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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LIST OF ACRONYMNS

ADAMS – Agency-Wide Documents Access and Management System (NRC)

ASLB – Atomic Safety and Licensing Board (NRC)

BLM – Bureau of Land Management (U.S. Department of Interior)

BRC – Blue Ribbon Commission on America's Nuclear Future

CAB – Construction Authorization Board (NRC)

CADC – U.S. Court of Appeals for the District of Columbia Circuit

CPCN – Certificate of Public Convenience and Necessity

DOE – U.S. Department of Energy

EIS – Environmental Impact Statement

EPA – U.S. Environmental Protection Agency

FEIS – Final Environmental Impact Statement for Yucca Mountain (2002)

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

HLW – High-Level Radioactive Waste

LA – License Application for Yucca Mountain (DOE application pending before the NRC)

LSN – Licensing Support Network (NRC)

MTHM – Metric Tons of Heavy Metal

MTU – Metric Tons of Uranium

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 for Yucca Mountain (2008)

SER – Safety Evaluation Report (NRC)

SNF – Spent nuclear Fuel

STB – U.S. Surface Transportation Board (U.S. Department of Transportation)

WEIB – Western Interstate Energy Board

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Introduction – Current Yucca Mountain Developments

In its last report to the Governor and Legislature in January 2017, the Nevada Commission on Nuclear Projects described the U.S. Department of Energy's (DOE) decision to terminate the unworkable Yucca Mountain repository project and replace it with a new consent-based site selection program. The 2017 report described the U.S. Nuclear Regulatory Commission's (NRC) resumption of the Yucca Mountain licensing proceeding, with limited funds, and without DOE's active participation. NRC staff issued the Yucca Mountain Safety Evaluation Report (SER) in 2015, issued a Supplement to DOE's EIS on Yucca Mountain Groundwater Impacts in 2016, and completed other pre-adjudicatory tasks ordered by the Commission. DOE provided groundwater information requested by NRC staff, but otherwise did not actively participate in the licensing proceeding.

DOE's policy has changed dramatically since January 2017. Secretary of Energy Rick Perry has advocated full resumption of the DOE Yucca Mountain repository program and the NRC licensing proceeding. The Trump Administration has requested new funding for DOE and for NRC to resume the adjudicatory portion of the licensing proceeding and has emphasized the importance of Yucca Mountain in its selection of new NRC Commissioners. Yucca Mountain advocates in Congress approved the new NRC Commissioners, and proposed new funding for licensing at even higher amounts than requested by the Administration. The House of Representatives in 2018 passed legislation that would have amended the Nuclear Waste Policy Act (NWPA) to speed up licensing and undercut Nevada's ability to protect its safety and environment. The efforts were strongly supported by the nuclear industry. Nevada succeeded in preventing these restart efforts in 2017 and 2018. New efforts to force Yucca Mountain forward are again underway in 2019, and these efforts appear likely to continue into 2020.

The 2018 elections brought in a new Nevada Governor and Attorney General, and nationally brought Nevada's congressional delegation into greater prominence in both the House of Representatives and the U.S. Senate. In his first State of the State speech, in January 2019, Governor Steve Sisolak declared: "…let me make something perfectly clear – not one ounce – not one ounce of nuclear waste will ever reach Yucca Mountain while I am Governor. Not on my watch. We will work hand-in-hand with our congressional delegation to stop the federal government from turning our state into their nuclear waste dump. It is not going to happen."[1]

In letters to Congressional committees currently considering nuclear waste authorizing legislation, Governor Steve Sisolak has stated Nevada's opposition to Yucca Mountain, and Nevada's support for consent-based siting as proposed by the Blue Ribbon Commission (BRC) on America's Nuclear Future. (Attachments 1 and 2)

Attorney General Aaron Ford fully supports Nevada's continued opposition to the DOE license application in the NRC licensing proceeding, and Nevada's litigation against DOE and NRC. The Nevada Legislature has consistently appropriated the funding requested by the Governor and the Attorney General for licensing, litigation and legislation analyses, and has gone on record in two joint resolutions opposing the Yucca Mountain project and shipments of high-level nuclear waste and defense plutonium to Nevada. (Attachments 3 and 4) The work of Nevada's congressional delegation is addressed in the next chapter of this report. In this section we address the Trump Administration budget requests and policy statements, and the ongoing NRC licensing proceeding.

The Trump Administration and the 115th Congress

Pro-Yucca Mountain forces in the nuclear industry revealed their intent to resume their three decade's quest for a nuclear waste repository at Yucca Mountain almost immediately after the November 2016 elections. On November 14, 2016, The Wall Street Journal published an editorial entitled "Harry Reid and the Horse He Rode In On" that stated bluntly, "Trump should revive the nuclear repository at Yucca Mt. in Nevada. … Mr. Trump owes no political debt to Nevada…."[2]

The Trump Administration moved quickly to revive Yucca Mountain, following the path recommended by the Wall Street Journal editorial. Former Texas Governor Rick Perry, confirmed as Secretary of Energy in March 2017, quickly announced his support for resumption of the Yucca Mountain licensing proceeding. Concurrently, President Trump designated Commissioner Kristine Svinicki, a member of the NRC since 2008, as Chairman.

