accordingly, proponents of Yucca Mountain argued that the stakes are much higher than just Yucca Mountain itself, and that a whole range of issues related to energy supply and diversity and global warming are implicated should Yucca Mountain fail.

Now NRC has determined, after consideration of numerous public comments, that safety impacts that would likely arise from a complete failure of the repository program (resulting in indefinite on-site storage of spent fuel) are SMALL. This environmental finding is based on a safety discussion and finding (in the GEIS and rule preamble) that indefinite on-site storage of spent fuel does not present any undue risk to public health and safety. ***Therefore it can no longer be argued that the successful licensing of Yucca Mountain is required to assure safety in the licensing of nuclear reactors. The future of Yucca Mountain and the future of nuclear power are separate, and the stakes for Yucca Mountain are lower.***

[12] *See, State of New York, et al. v. United States Nuclear Regulatory Commission*, No. 14-1210 (June 3, 2016); rehearing den'd (August 8, 2016).

In addition, as explained below, the 2014 NRC GEIS and rule raise grave questions about the continued validity of DOE's environmental impact statements supporting Yucca Mountain. NEPA environmental impact statements must include a consideration of the environmental impacts of a no-action alternative and a comparison of those impacts with the impacts of the proposed action. In the case of Yucca Mountain, the no-action alternative is a denial of the license application and cancellation of Yucca Mountain, resulting in the indefinite storage of spent reactor fuel (as is the case evaluated in the 2014 GEIS).

DOE's 2002 final environmental impact statement and 2008 supplemental environmental impact statement for Yucca Mountain identify two no-action alternative scenarios that would follow from cancellation of Yucca Mountain. Scenario 1 is long-term storage of spent nuclear fuel and high-level radioactive waste at current sites with effective institutional control. Scenario 2 is long-term storage of spent nuclear fuel and high-level radioactive waste at current sites with no effective institutional controls after 100 years.[13]

The environmental impacts of scenario 2, as assessed by DOE, are often very large.[14] It is apparent that DOE recommended the proposed action under NEPA (construction and operation of a repository at Yucca Mountain) to avoid the "large public health and environmental consequences under the No-Action-Alternative if there were no effective institutional control, causing storage facilities and containers to deteriorate and radioactive contaminants from the spent nuclear fuel and high-level radioactive waste to enter the environment."[15] Indeed DOE even described the adverse radiological impacts arising from scenario 2 as "catastrophic."[16]

***However, DOE's No-Action Alternative scenario 2 is effectively eliminated from consideration in the NRC licensing process because the subsequent 2014 NRC GEIS and rule determined that a loss of institutional control over spent fuel storage sites is remote and speculative and not suitable for consideration under NEPA. If this scenario is eliminated from NEPA consideration, leaving scenario 1 as the no-action alternative, DOE's conclusion that constructing and operating a repository at Yucca Mountain is the preferred alternative under NEPA, is no longer supported by DOE's own NEPA analysis.***

[13] FEIS at 7-1 and SEIS at 7-4
[14] FEIS Readers Guide and Summary at Table S-1 and SEIS Summary at Table S-3.
[15] FEIS Readers Guide and Summary at pg. S-83
[16] SEIS at 7-8

**ATTACHMENT III**

**LETTER FROM GOVERNOR SANDOVAL**
**TO REP. JOHN SHIMKUS DATED JULY 7, 2016**

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# Office of the Governor

July 7, 2016

The Honorable John Shimkus
Chairman, Subcommittee on Environment and the Economy
Committee on Energy and Commerce
2125 Rayburn House Office Building
U.S. House of Representatives
Washington, DC 20515

The Honorable Paul Tonko
Ranking Member, Subcommittee on Environment and the Economy
Committee on Energy and Commerce
2125 Rayburn House Office Building
U.S. House of Representatives
Washington, DC 20515

Dear Chairman Shimkus and Ranking Member Tonko:

As your subcommittee meets today to discuss the future of high-level nuclear waste storage in the United States, I write to reiterate the unchanged position of the State of Nevada on the proposed Yucca Mountain Nuclear Waste Repository.

My position, and that of the State of Nevada, remains unchanged from my previous letters to this committee in May 2015, and January 2016: **the State of Nevada opposes the project based on scientific, technical and legal merits.** Furthermore, as set forth in the Nuclear Waste Policy Act of 1982, only the Governor is empowered to consult on matters related to the siting of a nuclear waste repository.

As the committee knows, Nevada is host to two U.S. Air Force bases, a U.S. Naval Base, a U.S. Army Depot, the Nevada Nuclear Security Site (NNSS), and the Nevada Test and Training Range -- a total federal land withdrawal roughly the size of the State of Connecticut. Nevada is proud of these contributions to national defense and security.

Furthermore, it is important to remember Nevada has made historical contributions to nuclear energy as the host state for 928 nuclear tests -- 100 of which were conducted above ground. As a result of this testing, the federal government has paid $1.9 billion over the past 25 years to affected residents of Nevada and individuals from neighboring states who were exposed to dangerous levels of radioactive material.

Nevadans also believe our relationship with the federal government should be one where the state is seen as a valued partner; an ideal that often is not realized. The proposed siting of a national nuclear waste repository in Nevada provides a vivid example of the failure of this partnership when, in 1987, Congress substituted politics for science to amend the Nuclear Waste Policy Act to limit the repository options to one state: Nevada.

As you meet to consider these issues, I would suggest your attention be directed to bipartisan efforts in Congress to pursuing a long-term sustainable solution for the nation's nuclear waste through a consent-based process. If such a process had been embraced by the Congress when my predecessor, Governor Kenny Guinn, vetoed the selection of Yucca Mountain 14 years ago, we might today be closer to a long-term solution for the nation's spent nuclear fuel.

Sincere regards,

BRIAN SANDOVAL
Governor

# ATTACHMENT IV

# POTENTIAL FOR VOLCANISM AT AND NEAR THE YUCCA MOUNTAIN REPOSITORY SITE

# Volcanism and Yucca Mountain

Prepared for the Nevada Agency for Nuclear Projects
Nuclear Waste Project Office

November 9, 2016

Describing the volcanism issue and contentions, the differences between the approach taken by the Department of Energy and the State of Nevada, and a review of lessons learned based on 30 years of interaction with government agencies.

By

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This paper, prepared for the Nevada Agency for Nuclear Projects, is designed to provide a summary of Nevada's volcanism contentions submitted in the US Nuclear Regulatory Commission (NRC) Yucca Mountain licensing proceeding, introduce a new contention related to the potential for explosive volcanism near Yucca Mountain, and provide an historical perspective of work performed over the past 30 years. It is intended to help the reader understand the volcanism issue, the differences between the approach taken by the Department of Energy (DOE) and the State of Nevada, and review lessons learned based on 30 years of interaction with government agencies (DOE and NRC, in particular).

Our scientific approach from the start of our work in 1986 for the State of Nevada was directed toward addressing DOE's basic assumptions regarding volcanic hazard studies rather than simply calculating new probability estimates of the disruption of the repository by a volcanic event. In practice, we started with five of DOE's major assumptions:

1. Understanding the process of volcanism is not important for calculating the probability of future volcanism.
2. Melting to produce volcanoes near Yucca Mountain occurred shallow in the lithospheric mantle. This model infers that volcanism will die out over the next 10,000 to 1,000,000 years and that the probability of future volcanism is very low.
3. The volcanic field used to calculate probability is restricted to the immediate area around Yucca Mountain.
4. Looking at volcanism near Yucca Mountain, it is permissible to use only the last five million years of activity. It is not necessary to look at the entire 11-million-year record.
5. Relatively non-explosive and low-volume basaltic volcanism will characterize future activity around Yucca Mountain. Explosive felsic (rhyolitic) volcanism will not occur.

We prepared nine contentions for Nevada and two for Inyo County, California that addressed and countered DOE's assumptions. The contentions use new observations and data based on years of field and laboratory research. The contentions are listed at the end of this paper and each is followed by a short summary. Most, if not all, of the data and interpretation used in the contentions were first published in peer-reviewed journals and then incorporated into the contentions. Assumption #5 is the topic of a new contention currently being prepared.

*Assumptions 1 and 2:* In the contentions, we argue that it is unreasonable to develop a prediction of future volcanism without understanding the underlying processes that control that volcanism. For example, DOE and two Probabilistic Volcanism Hazard Assessment (PVHA) panels (PVHA in 1996 and PVHA-U in 2007-2008) used the assumption that melting to produce basalt near Yucca Mountain is shallow in the lithospheric mantle. This model implies a finite amount of mantle material suitable for melting and therefore low and reduced rates of future volcanism. Based on work done with Dr. Terry Plank at Columbia University in New York and Dr. Cin-Ty Lee at Rice University in Houston, we developed techniques to calculate the depth of melting of basaltic rocks within continents. Our depth-of-melting estimates in the contentions were based on these techniques; recently, however, Dr. Keith Putirka at California State University in Fresno developed a better calibrated depth-of-melting model that we currently use. Existing contentions will be modified to include results from the new model. We do not expect major differences

between earlier calculations and those done using the Putirka formulation. However, it is important to update the melting depths to include the latest techniques. Calculations show that melting depths were deep in the Earth's asthenosphere and melting temperatures were high. We therefore challenged DOE's arguments by proposing a deep-hot melting model.

The question is: Why is knowledge of mantle source and temperature important? The answer is that where the melting occurs controls the nature and frequency of future volcanism.

The Earth's mantle is divided into several parts. The upper part is solid and old and is part of the Earth's outer shell or lithosphere. It represents solid mantle material with veins and irregular pods of rock that melt to produce basalt magma. Below the lithospheric mantle is the asthenospheric mantle. This mantle is semi-liquid and actively circulating. If the lithospheric mantle is melted, only the veins and pods melt; therefore, magma production is limited and, eventually, this material be depleted, resulting in a cessation of volcanism. This is the model relied upon by DOE. On the other hand, the volume of material available for melting and creating volcanoes in the asthenosphere is almost infinite. If the asthenosphere is the source, then volcanism may flare up again near Yucca Mountain.

In summary, the big difference between our model and the one proposed by DOE is that our model suggests that volcanism may increase in intensity and infers a higher probability of volcanism and repository disruption, whereas DOE's model favors decreasing volcanism over time and a lower probability of repository disruption.

Another advantage of the deep melting model is that it allows us to address the following issues:

- The reason volcanic fields form at certain locations and not in others.
- The rates and intensity of eruptions.
- The reason why in most cases volcanism occurs over and over again in basically the same location.

For example, in Crater Flat just west of Yucca Mountain, basaltic volcanism has occurred in a fairly restricted area for the past 11 million years. Working with Dr. Clint Conrad at the University of Hawaii at Manoa (now at the University of Oslo, Norway), Dr. Todd Bianco at Brown University in Rhode Island, and Dr. Maxim Ballmer at ETH in Zurich, Switzerland, we modeled the conditions favorable for the melting of mantle rock and concluded that melting is related to hot or damp (areas that are water-rich) pockets in the asthenosphere. Within the asthenosphere, shear stresses cause mantle rock to rise. When mantle rock rises to lower pressures, it melts and produces magma (that eventually rises to the surface and erupts). We named this phenomenon shear-driven upwelling (SDU) and published several articles describing this process. It is interesting that melting occurs without the addition of heat; all that is required is a reduction in pressure. Our work also showed that volcanism unrelated to subduction or mantle plumes occurs in areas of high mantle shear and also where these hot or damp pockets intersect a place at the base of lithosphere where thickness changes abruptly producing a topographic barrier (the lithosphere can have topography both at its top forming mountain ranges and basins, and at its base) (Figure 1). The western US where the shear rate in the asthenosphere is 5 cm/year is a prime example. These results were published in March 2011 in the journal

"Nature Geoscience." Also, the effects of a damp or hot pocket hitting a lithospheric topographic barrier were published in the journal "Geology" in 2015. In summary, a volcanic field may form under the following conditions:

- High mantle shear rates.
- The presence of hot or damp pockets.
- The occurrence of SDU (shear-driven upwelling).
- Where a hot or damp pocket intersects a lithospheric barrier.

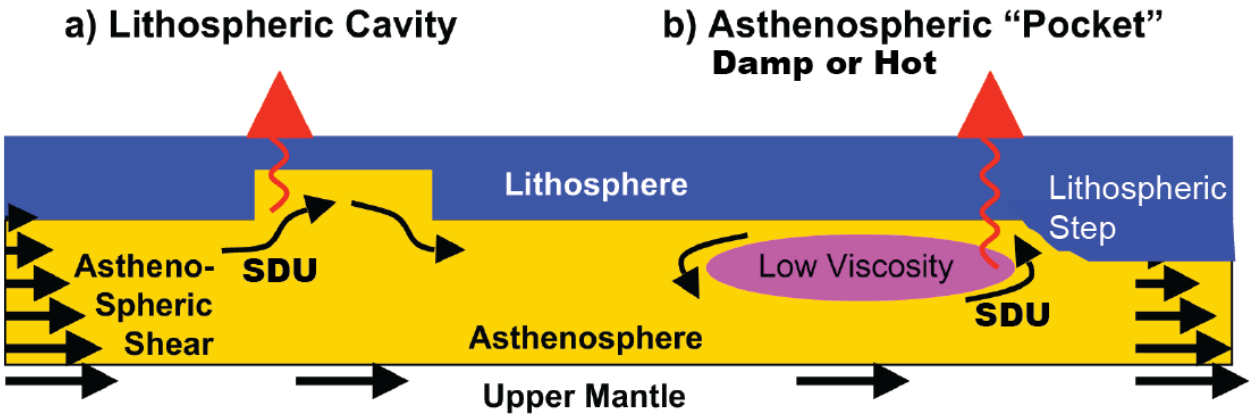



**Figure 1. Illustration of shear-driven upwelling (SDU) in a hot or damp pocket (in purple) in the asthenospheric mantle. Where the pocket intersects a topographic step at the base of the lithosphere (blue), melting occurs due to pressure release and does not require the addition of heat. SDU may also occur at the edge of a lithospheric cavity (left side of diagram). Both SDU and the position of the topographic step may control the location of a volcanic field.**