Soon thereafter, President Trump's Budget Blueprint proposed $150 million to restart Yucca Mountain licensing. On March 27, 2017, Secretary Perry traveled to Nevada for an unannounced visit to Yucca Mountain, followed by a meeting with then-Governor Brian Sandoval in Las Vegas. Following the meeting, Governor Sandoval issued a strongly worded statement saying, "I reaffirmed my unwavering opposition to any potential progress toward developing the site as a potential destination for high-level nuclear waste." In setting out

Nevada's position, Governor Sandoval said, "Nevada will oppose any federal government effort to dump nuclear waste here that will threaten our health and economy for centuries to come. We will leave no stone unturned as we pursue all viable options to defeat this ill-conceived project, including litigation."[3]

Under this direction, the Agency has continued to oppose Yucca Mountain in the licensing proceeding, through legislation, and through litigation. Over the first 9 months of 2017, the pro-Yucca forces concentrated their congressional efforts on actions to provide new funding for DOE and NRC, and to amend the federal Nuclear Waste Policy Act. The Administration's detailed budget request for DOE ($120 million) and NRC ($30 million) for Fiscal Year 2018 was released in May 2017 and was approved by the House of Representatives on July 27, 2017. The Senate, however, rejected funding for Yucca Mountain on July 20, 2017. Nevada's U.S. Senators Dean Heller and Catherine Cortez Masto were able to defeat subsequent efforts to provide new funds for Yucca Mountain on continuing resolution appropriations for the remainder of FY 2018 (October 1, 2017 through September 30, 2018).

Beginning in April 2017, Rep. John Shimkus of Illinois, began a concerted effort to jump-start the Yucca Mountain project. In May 2018, Shimkus' bill, H.R. 3053, the Nuclear Waste Policy Amendments Act of 2018, passed the House of Representatives by a recorded vote of 340-72. Nevada's four House Members voted against passage. A substitute amendment sponsored by Rep. Dina Titus, to strike the language of H.R. 3053 and adopt the Nuclear Waste Informed Consent Act, was defeated on a recorded vote of 80-332. On May 14, 2018, H.R.3053 was received in the Senate, and referred to the Committee on Environment and Public Works. Senators Heller and Cortez Masto worked in opposition to H.R. 3053, and no further action occurred in the Senate. The Shimkus bill expired at the end of the congressional session.

The battle over new funding to support restart of the Yucca Mountain licensing proceeding resumed in March 2018 when the Administration again requested $120 million for DOE, and requested an increased amount, $47.7 million, for NRC licensing activities in Fiscal Year 2019. The House Appropriations Committee voted in May 2018 to give DOE $220 million ($100 million more than requested) and NRC $47.7 million (as requested) for Yucca Mountain licensing in FY 2019. Senators Heller and Cortez Masto were again able to convince the Senate to provide no new funding in the July 2018 Conference Committee Report, for the FY 2019 Minibus containing Energy and Water Development (EWD) appropriations. Then on September

21, 2018, H.R. 5895, the bill containing the FY 2019 Energy and Water Development appropriation passed the Senate 92-5, passed the House 377-20, and was signed by President Trump during a visit and campaign stop in North Las Vegas. The final version of the bill contained no funds for Yucca Mountain. Rep. Shimkus responded in September 2018 with a vow that he would continue to push for Yucca Mountain appropriations.

At the end of calendar year 2018, DOE still had available about $25 million for Yucca Mountain from prior year appropriations. Additionally, the FY 2019 EWD appropriations bill provided DOE with $63.9 million for spent nuclear fuel research and development, including $22.5 million for unspecified waste management system activities. These funds could possibly be used for spent nuclear fuel storage, transportation, and disposal canister design activities that would support a restarted Yucca Mountain repository program.

The 116th Congress convened on January 3, 2019. The Democratic Party held a majority in the U.S. House of Representatives (235-199-1 vacant). The new Democratic majority in the House resulted in new House leadership and new committee chairs and ranking members for the House Committee on Energy and Commerce, the House Subcommittee on Environment and Climate Change, and the House Committees on Appropriations, Ways and Means, and Rules. The Republican Party continued to hold a majority in the U.S. Senate (53-45-2 Independent). There were few changes in leadership and ranking members for the Senate Committees on Energy and Commerce, Environment and Public Works, Appropriations, and their subcommittees of jurisdiction.

In March 2019 the Trump Administration budget for Fiscal Year 2020 (beginning October 1, 2019) requested $154.5 million for Yucca Mountain and high-level nuclear waste activities, $116 million for DOE and $38.5 million for NRC. The DOE request included $86.484 million for resumption of the Yucca Mountain site licensing activities; $6.516 million to develop interim storage capability for SNF; and $23.0 million in program direction support for both Yucca Mountain licensing and interim storage. Overall, DOE requested 83 Federal FTEs (full-time equivalents) to be employed in Nevada and at DOE headquarters in Washington, and $43.95 million for contracts with National Laboratories ($35.43 million for Sandia National Laboratories).[4] The NRC budget request included funding for 77 FTEs plus contract support and travel, to support restart of the adjudicatory proceeding, infrastructure for hearings and IT capabilities, and associated rulemakings.[5]

DOE explained its approach to preparing for licensing resumption: "As the license applicant to the NRC, the Department of Energy (DOE) must comply with the NRC's process and schedule. Moreover, DOE has the burden of proof in the hearing process. To meet this burden effectively and provide NRC an appropriate and sufficient basis on which it can fulfill its statutory obligations, the DOE Office of the General Counsel (GC) staff will represent DOE in the administrative litigation aspects of the licensing process. The GC also will support outside legal counsel. Federal staff will address technical issues with the support of contractors and scientists from entities such as the National Laboratories. Likely activities in support of the licensing process will include:

- Appearance before the Atomic Safety and Licensing Boards (ASLBs) as issues are identified and addressed through interactions with the regulator and intervenors in the adjudicatory hearing process;
- Identification of likely topics for interrogatories;
- Response to admitted contentions;
- Preparation of anticipatory response plans, responses, and draft testimony and assistance in the preparation of witnesses; and
- Presentation of affirmative case in support of license application and demonstration of compliance with applicable regulatory requirements."