*Assumption 3:* Most of DOE's PVHA and PVHA-U experts assumed that the area directly about Yucca Mountain (including the aeromagnetic anomalies in the Amargosa Valley) is the region to be used for probability calculations. Although each expert used a different area of interest, none considered close by and coeval volcanic fields. One such field is in the Greenwater Range just east of Death Valley in Inyo County, California (only 25 miles south of Yucca Mountain). Volcanoes in this field erupted at the same time and are chemically similar to those near Yucca Mountain. As part of mapping by our group at UNLV, an additional 29 volcanic vents were located in the Greenwater Range. These are new, never previously recognized, volcanoes. Because of similarities in age, chemistry, and eruptive style, we suggested that the Greenwater Range should be included in the area used to count volcanoes for probability studies. If included, these volcanoes could increase the probability of future volcanic events.

*Assumption 4:* The 4$^{th}$ assumption states that only volcanic activity younger than five million years is considered for probability calculations. Volcanism over this period from 5 million years to the present decreases in volume and appears to represent a dying volcanic field. DOE and the PVHA-U panel assumed that future activity near Yucca Mountain will be less intense and eventually die out completely and showed numerous geochemical plots supporting this observation. We agreed that the trend over the past five million years is toward decreasing volcanic activity, but we disagreed with the five-million-year cut off. Basaltic volcanism near

Yucca Mountain started nearly 11 million years ago. If the entire record is used, a surprising pattern of cyclic volcanism emerges. Two trends are clearly observed (Figure 2). The first occurred from 11 to about seven million years ago, and the second occurred from five million years ago to the present. Each cycle shows larger volume activity at the start, trending toward lower volume at the end of the period. Viewing the entire record indicates that there have been two periods of volcanism at Yucca Mountain, not just one. This suggests the alternative future scenario that a third cycle may start, repeating the events of first two cycles. In this scenario, the probability of volcanism and repository disruption is considerably higher than DOE estimates imply.

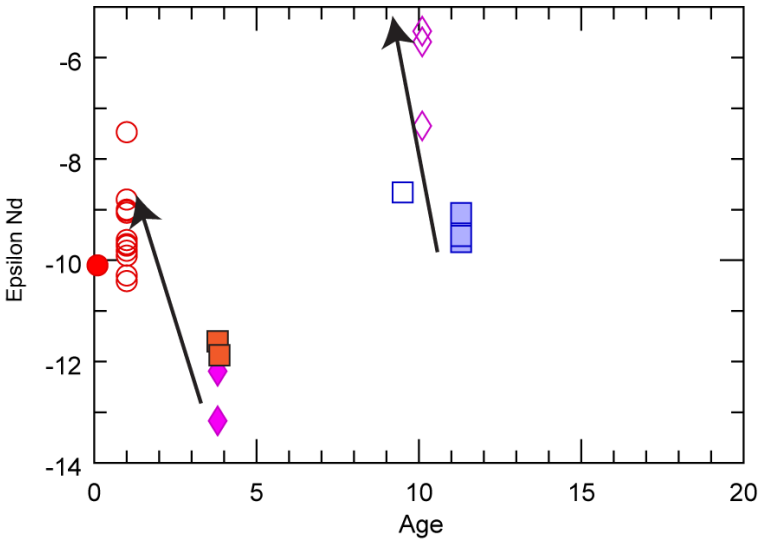



**Figure 2. Plot of epsilon Nd vs. age for Yucca Mountain core, samples from Crater Flat (open circles), SE Crater Flat (orange squares) and the Lathrop Wells cone (filled red circle). There are two super-episodes of activity; one between 11 and about 9 million years and the second between 3.5 and 1 million years. Each episode shows decreasing epsilon Nd with time. The young (80,000 years old) Lathrop Wells cone has an epsilon Nd value toward the lower end of the 1.0 Ma Crater Flat data. An important question is whether the Lathrop Wells eruption represents the beginning of a new episode of eruption or the end of the second episode. Decreasing epsilon Nd reflects a smaller degree of crustal contamination or a larger asthenospheric contribution with time.**

## The New Contention

*Assumption 5:* DOE assumes eruptions of basalt will form small cinder cones and localized lava flows and that this style of activity will characterize the future volcanism of Yucca Mountain. Furthermore, DOE assumes that explosive activity will not occur in the future. Our new contention will argue the following:

- Explosive rhyolite volcanism is possible in the Yucca Mountain area and has occurred in the last 5 to 11 million years in the vicinity of Yucca Mountain. Our work in the Greenwater Range, just south of Yucca Mountain, indicated that explosive rhyolitic volcanism occurred between 4.9 and 6.58 million years ago, within the time period considered significant for risk assessment at Yucca Mountain. Most of the central part of the Greenwater range is composed of rhyolite possibly occupying a caldera (volcanic

crater formed by collapse). Despite the lack of this type of activity directly adjacent to Yucca Mountain (at least for the last 11 million years), the occurrence of explosive volcanism in the Greenwater Range raises the question of whether this type of activity is possible at Yucca Mountain. This question is especially important if the safety of the repository has to be guaranteed for 1,000,000 years. The contemporaneous eruption of basalt and rhyolite is actually a common occurrence even in post-extensional volcanic fields. Racheal Johnsen, a Post-Doctoral Fellow at UNLV, is finding examples of this type of activity in many of the young volcanic fields (the same age as those about Yucca Mountain) in western Utah. Also note that explosive rhyolitic volcanism occurred to form the Black Mountain caldera about 35 km north of Yucca Mountain approximately seven million years ago.

- We argue that the Greenwater Range, buried basalt centers in the Amargosa Valley, and volcanoes in Crater Flat near Yucca Mountain are part of the same volcanic field and may have similar evolutionary histories. An issue important for constructing this contention is the characterization of the conditions necessary to produce explosive volcanism in the Greenwater Range and to determine whether similar conditions exist near Yucca Mountain. Specifically, we are looking at the composition of the source for the rhyolitic magma and the relationship between basalt and rhyolite. We are currently doing the work necessary to determine this relationship.

- The possibility of explosive volcanism as a natural hazard was not considered in DOE's license application. Our work shows that explosive activity occurred in the past seven million years and that it may be an important component of future volcanic activity near Yucca Mountain.

Our current work is directed toward investigating the main points listed above.

**The Numbers Game**

In an article published in 2005 in EOS, the Transactions of the American Geophysical Union, Dr. Eugene Smith wrote; "Using a probabilistic approach to hazard assessment, DOE applies the following U.S. Environmental Protection Agency (EPA) guideline that volcanism is not an issue if there is less than one chance in 10,000 in 10,000 years of repository disruption by volcanic eruption (or less than $1.6 \times 10^{-8}$ events per year). A DOE expert panel calculated the probability of magmatic disruption of the Yucca Mountain site at $1.5 \times 10^{-8}$ events per year. Other calculations by the Southwest Research Institute's Center for Nuclear Waste Regulatory Analyses and the State of Nevada estimated probability as much as two orders of magnitude greater than the EPA guideline. In 2004, the U.S. Court of Appeals ruled that the 10,000-year compliance period is an arbitrary standard and the court ordered EPA to establish a new health standard that reflects the time of maximum radioactive contamination of the environment as originally recommended by the US National Academy of Sciences. Following this legal decision and a new health standard recently proposed by EPA, DOE may have to guarantee repository safety for as long as 1,000,000 years."

A common question is: How will this new work change the probability estimate for repository disruption by volcanic activity? The simple answer is that we have found additional volcanic centers in the Greenwater Range and the addition of these will certainly increase probability numbers. However, the area of interest is much larger, so the number of eruptions per unit area (the number used in calculations) may not significantly increase. The discovery of explosive activity in the Greenwater Range changes the nature and destructive potential of the volcanic hazard, but we still need to evaluate how this will change probability estimates.

Most volcanic risk studies are done for much shorter time periods than required for Yucca Mountain. These studies are meaningful because sources of melting and tectonic environment do not change much in a few hundred years or so. Evaluating volcanic risk 10,000 years or 1,000,000 years into the future is a bit problematic. If our model of deep melting of hot or damp pockets by the process of SDU is correct, then prediction of future events becomes very difficult because of the many variables involved. For example, SDU causes melting but only if the hot or damp mantle pocket retains an optimal shape. If mantle shear changes the shape of the pocket, then SDU as well as volcanism may stop. At the present time, because imaging of mantle structure is still relatively primitive, it is difficult to predict how an existing pocket will change shape and how this will affect future volcanism. Volcanism could increase in intensity if a pocket's shape becomes optimal or if a new pocket develops, but could die out completely if the pocket's shape changes drastically or disappears. We can predict how pockets change shape by using numerical models such as those done by our colleagues Clint Conrad and Maxim Ballmer. We need to use these models to predict how the pocket beneath Crater Flat and the Greenwater Range will evolve with time and then use these results to calculate probability of new eruptions and repository disruption.

It is relatively easy to calculate disruption rates if they are based only on vent counts and areas of interest. This is what has been done in the past. While this passes the regulatory test, these probability numbers have little meaning when considering the nature of the mantle source. DOE and the PVHA panels take the top-down approach and consider volcanic events and faulting at the surface as the controls of volcano location. We look at this differently and suggest that processes at depth in the Earth's mantle are the primary controls of volcano location on the surface. Using this approach, numerical models describing mantle flow, the shape of hot or damp pockets, and mantle shear rates are necessary to calculate probability numbers.

Although calculating probability of repository disruption is a difficult problem especially when considering complex geophysical models, we realize that playing the numbers game is important for the contentions and evaluating EPA regulations. Based on our new work, we will try to provide an estimate of volcanic disruption based on new volcanic vents in the Greenwater Range and hopefully on numerical models of mantle behavior, but want the reader to appreciate the significant differences between the approach taken by DOE (and the PVHA panels) and our work for the State of Nevada.

**Summary of some of Lessons Learned from 30 years of Volcanism Studies**

Much of this text was originally produced in 2011 for Clark County to be included in a Lessons Learned publication. Unfortunately, the paper was never published, but the points below are still

valid. They will hopefully serve as a guide for future scientists who may have to deal with the Yucca Mountain issue.

**Conduct independent research and counter arguments based on the new data and models:** An oversight role is more effectively accomplished if backed up by original scientific studies. In other words, an active role involving the development of alternative ideas and models is preferred over a passive role that involves the reading and critiquing existing documents. The selection of the area of interest for counting volcanic events for volcanic hazard studies is an example of this procedure. In the late 1980s, Dr. Bruce Crowe, working for DOE, proposed the Crater Flat Zone that extends from the Lathrop Wells volcano just south of Yucca Mountain to the Sleeping Butte cones north of Beatty, Nevada. Interestingly, this zone avoided the Yucca Mountain repository block and did not include all Pliocene-Quaternary aged volcanoes in the area. Instead of criticizing this work, we countered with original work and suggested an alternative zone, which we named the Area of Most Recent Volcanism (AMRV). Our zone was more inclusive and extends from Lathrop Wells in the south to Sleeping Buttes in the north to Buckboard Mesa to the northeast of Yucca Mountain. We felt that the AMRV was a more robust solution because it included all volcanoes of the appropriate age in the Yucca Mountain area. Further, it encompassed the Yucca Mountain repository block. DOE responded to the AMRV by saying that it was possible, but they really did not like the idea. Later work by my research associate Dr. Gene Yogodzinski showed that the AMRV corresponded to an area of Nevada with a distinctive geochemical signature, which he named the Amargosa Valley Isotope Province (AVIP). This work confirmed that the AMRV was a more viable zone to use for hazard studies. It was gratifying to see that nearly 10 years later, many of the PVHA and PVHA-U experts, used the AVIP (based on the AMRV) as their area of choice for probability calculations; very few used the Crater Flat Zone.

**Do not be concerned with attempts to discredit and ignore original work that counters the research done by the government agency:** In terms of our work, DOE first tried to discredit and then ignored our first attempts at providing alternative models. Looking back, these attempts were designed to scare and intimidate. In geology, this type of behavior is unusual and unexpected. Geologists, like other scientists, can be very critical, but in most cases, the criticism is designed to help improve the research, not discredit it. This unexpected behavior might cause the geologist under attack to give up. In our case, this behavior stopped because NRC scientists and administrators participating in meetings and on field trips recognized that our alternative models had merit and encouraged DOE to take us seriously and consider them.

**Spending money to include the participation of the best scientific minds available is an excellent investment:** Recognize that to produce an alternative model, you cannot do everything yourself. Commonly, model development will involve knowing techniques or theory that others understand better than you. Some of the theory and techniques can be learned, but a better tack to take is to involve experts. We took this path early in our work and involved Dr. Chih-Hsiang Ho at UNLV to do probability calculations. Dr. Ho is an excellent statistician, but did not know much about volcanoes. He spent time learning volcanology by attending meetings at volcano locations worldwide and over a period of 5 years, Dr. Ho became one of the world's experts in volcanic hazard studies. Recently, we involved Dr. Terry Plank at Columbia University and Dr. Clint Conrad at the University of Hawaii at Manoa. Drs. Plank and Conrad are experts in their

respective fields and have made important contributions to our volcanic hazard studies. Our work could not have come this far, this fast without their collaboration. Involving experts is expensive, but based on their important contributions, using experts as collaborators is an excellent investment.