DOE also sought funding for plant infrastructure at the Yucca Mountain site to support continuation of performance confirmation testing and to allow access to the site at the request of NRC staff and intervenors. "Activities in FY 2020 will include maintaining the safety at the Yucca Mountain site at appropriate levels to support performance confirmation and site access requests in support of the NRC licensing process." The DOE project support portion of budget includes general project services, information management, and compliance with the National Environmental Policy Act (NEPA).[6]

On May 15, 2019, the House Appropriations Subcommittee adopted the FY 2020 Energy and Water Development appropriations bill with no funding for DOE Yucca Mountain activities. On May 21, 2019 the House Appropriations Committee defeated an amendment by Rep. Mike Simpson (R-ID) that would have added Yucca Mountain funding, at a lesser amount than requested by the Administration, by 27-25, with Rep. Mark Amodei of Nevada voting against Simpson's amendment.[7] That bill, H.R. 2960, was passed by the full committee 31-21,[8] and later passed the House as part of a so-called "mini-bus" package, H.R. 2740, including two other appropriations bills, by a vote of 226-203, June 21, 2019.[9]

On September 12, 2019, the Senate Appropriations Committee marked up the EWD appropriations bill, and voted 31-0 to pass a bill which did not contain the Administration's Yucca Mountain requests for DOE and NRC.[10] The bill did authorize DOE to carry out a pilot interim storage program for SNF, using consent-based siting and requiring public input, and authorized DOE to store SNF at facilities licensed by NRC. [Section 306] A government shutdown was averted in late September 2019 when the House and Senate passed a continuing resolution to fund federal operations through November 21, 2019, with no new funding for Yucca Mountain.[11] Yucca proponents have promised that they will continue to seek new funding for the remainder of FY 2020, which began October 1, 2019.

The NRC's Yucca Mountain Licensing Process

DOE sought to terminate the Yucca Mountain program in 2010 and requested no new funding for FY 2010. Congress provided only $10 million for NRC in FY 2011. The NRC voted to suspend the licensing proceeding in September 2011 due to lack of funding. On August 13, 2013, the U.S. Court of Appeals for the District of Columbia Circuit (CADC) issued a decision (authored by now Supreme Court Justice Brett Kavanaugh) in *in re Aiken County*, 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.[12] The ruling was a split decision with Judge Merrick Garland asserting in a strongly-worded dissent that NRC was being ordered to do a "useless thing." The court was ordering NRC to restart a proceeding everyone agreed could not be sustained, let alone completed, without substantial new congressional appropriations.[13]

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.[14] Since then, NRC staff has completed several tasks, as directed by NRC, including completing the Safety Evaluation Report (SER), preparing an Environmental Impact Statement Supplement on groundwater issues, and preparing a lessons-learned report documenting the NRC's experience in the licensing process thus far. Over the past two years, NRC has directed its staff to complete the following two tasks:

1. Hold a virtual meeting of the Licensing Support Network Advisory Review Panel (LSNARP) to provide information to, and gather input from, advisory panel members and the public regarding reconstitution of the LSN or a suitable replacement system.

(The LSN is an electronic database designed to provide access to all relevant Documentary Material to the parties in the Yucca Mountain licensing proceedings.)

2. Gather preliminary information regarding potential adjudicatory hearing venues.

Nevada sent two official representatives to a February 2018 meeting of the LSNARP at NRC Headquarters in Rockville, MD. Additionally, other Nevada representatives of Counties, Native American Tribes, and citizen groups, and members of Nevada's licensing team, participated in the virtual meeting arranged by the NRC. Nevada submitted written and oral comments identifying the shortcomings of the current NRC Agency-wide Documents Access and Management System (ADAMS) as a replacement for the previous LSN and described the necessary requirements for an adequate LSN should licensing resume. It is not yet clear whether NRC's ADAMS will be an adequate and accessible replacement for the defunct LSN. NRC staff recommended that an additional $212,000 of previously appropriated Nuclear Waste Fund monies be authorized to improve the LSN Library user interface, but the majority of the Commission disapproved the staff recommendation.[15]

Also unresolved is the potential adjudicatory hearing venue. As of October 15, 2018, the NRC Commission approved the NRC staff's recommendation that the Commission defer further action regarding a Nevada hearing facility,[16] until (and if) new funding for licensing work is available.[17] Nevada remains adamantly opposed to any venue located out of the State of Nevada if licensing resumes.

At the end of July 2019, the NRC had $434,262 in total funds remaining from prior year congressional appropriations from the Nuclear Waste Fund (NWF), including $26,223 of unexpended obligations.[18] Over the past seven months, NRC's Yucca Mountain expenditures have hit an all-time low, averaging less than $1,200 per month.[19] Without an infusion of new funding from Congress, little can be accomplished with NRC's remaining funds. To that end, the Commission has indicated it intends to reserve remaining funds for possible or anticipated litigation expenses[20]and plans no new licensing activities pending further action by Congress.