**Publication of results is the best way to achieve scientific credibility. Our research has led the way in terms of publication of results in peer-reviewed scientific journals:** The acceptance of a new model or idea is difficult to achieve. The scientific community may react in several ways to a new concept; it might be accepted as the new paradigm, it might have temporary acceptance and become quite popular but over a period time replaced by another model, or it may be simply ignored. Unfortunately, the vast majority of new ideas do not gain acceptance and are ignored. The first step in achieving acceptance and scientific credibility is publishing the study in a peer-reviewed journal. We recommend first selecting the highest ranked journal for a paper, but having several backup journals in mind just in case the paper is rejected by the first journal. Also, it is important to present the model as it develops at scientific meetings by publishing abstracts. Over the past 30 years, our group has published 43 papers and abstracts either directly or indirectly related to Yucca Mountain. In contrast, DOE scientists rarely published their work in peer-reviewed journals. Most of their work is reported in informal DOE reports and presented at DOE-sponsored meetings. Recently, with DOE scientists leaving the Yucca Mountain project and taking jobs at academic institutions, they have started to report earlier and updated work to the scientific community in peer-reviewed journals.

**Recognize that work done for Yucca Mountain may have far reaching implications:** Several benchmarks that can be used to judge good science are whether the work can be applied not only to the immediate problem but can also be used to address larger issues, whether it helps train and direct the careers of young scientists, and finally, whether it has implications for the local community. We have strived to live up to these benchmarks in our Yucca Mountain volcanism research. Much of our work can be used to address global issues. For example, the recent work with Dr. Clint Conrad not only explains the location, volume, and eruption patterns at Yucca Mountain, it also explains why volcanoes form where they do worldwide. It is important that good research has an educational component. Over the past 30 years, 17 students have received either Master of Science or Doctor of Philosophy degrees while working on Yucca Mountain-related projects. All of these students now have successful careers, many although originally from other areas, decided to stay in Nevada and are now productive members of our community. Further, 11 scientists have worked as Post-doctoral fellows or research associates on Yucca Mountain volcanism studies. Nearly all of these people are working as professional geologists for academic institutions or within the industry and give credit to their Yucca Mountain work for their success. Benefits of research should also be felt in the local community. For example, our work is intended to keep the people of Nevada as safe as possible by assuring that if a nuclear waste repository is built, it is placed in a geologically stable and suitable location. Understanding the style, location and type of volcanism is also important for local emergency preparedness. Although the volcanoes near Yucca Mountain do not pose a serious threat to the Las Vegas Valley, larger volcanoes in eastern California (for example the Long Valley Caldera) may be a major threat if a large eruption were to occur. The last eruption from the Long Valley caldera 670,000 years ago dumped a foot of hot ash over most of the Las Vegas Valley. If a similar event were to occur again, the implications for the community could be

disastrous. One of the spinoffs of our work at Yucca Mountain and in other areas allows us to understand the nature of future eruptions.

**Analog studies are very useful for understanding concepts and volcanic processes that might occur near Yucca Mountain**: An accepted way of doing a scientific investigation is to use analogs situations or areas. An analog in geologic context is a location similar to the area of interest that can be used to gather data that might be hard or impossible to obtain in the study area. For example, early in our study of the Greenwater Range in Inyo County, California, a large area of rhyolite was located adjacent to a field of basaltic volcanoes. The rhyolite represents explosive eruptions and its discovery was unexpected. Later work showed that the rhyolite erupted at about the same time as the basalt. After this discovery, we wondered whether the occurrence of basalt and rhyolite in the same volcanic field was common. To answer this question, we decided to do analog studies by mapping several volcanic fields in western Utah similar in age, rock type and size to the volcanic field about Yucca Mountain. This work done by Post-Doctoral Fellow Racheal Johnsen showed that the contemporaneous eruption of explosive rhyolite and relatively quiet basalt is a common occurrence and raised the question of whether this type of activity could occur in the future near Yucca Mountain. Another example from our early days of Yucca Mountain work is the use of Fortification Hill near Lake Mead as an analog to the plumbing or vent system that might exist beneath volcanoes near Yucca Mountain. This is an ideal area to study the subsurface expression of a volcano because volcanic vents are perched and exposed on a 1000-foot high mesa with the dike system that fed the volcano nicely exposed. We felt that this was an ideal site to observe the dimensions of dikes that might be related to volcanoes in Crater Flat and Lathrop Wells.

**Keep alert for new developments and keep up in your field. In other words, be prepared for unexpected developments:** It is critical to keep current in your field of interest. Do this by reading articles in journals, keeping in contact with colleagues, and attending meetings whenever possible. What is a scientific surprise? One example is seeing an article that criticizes your work in print without you knowing about it beforehand. In science, surprises like this are not welcome but unfortunately they do occur. Try to minimize surprises by not becoming complacent. The goal is to avoid unexpected events by keeping up and being aware of new developments. Know what other scientists in your field are doing!

# List of Nevada Contentions

**NEV-SAFETY-150 - BASALTIC MAGMA MELTING DEPTH:**

DOE's assumption that the source of the basaltic magma is in the shallow lithosphere infers a dwindling supply of new basalt and little chance of future events. DOE does not account for published data and interpretations that indicate that melting to produce basalt is in the asthenosphere and not in the lithosphere. Melting of asthenosphere implies a more active igneous future for Yucca Mountain and a higher probability of igneous activity disrupting repository drifts.

**NEV-SAFETY-151 - TIME SPAN OF BASALTIC VOLCANISM:**

Despite the 11-million-year long record of basaltic volcanism near Yucca Mountain, DOE uses the past 5 million years of the record to conclude both that volcanism near Yucca Mountain is decreasing in volume and number of events and that future eruptions are very unlikely. These observations do not consider the entire history of volcanism as recorded in surface outcrops and core from borings about Yucca Mountain that define two super-episodes of volcanism. Rather than a single, slowly dying igneous system, volcanism near Yucca Mountain occurred in two periods over the last 11 million years, each lasting 3 to 4 million years. Both super-episodes show chemical signs of a waning volcanic system toward the end of their history. The implication is that volcanism near Yucca Mountain does not record a single waning system but represents igneous activity that periodically starts and stops. Two periods of volcanic activity have already occurred at Yucca Mountain. Consideration of the complete record would support the proposition that the eruption at Lathrop Wells at 78,000 years ago represents the beginning of a third super-episode.

**NEV-SAFETY-152 - FOCUS ON UPPER CRUSTAL EXTENSION PATTERNS:**

Understanding the process of volcanism is critical for calculating the probability of future events. DOE clearly lacks this understanding and instead focuses on upper crustal extension patterns to explain volcano location and the timing of volcanic events. Contrary to DOE's arguments, the primary controls of the location of a volcanic field lie in the earth's mantle. The location of thermal anomalies, the topography at the base of the lithosphere, and patterns of mantle flow together control the location and timing of volcanism. Upper crustal structures and extension rates may be important for controlling the location of volcanoes whose magma resides for periods of time in the crust, but have less of an effect for basaltic magmas that rise quickly from their mantle source without stalling for long periods of time in the crust.

**NEV-SAFETY-153 - EXCLUSION OF DEATH VALLEY FROM VOLCANISM CALCULATIONS:**

DOE's Safety Analysis Report (SAR) Subsections 2.2.2.2, 2.2.2.2.3.1, 2.3.11.2.1.1, and 2.3.11.2.2.5 claim that the essential characteristics of the age and location of basaltic volcanism near Yucca Mountain were fundamentally understood when the PVHA was completed in 1996;

however, this statement ignores volcanic activity in the Greenwater Range just 20 km south of buried basalt in Amargosa Valley. Volcanic rocks in the Greenwater Range have chemical, mineralogical and age similarities to those near Yucca Mountain and clearly represent the southern extension of the field of volcanoes about Yucca Mountain. This larger volcanic field, therefore, should be considered in any calculation of repository disruption by volcanic activity.

**NEV-SAFETY-154 - IGNEOUS EVENT PROBABILITY FOR 10,000 YEARS AND 1,000,000 YEARS:**

Despite legal requirements to consider compliance periods greater than 10,000 years, DOE essentially ignores this requirement in the license application. Compliance periods greater than 10,000 years are only briefly mentioned and DOE claims in SAR Subsections 2.3.11 that because of the overall volcanic stability of the region (in terms of recurrence rate, eruptive style, volume, and location relative to the repository) over the last 2 million years, this same estimated annual frequency of intersection is also valid for evaluations over time periods that extend beyond 10,000 years. This statement does not consider deep melting models or the entire period of volcanism from 11 million years ago to the present.

**NEV-SAFETY-155 - 11-MILLION YEAR VS. 5-MILLION YEAR VOLCANISM DATA:**

Contrary to the claim in SAR Subsection 2.3.11.2.1.1 that the chemistry of buried basalt bodies is essentially the same as basalt exposed on the surface, buried basalt contains rock types not found or are rare at the surface. Buried basalt observed in core from borings in Crater Flat, Amargosa Valley and Jackass Flat reveal compositions not found or rare at the surface. Combining core with surface data reveals a geologic history back to 11 million years characterized by two super-episodes of volcanism each independently showing major and trace element signs of a developing and then dying system that may be replicated in the future. DOE ignores the rich data set obtained from core and relies on the chemistry of surface basalt erupted over the past 5 million years to make assumptions about the frequency of future events. This approach obscures long-term trends and provides an inaccurate prediction of future events.

**NEV-SAFETY-156 - ALTERNATIVE IGNEOUS EVENT CONCEPTUAL MODELS:**

SAR Subsection 2.2.2.3 and related subsections indicate that the license application (submitted in 2008) relies on the results of the 1996 report of Probabilistic Volcanic Hazard Assessment (PVHA) expert panel report released in 1996 as the basis for hazard assessment. Except for new work on the tectonics of the Crater Flat area and a brief mention of buried basalt, DOE has not updated the PVHA findings, but still bases its conclusions on this outdated report. The PVHA panel of experts based their results on the assumption of shallow melting to produce basaltic magma. Using this assumption results in an underestimate of the probability of repository disruption, and at the least, the alternative model whereby melting to produce basalt occurs in the asthenosphere should have been included in the total systems performance assessment.

**NEV-SAFETY-157 - IGNEOUS EVENT DATA IN THE TSPA:**

SAR Subsection 2.2.2.3 and related sections indicate that the license application relies on the results of the Probabilistic Volcanic Hazard Assessment expert panel report released in 1996 (PVHA) as the basis for hazard assessment. Except for new work on the tectonics of the Crater Flat area and a brief mention of buried basalt, DOE has not updated the PVHA findings, but still bases its conclusions on this outdated report. Much research has been done since 1996 by DOE, NRC, the State of Nevada and Clark County that is pertinent to hazard analysis but is not considered in the license application.

**NEV-SAFETY-158 - GEOPHYSICAL DATA IN DOE'S VOLCANIC MODEL:**

Although geophysical studies are mentioned in SAR Subsection 2.2.2.1.2 as a way to identify and characterize the orientation of faults in the subsurface, the license application lacks geophysical data to document models proposed by DOE that use upper crustal structure and the local stress field to explain the location of volcanoes in the Yucca Mountain area. Geophysical studies are also critical for testing and comparing deep versus shallow melting models by revealing the location of low-viscosity zones (hot zones) in the crust and mantle that might contain magma or rock close to the melting temperature. Furthermore, identifying patterns of mantle circulation and the nature of the topography at the base of the lithosphere are important for describing the geometry of volcanic source zones which ultimately control the location and shape of volcanic fields at the surface.

**CONTENTIONS PREPARED FOR INYO COUNTY**

**INY-SAFETY-2: FAILURE TO ADEQUATELY DESCRIBE AND ANALYZE THE VOLCANIC FIELD IN THE GREENWATER RANGE IN AND ADJACENT TO DEATH VALLEY NATIONAL PARK:**

SAR Subsections 2.2.2.2, 2.2.2.2.3.1, 2.3.11.2.1.1, and 2.3.11.2.2.5 claim that the essential characteristics of the age and location of basaltic volcanism near Yucca Mountain were fundamentally understood when the probabilistic volcanic hazard analysis ("PVHA") was completed in 1996. (The PVHA described the estimated annual frequency of intersection of the repository by an igneous event.) The claim in the SAR ignores volcanic activity in the Greenwater Range just 20 km south of buried basalt in Amargosa Valley and within approximately 50 kilometers (30 miles) of the proposed repository site. The volcanic rocks in the Greenwater Range have chemical, mineralogical and age similarities to those near Yucca Mountain and clearly represent the southern extension of the field of volcanoes about Yucca Mountain. This larger volcanic field, therefore, should be considered in any calculation of repository disruption by volcanic activity.

**<u>INY-NEPA-2:</u> FAILURE TO ADEQUATELY DESCRIBE AND ANALYZE THE POTENTIAL CUMULATIVE ENVIRONMENTAL IMPACTS RESULTING FROM IGNEOUS ACTIVITY THAT DISRUPTS THE REPOSITORY:**

The volcanic rocks in the Greenwater Range have chemical, mineralogical and age similarities to those near Yucca Mountain and clearly represent the southern extension of the field of volcanoes about Yucca Mountain. This larger volcanic field, therefore, should be considered in any calculation of repository disruption by volcanic activity. As a result of ignoring these volcanoes, the applicant underestimates the probability of igneous activity disrupting the repository, likely by two or more orders of magnitude. Thus, neither the Final EIS nor the Final SEIS adequately describe the potential cumulative environmental impacts that may result from igneous activity disrupting the repository and are inadequate pursuant to NEPA and NRC regulations at 10 CFR 51. As a result, the FEIS and Final SEIS should not be adopted by the NRC.