Despite the futility of restarting the adjudicatory proceeding without additional funding, the State of Texas unsuccessfully attempted to force this action by NRC and DOE through legal action. In March 2017, the state of Texas filed a writ of mandamus in the 5th circuit appellate court against DOE, NRC, and other federal respondents for alleged violations of the Nuclear Waste Policy Act. See *Texas v. United States*, No. 17-60191 (5th Cir. 2017). Specifically,

Texas asserted that NRC and DOE's failure to move forward with the Yucca Mountain licensing proceedings and DOE's consent-based siting initiatives violated the NWPA.

Some of the requests for relief, if granted, were particularly concerning for Nevada. The Texas lawsuit sought to force the federal government to cut short the Yucca Mountain licensing process and put an end to the U.S. Department of Energy's (DOE) promising consent-based siting initiative for nuclear facilities. Not only was Texas attempting to circumvent Congressional funding limitations through the courts, but Texas also sought to drastically diminish Nevada's ability to present its opposition to DOE's license application by requesting the court establish a deadline within six to twelve months to complete the Yucca Mountain adjudicatory hearings.

Because of Nevada's unique interests in the case as the potential host site of the Yucca Mountain repository, Nevada filed and was granted a petition to intervene. The Nevada motion to intervene noted that the State has compelling interests "in protecting the health and safety of its citizens from radiological injuries and in protecting its lands and groundwater from radioactive contamination." The motion to intervene also noted that transporting nuclear waste across Nevada poses substantial risks to the State, will increase radiation exposure to workers and the general public, and create the risk of severe accidents and sabotage incidents. "The cleanup costs and other economic impacts of transportation events resulting in the release of radioactive materials could, by DOE's own estimates, amount to hundreds of millions and even billions of dollars."

Nevada successfully defeated Texas's attempt to force a licensing restart. Based on Nevada's motion, the court determined that it lacked jurisdiction under the NWPA and granted Nevada's motion to dismiss.[21] If Texas had been successful, the end result would have been to short-circuit the current legislative process, hamper Nevada's ability to present its case in full and fair licensing and adjudicatory hearings, and ultimately impose a flawed and dangerous nuclear waste dump on Nevada and its citizens. This victory illustrates Nevada's unified fight to protect its citizens from all attempts to force forward the proposed Yucca Mountain nuclear waste dump.

Despite Congress's continued stalemate on funding the Yucca Mountain licensing proceeding, Nevada's costly opposition is forced to endure using state funds in the face of the continued political and legal pressures to restart the licensing proceeding. In total, Nevada has received $17.9 million in appropriations from the Federal Nuclear Waste Fund for Nevada's

participation in Yucca Mountain licensing activities, but the last such appropriation was in 2010. These federal funds have now been expended. The Nevada Legislature and elected officials remain committed to funding the State's opposition to this ill-conceived project. Since 2008, Nevada has expended $26.4 million in state funds on technical, policy, legal and licensing work related to Yucca Mountain. In the June 13, 2019 House Subcommittee Hearing on "Cleaning Up Communities: Options for the Storage and Disposal of Spent Nuclear Fuel," Representative John Shimkus (R-IL) implied that Nevada was relying solely on federal funds to fight the federal Yucca Mountain project. This is plainly not true. The Legislature has consistently dedicated substantial state resources to prevent Nevada from becoming the nation's nuclear waste dump.[22]

Nevada's Yucca Mountain Licensing Work over the Past Three Years

Nevada recommitted the efforts of its expert legal and technical team by holding a two-day conference in Las Vegas June 28-29, 2017. Over 20 technical experts and 10 attorneys were in attendance. The meetings focused on new contention work, legal strategy, and preparation for an anticipated restart of the Yucca Mountain Licensing adjudication proceedings. While many of DOE's and NRC's Yucca Mountain experts have moved on to other agencies and other work over the years, Nevada's team of legal and technical experts has remained substantially intact.

Over the past two years, Nevada has been preparing to adjudicate its already admitted contentions as well as preparing new contentions. The contentions are Nevada's challenges to DOE's Yucca Mountain License Application (LA), submitted to the NRC licensing boards, which address the serious deficiencies in the LA. The total number of the State's admitted contentions before the NRC is an unprecedented 218. A total of 299 contentions from all parties to the licensing proceeding have been accepted by the NRC licensing boards to date. The majority of the contentions are technical in nature and range from flaws in the overall performance assessment model and calculations to very 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 challenge the adequacy of DOE's repository and transportation environmental impact assessments.

The brief discussion above describes, in very general terms, some of the challenges Nevada has made to DOE's license application and related environmental documents.

However, we should not lose focus on the unprecedented depth and breadth of Nevada's concerns about the safety of the proposed repository at Yucca Mountain. These concerns are set forth in over two-hundred admitted safety contentions, each of which documents a violation of the NRC's safety regulations applicable to Yucca Mountain. These safety contentions are critical to Nevada's case against the license application because a "win" on any one of them will lead the NRC to deny the license application.

Nevada's admitted safety contentions have all been found to be fully supported by the necessary facts and expert affidavits. These include: (1) three challenges regarding the absence of emergency plans, plans for reporting defects and non-compliances, and quality assurance programs for repository operation; (2) a challenge to DOE's ability to implement an adequate quality assurance program; (3) eleven challenges to DOE's evaluation of future climate change, including global warming; (4) twenty-two challenges to DOE modeling of water infiltration; (5) thirteen challenges to DOE's modeling of water flow through the upper unsaturated zone; (6) six challenges to DOE's analysis of the geochemistry of the unsaturated zone; (7) six challenges to DOE's evaluation of seepage in the waste placement tunnels; (8) seven challenges to DOE's evaluation of the geochemistry of the waters and deposits in the emplacement tunnels; (9) forty-one challenges to DOE's evaluation of corrosion of the waste packages and drip shields; (10) two challenges to DOE's evaluation of waste dissolution; (11) six challenges to DOE's modeling of the movement of wastes through the saturated zone below the repository; (12) four challenges to how DOE calculated radiation dose; (13) three challenges to DOE's evaluation of tunnel integrity; (14) twenty-four challenges to DOE's reliance on engineered barriers, including effects of earthquakes and reliance on drip shields; (15) two challenges to DOE's evaluation of human errors; (16) ten challenges DOE's analysis of igneous (volcanic) events; (17) seven challenges to DOE's treatment of uncertainties and support for its performance assessment; (18) a challenge to DOE's evaluation of nuclear criticality; (19) ten challenges to DOE's evaluation of aircraft crash hazards to surface facilities; and (20) eleven challenges regarding DOE's failure to obtain necessary land and water rights.

Nevada may also further adjudicate one important safety contention regarding erosion that was not previously admitted because the CAB erroneously thought it had been solved previously by an NRC regulation. Nevada submitted an expert affidavit and a peer-reviewed scientific study to establish Yucca Mountain would erode down to the level of the emplacement tunnels within

the NRC- and EPA-mandated compliance period, exposing high-level nuclear waste to persons and the environment without any intervening cover or other shielding. The CAB's ruling is subject to administrative appeal.

In anticipation of a restart of licensing, the State has been preparing new contentions based on new information that has come to light since the 2011 suspension of licensing activities. The State anticipates filing at least 30 new contentions should the licensing proceedings restart. A sampling of these new contentions includes:

- The Supplemental Environmental Impact Statement on groundwater should be nullified because the NRC's rules in 10 C.F.R. § 63.24(c) require that DOE shall supplement its EIS where required based on significant new information relevant to its environmental concerns. These rules do not authorize NRC staff to usurp that roll.
- DOE's proposed transport routes fail to acknowledge the July 10, 2015 Presidential designation of the Basin and Range National Monument in Nevada. The new national monument designation would affect between 25 and 30 miles of the proposed Caliente rail alignment identified in the EISs.
- New information from technical expert work done by the State indicates that salt deliquescence increases crevice and pitting corrosion of the waste packaging even at low temperatures contrary to assumptions made in DOE's LA.
- New information from Nevada's technical experts indicates the LA is deficient in failing to include rhyolitic volcanism at Yucca Mountain as an alternative conceptual model.
- The TAD canisters, which are integral to the design, operation and performance of the Proposed Yucca Mountain Repository and central to the LA, are obsolete.

In addition to this sampling of new contentions, the State continues to develop its scientific work in areas such as volcanism, deliquescent salts, and transportation risks which may lead to additional new contentions in the future.

Preparing for an Accelerated Federal Licensing Effort

Without an infusion of funding from Congress, it is unlikely that NRC will restart the suspended adjudicatory proceeding.[23] Nevertheless, the lifting of the suspension and restart of the adjudicatory portion of the full licensing proceeding would start the clock on short, crucial

deadlines. The State of Nevada must be prepared to respond to events on very short notice. The Agency for Nuclear Projects and the Attorney General's Office, together with 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.

Upon resumption of the licensing proceeding, there would be a very short deadline for submitting new contentions and for filing important procedural motions. For example, 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 object to any hearing location out of the State consistent with long-standing NRC policy to conduct licensing hearings in proximity to the affected communities. Nevada is prepared to immediately file a motion on venue should the licensing proceedings restart.

At a minimum, the State estimates that 560 calendar days will be required for hearings to address the over 250 admitted contentions. This figure contrasts sharply with the 90 days allotted from start to finish of hearings in NRC's regulations applicable to a Yucca Mountain proceeding.[24] In addition, preliminary matters such as discovery will consume substantial additional time. The Commission or licensing board (CAB)[25] 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 even the regulatory 90 days, and the commission might order multiple hearings be held before more than one CAB simultaneously.

There are three primary remaining phases of the Yucca Mountain licensing proceeding: discovery, the evidentiary hearings, and the decisions. Discovery had barely begun before the proceeding was stopped when DOE moved to withdraw its LA in early 2010 and would likely be the first step to a restart of the licensing proceedings. Parties and interested governmental participants in the Yucca Mountain licensing proceeding are authorized to obtain discovery regarding any matter, not privileged, which is relevant to the licensing of the Yucca Mountain repository. Discovery principally takes the form of depositions. Once discovery is complete, the evidentiary hearings before the Atomic Safety and Licensing Board(s) and CAB(s) 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 a CAB will make its decisions and recommendation to the Commission regarding issuance of a construction

authorization. After the evidentiary hearings, one or more CABs will issue one or more initial decisions regarding the construction authorization. The Commissioners issue the final agency action based on the CABs' initial decisions and NRC Staff's safety evaluation report (SER). The Commission's final decision is subject to an appeal to an appropriate federal appellate court.

Nevada's licensing team of technical experts and attorneys is continuing to prepare extensive contingency plans in anticipation of a restart of NRC's adjudicatory proceeding, particularly in light of the Trump Administration's 2018, 2019, and 2020 funding requests for the Yucca Mountain licensing proceedings. A restart of the licensing proceedings 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. However, as described above, with the support of the Governor, the Attorney General's Office, and the state legislature, Nevada is prepared to the fullest extent possible for a licensing restart.