**ATTACHMENT V**

**PRESENTATION TO THE AMERICAN NUCLEAR**

**SOCIETY WINTER MEETING, NOVEMBER 2016**

# Getting Beyond Yucca Mountain

Robert Halstead
Nevada Agency for Nuclear Projects

American Nuclear Society Winter Meeting
Las Vegas, Nevada

November 7, 2016

Visit our website at http://www.state.nv.us/nucwaste/

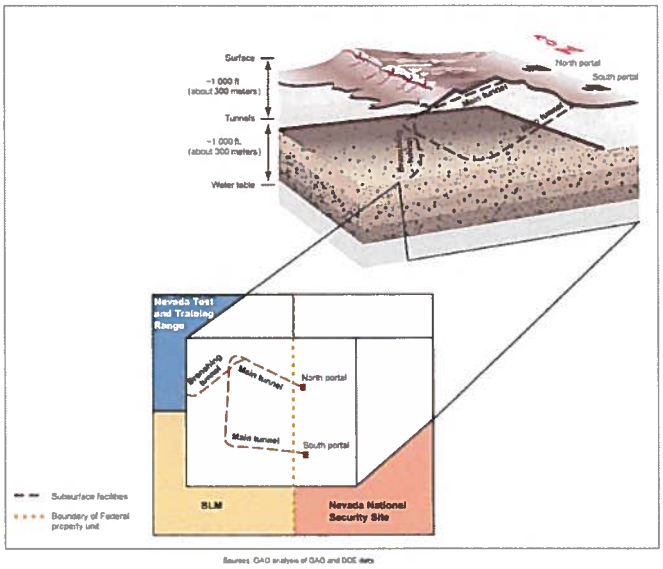
## Feasibility of Yucca Mountain Project Restart is Uncertain at Best

- Congressional supporters say they will restart DOE program and provide funds for NRC licensing proceeding in 2017
- Estimated need for licensing: DOE $1.66 billion, NRC $330 million
- Congress will have difficulty providing more than symbolic funding for Yucca Mountain (budget restrictions, fee collection suspended)
- DOE Yucca Mountain Program no longer exists and creating new program would be legally, financially, and logistically difficult
- What exists today at Yucca Mountain (next slide)

# What Exists Today at Yucca Mountain

Only 5-Mile Exploratory Tunnel that cannot be used for storage or disposal

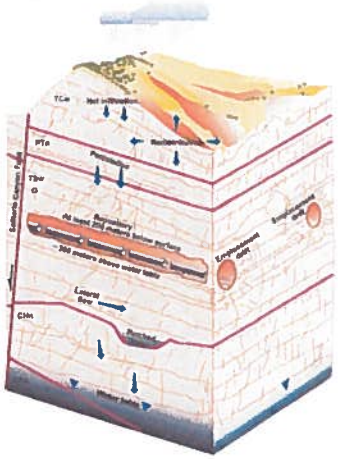
- No waste disposal tunnels (Over 40 miles needed beyond current 5 miles)
- No waste handling facilities
- No state water permit
- No construction authorization
- No railroad
- Expired BLM land withdrawal



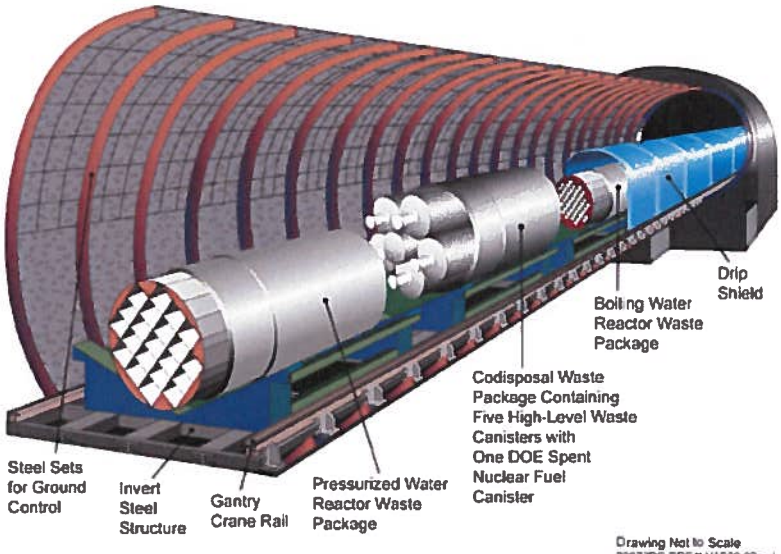

# Yucca Mountain Project Restart is a Bad Idea

- Nevada Gov. Brian Sandoval, AG Adam Laxalt, and the Commission on Nuclear Projects are strongly opposed to Yucca Mountain
- State of Nevada plans to fully adjudicate 218 admitted contentions in opposition to DOE license application (LA) and submit 30-50 new contentions based on new information and NRC EIS Supplement
- Nevada estimates over 400 hearing days needed to adjudicate 250 contentions, plus time for discovery, motions and appeals, so legally mandated proceeding could require 4-5 years
- Nevada contentions challenge all aspects of DOE LA (next slides)