Recent Developments at the NRC

While the NRC's Yucca Mountain licensing activities have slowed as the Commission's remaining available funds have been consumed with work conducted since the court-mandated restart of the licensing process, several other developments affecting NRC have the potential to importantly influence the course of the Yucca Mountain proceeding.

New NRC Commissioners

In May 2018, two new individuals were confirmed by the U.S. Senate and sworn in as NRC Commissioners: Annie Caputo, former staff member for the U.S. House Committee on Energy and, and David A. Wright, former member of the South Carolina Public Service Commission. With the addition of Ms. Caputo and Mr. Wright and the re-confirmation of Commissioner Jeff Baran, the Commission had a full complement of members for the first time in over a year.

The addition of David Wright to the Commission has the potential to significantly impact the Yucca Mountain licensing proceeding and Nevada's case. Between 2005 and 2010, Commissioner Wright was a member of the Nuclear Waste Strategy Coalition, an organization that was active in seeking to promote the Yucca Mountain program and critical of DOE's attempts to terminate the Yucca project. Wright was also a member of the South Carolina Public

Service Commission when the State of South Carolina sued the NRC over NRC's decision to suspend the Yucca Mountain licensing proceeding.

In response to Wright's confirmation, Nevada, in June 2018, formally requested that Commissioner Wright recuse himself from any NRC deliberation related to Yucca Mountain. In July, 2018, Commissioner Wright refused Nevada's recusal request, asserting that his public statements were intended as general support for a long-term nuclear waste solution and that he "has not prejudged the technical, legal, or policy issues in the licensing proceeding."

Since the Yucca Mountain licensing proceeding was formally initiated in 2008, no member of the Commission had publicly advocated for advancing the Nevada repository project. Due to concerns about Commission Wright's ability to render fair judgements in the licensing proceeding, the state of Nevada filed a petition for judicial review in the CADC challenging Commissioner Wright's refusal to recuse himself in NRC actions on Yucca Mountain over concerns that his participation would violate the state's due process right "to a neutral and unbiased decision-maker." *See State of Nevada v. NRC, No. 18-1232 (DC Cir. 2018).* The case was dismissed on ripeness grounds thus preserving Nevada's ability to raise the issue of Commissioner Wright's impartiality after a final decision is made.

A new development at NRC is the resignation of Commissioner and former Chairman Stephen G. Burns on April 30, 2019. His term would have expired on June 30, 2019.[26] His position on the Commission is currently vacant.[27]

NRC's Continued Storage Rule

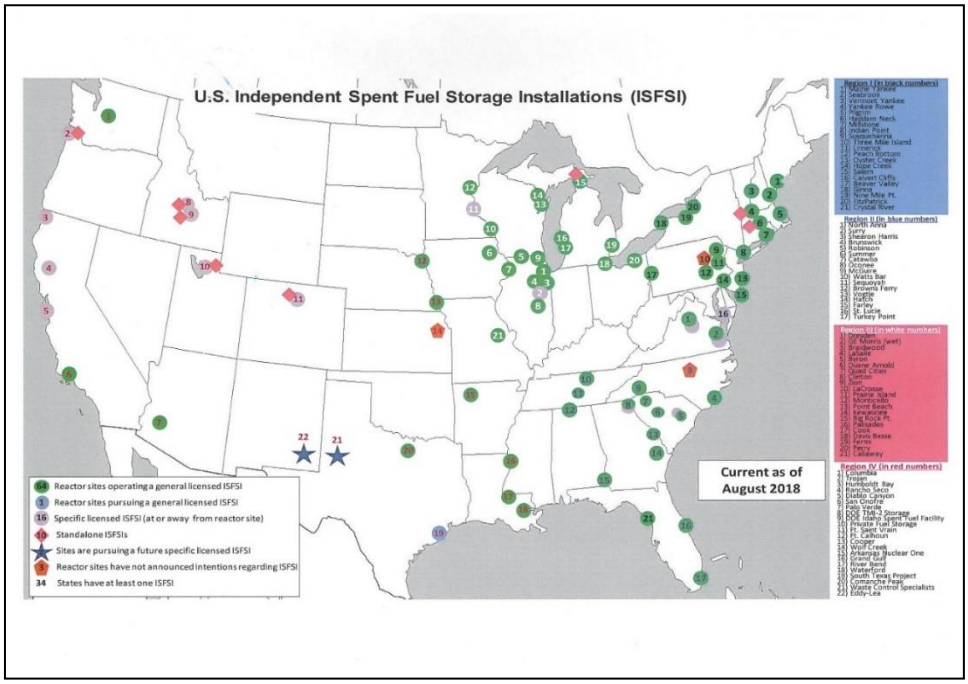
As discussed in the 2017 Commission report, the NRC determined in 2014 that spent nuclear fuel can be safely managed at nuclear reactor locations in dry casks and at consolidated interim storage locations for up to 160 years. The NRC's Continued Storage ruling essentially eliminates the argument that the licensing of Yucca Mountain is required to assure the continued licensing and operating of existing and new commercial nuclear reactors. In light of the NRC's rule, the future of Yucca Mountain and the future of nuclear power are separate issues. In addition, the NRC's generic environmental impact statement that was prepared in support of the Continued Storage Rule negates DOE's 2008 conclusion that constructing and operating a repository at Yucca Mountain is the preferred alternative under NEPA. [28]

NRC's ruling on Continued Storage has significant implications for future nuclear waste legislation as well as for future approaches to nuclear waste management. It means that spent

nuclear fuel from shutdown reactors can be stored on site, and that operating reactors can continue to store spent fuel on-site, for an extended period of time. And it has encouraged major developments regarding consolidated interim storage over the past three years.

Interim Storage Partners (ISP), a joint venture of Orano USA and Waste Control Specialists (WCS), submitted an application to NRC in 2016, and a revised application on June 8, 2018, to construct and operate an interim storage facility for spent nuclear fuel at the existing WCS radioactive waste storage site in Andrews County, Texas. In its application, ISP proposes an initial 40-year license to consolidate and store an eventual total of 40,000 metric tons of SNF, using the dry-storage canister designs developed by Orano and NAC International for at reactor storage in the United States.

Holtec International submitted a license application to the NRC on March 31, 2017, for a consolidated interim storage facility that it calls, "HI-STORE CISF", near the existing Waste Isolation Pilot Plant (WIPP) site in southeastern New Mexico. Holtec is working with the Eddy-Lea Energy Alliance, LLC (ELEA), a local-government consortium formed in 2006. Holtec proposes a storage capacity of 10,000 canisters holding approximately 120,000 metric tons of SNF, and claims that it can operate as a universal storage facility, capable of receiving all of the various dry-storage canisters currently licensed by the NRC for at-reactor storage. Figure 1 shows the locations of the proposed interim storage sites, and the at-reactor storage installations where spent nuclear fuel is currently located.



The Nevada Legislature's Opposition to Yucca Mountain

The 79th Legislature overwhelmingly approved the passage of Assembly Joint Resolution (AJR) 10 which expresses opposition to the development of a repository for spent nuclear fuel and high-level radioactive waste at Yucca Mountain in the State of Nevada. AJR 10 passed the Assembly in April 2017 (32 yeas, 6 nays, and 4 excused) and passed the Senate in May 2017 (19 yeas and 2 nays).[29] The Legislature found that the proposed repository poses an unacceptable hazard to the health and welfare of the people of Nevada and that transportation of spent nuclear fuel and high-level radioactive waste to a repository at Yucca Mountain poses serious and unacceptable risks to the environment, economy and residents of Las Vegas, Nevada, the largest city in the State.

This was the first resolution of the Nevada legislature opposing Yucca Mountain since 2005.[30] In the AJR, the Legislature calls on President Trump to veto any legislation that would attempt to locate any temporary, interim or permanent repository or storage facility for spent nuclear fuel and high-level radioactive waste in the State of Nevada. Further, the Nevada Legislature calls on Rick Perry, the Secretary of Energy, to find the proposed repository for spent nuclear fuel and high-level radioactive waste at Yucca Mountain unsuitable, to abandon consideration of Yucca Mountain as a repository site, and to initiate a process whereby the nation can again engage in innovative and ultimately successful strategies for dealing with the problems of spent nuclear fuel and high-level radioactive waste. This AJR unequivocally communicates to the federal government the State's continued unwavering and unified opposition to a repository at Yucca Mountain. A copy of AJR 10 is included with this report as Attachment 3.

The 80th Legislature overwhelming approved Assembly Joint Resolution (AJR) 1, which expresses opposition to DOE shipments of weapons-grade plutonium from South Carolina to Nevada, and any other high-level radioactive materials, including without limitation, high-level radioactive waste as defined in NRS 459.910, to Nevada, without the State's knowledge or consent. AJR 1 passed the Assembly in February 2019 (34 yeas, 6 nays, 2 excused) and passed the Senate in May 2019 (20 yeas, 0 nays, 1 excused).[31] A copy of AJR 1 is attached to this report as Attachment 4.

Other Developments Related to Yucca Mountain

On February 27, 2019, a new expert study group report on nuclear waste policy with implications for Yucca Mountain was unveiled in Washington DC. About 100 people attended a

meeting in a Senate office building to hear from a bipartisan group convened by Stanford University Center of International Security and Cooperation and George Washington University Elliott School of International Affairs. The report titled, "Reset of America's Nuclear Waste Management Strategy and Policy" is the result of two years of meetings and fact-finding activities.[32] While not a federal government effort, the report makes recommendations to the federal government for new authorizing legislation that would take the nuclear waste program out of DOE and suggests new regulatory standards for geologic repositories. The Reset Report is contradictory regarding Yucca Mountain. On one hand, it recommends that a potential repository host state should have a limited right to veto a site (the veto could be overridden by a supermajority in Congress). On the other hand, disregarding Nevada's longtime opposition, it assumes that the Yucca Mountain licensing proceeding will be restarted.

Another recent indication of Trump Administration and congressional interest in restarting Yucca Mountain is the Yucca Mountain site visit originally planned for March 1, 2019, by Energy Secretary Perry, six members of the U.S. Senate (including Nevada Senators Cortez Masto and Rosen), and a contingent of DOE and congressional staff members. The trip was cancelled on February 27, 2019. Senator Cortez Masto visited Yucca Mountain on May 31, 2019. Another congressional delegation visit, including Rep. Steven Horsford, occurred on August 2, 2019.