# Contentions Challenge Site Suitability



# Contentions Challenge Disposal Concept
# Titanium Drip Shields



# Contentions Challenge Disposal Concept

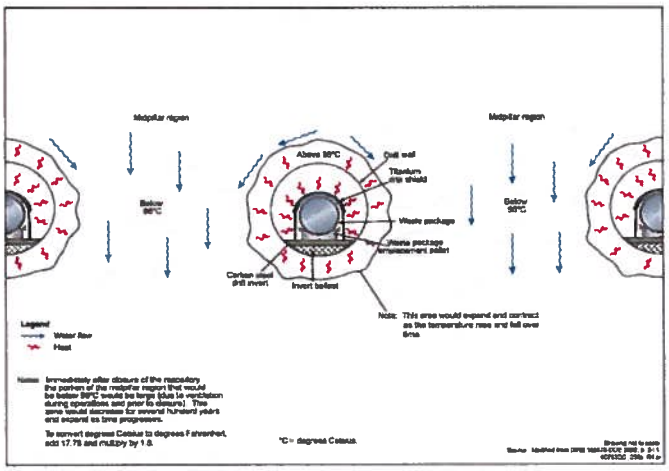
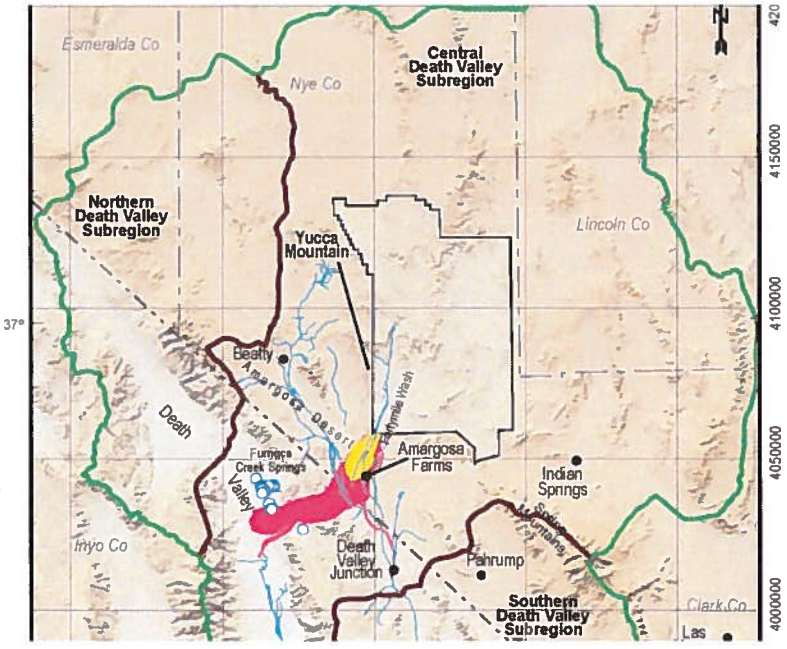


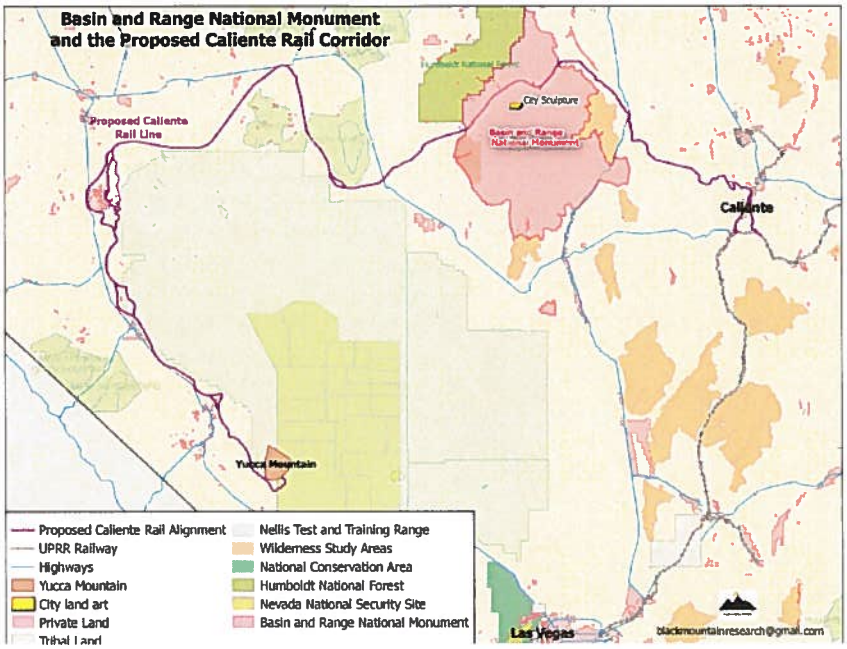

Figure 5-8. Management of waste package emplacement using thermal energy density (artist's concept).

# Contentions Challenge Groundwater Impacts (NUREG-2184)

Figure 2-5, Groundwater Flow Paths for Contaminants for the Pumping (Yellow) and No Pumping (Fuchsia) Analysis Cases

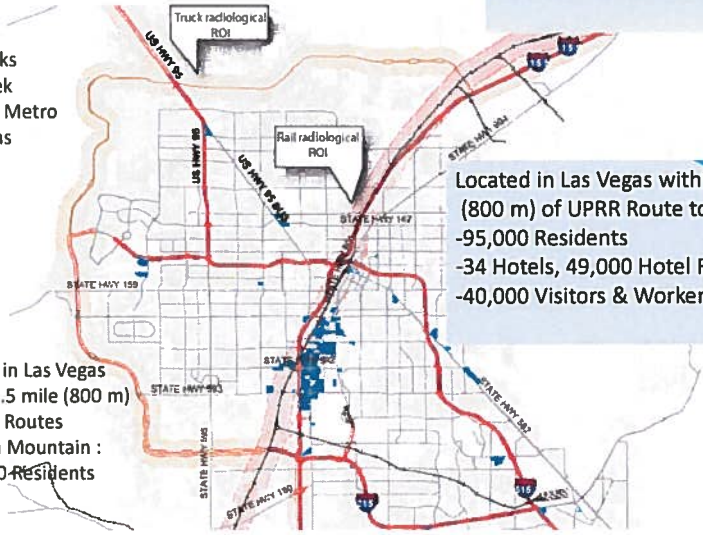
# Contentions Challenge Rail Access




# Contentions Challenge Las Vegas Impacts

**Rail Casks through Las Vegas**
to Yucca Mountain via Caliente
Minimum – 8% Maximum – 79%
4 - 110 trainloads per year

1-2 Trucks per Week through Metro Las Vegas




Located in Las Vegas within 0.5 mile (800 m) of UPRR Route to Caliente :
-95,000 Residents
-34 Hotels, 49,000 Hotel Rooms
-40,000 Visitors & Workers

Located in Las Vegas within 0.5 mile (800 m) of Truck Routes to Yucca Mountain :
-113,000 Residents

# Nuclear Waste Informed Consent Act

- S. 691 (Reid & Heller), H.R.1364 (Titus & Heck), The Nuclear Waste Informed Consent Act: Extend consent to Nevada by restricting NRC issuance of construction authorization
- S.1825, The Nuclear Waste Informed Consent Act (Reid & Heller): Extend consent to Nevada by restricting NW Fund expenditures
- Parties to written consent agreement with Secretary of Energy: (1) Governor of the host State; (2) each affected unit of local government; (3) any unit of general local government contiguous to the affected unit of local government if spent nuclear fuel or high-level radioactive waste will be transported through that unit of general local government for disposal at the repository; and (4) each affected Indian tribe

# Getting Beyond Yucca Mountain - What U.S. Should Do With Nuclear Waste

- Walk away from Yucca Mountain
- Restructure nuclear waste program as recommended by BRC (2012)
- Reinstate NWF fee and take title to SNF at reactors
- Address stakeholder concerns about at-reactor storage
- Implement NAS (2006) and BRC transportation recommendations
- Implement BRC recommendations about consolidated interim storage
- Implement BRC recommendations about generic repository performance standards and repository consent-based siting