Since October 2018, the Agency has provided technical assistance and support for efforts by the Governor and the Attorney General to halt DOE's shipments of weapons grade-plutonium from storage facilities at the Savannah River Site (SRS) in South Carolina, to Nevada for indefinite "staging" at the Nevada National Security Site (NNSS). The Agency's staff and technical experts have provided information regarding the isotopic composition, physical form, and packaging of the weapons-grade plutonium shipped to Nevada; information regarding the risks and impacts associated with the shipments to Nevada and storage in Nevada; and information regarding DOE's surplus plutonium disposition program, and relevant federal regulations. The Agency has worked closely with the AG's Office and contract attorneys as they developed documents for use in litigation.[33]

The Agency's technical and policy work on plutonium is part of the Agency's overall work on Yucca Mountain licensing issues, especially impacts of transportation accidents and incidents, and repository long-term post-closure environmental impacts. DOE's Yucca Mountain

Proposed Action states that all or most of the surplus weapons-grade plutonium and defense-related plutonium materials stored at DOE's SRS facilities, would be shipped to the Yucca Mountain repository for geologic disposal. Geologic disposal of surplus defense plutonium at Yucca Mountain is addressed in great detail in DOE's 2002 and 2008 Environmental Impact Statements (EISs), which are part of the license application package submitted by DOE to NRC in June 2008. The primary plutonium isotope in both weapons-grade plutonium, and in spent nuclear fuel from commercial nuclear power plants, is plutonium-239. Plutonium-239 is of particular concern for geologic disposal because of its long half-life, more than 24,000 years. DOE's 2008 Final Supplemental EIS for Yucca Mountain identifies plutonium-239 as one of the radionuclides of primary concern in the post-10,000-year performance period for groundwater contamination health effects. DOE's 2008 Final Supplemental EIS for Yucca Mountain evaluates transportation accidents involving release of plutonium and acknowledges that a DOE contractor study found that a transportation accident in which plutonium was dispersed in an urban area could result in clean-up costs ranging from $89 million to $400 million per square kilometer.[34]

Proposals for SNF Reprocessing at or near Yucca Mountain

As the State of Nevada prepares for a ramped-up effort in the NRC's Yucca Mountain licensing arena, Nye County and a number of rural counties continue to support a resumption of Yucca Mountain licensing.[35] At the same time, advocates of nuclear technology in the State of Nevada are advocating for reprocessing of spent nuclear fuel at or near the Yucca Mountain repository site, or in association with a repository at Yucca Mountain. During the past three years, this Commission and the Nevada Legislature's Interim Committee on High-Level Radioactive Waste have heard presentations from groups both in northern and southern Nevada that advocate combining or replacing the current Yucca Mountain project with new proposals for co-locating spent nuclear fuel reprocessing, interim/temporary storage and handling facilities, and even nuclear reactors and reactor research projects. The groups include the American Nuclear Society – Nevada section, the National Defense Industrial Association, Nevadans Citizen Action Network, and the U.S. Nuclear Energy Foundation.[36]

Governor Sisolak and the Nevada Legislature, supported by Attorney General Ford, strongly oppose all efforts to import spent nuclear fuel or nuclear fuel materials into Nevada. Moreover, the proponents of reprocessing appears to have unrealistic expectations about the

economics of recycling uranium and plutonium from spent nuclear fuel for use in production of new reactor fuel and ignore the unsuitability of Yucca Mountain and the surrounding area for reprocessing and fuel fabrication operations. Agency staff and contractors have prepared an updated summary of issues associated with spent nuclear fuel reprocessing at Yucca Mountain (see Attachment 5).

Developments in Congress with Implications for Yucca Mountain

Current Legislation in the 116th Congress

The 116th Congress is currently considering two very different approaches to authorizing legislation, H.R. 2699 in the House and S. 1234 in the Senate, each of which would dramatically impact the federal nuclear waste program and the DOE proposed Yucca Mountain project. Nevada Senators Catherine Cortez Masto and Jacky Rosen testified against the Senate discussion draft version of H.R. 2699, at the Senate Committee on Environment and Public Works hearing in May 2019. The Agency Executive Director testified against H.R. 2699 at the House Subcommittee on Environment and Climate Change hearing in June 2019. Senator Cortez Masto, a member of the Senate Committee on Energy and Natural Resources, spoke and cross-examined witnesses at the committee hearing on S. 1234 in June 2019. Governor Sisolak's comments on the bills are Attachments 1 and 2 to this report. Detailed comments prepared by Agency staff and contractors on H.R. 2699 and S. 1234 are attachments 6 and 7 to this report.

The Nevada congressional delegation has introduced legislation in the House (H.R. 1544) and Senate (S. 649), the Nuclear Waste Informed Consent Act, to protect Nevada's interests by extending consent to Nevada regarding Yucca Mountain, and by requiring a re-examination of alternative uses of Yucca Mountain and economic benefits of those alternatives (S. 721). As this report is being written, Senator Cortez Masto is deeply involved in efforts to amend S. 1234 to incorporate the key provisions of the Nuclear Waste Informed Consent Act, to extend consent to Nevada. S. 649, S. 721, and H.R. 1544 are attachments 8, 9, and 10 to this report.

H.R. 2699, the Nuclear Waste Policy Amendments Act of 2019, is sponsored by Rep. Jerry McNerney (D-CA) and Rep. John Shimkus n(R-IL). H.R. 2699 is nearly identical to the 2018 bill of the same name introduced by Rep. Shimkus, H.R. 3053.

H.R. 2699 would restart the forced siting of a high-level nuclear waste repository at Yucca Mountain in Nevada. It would continue and expedite the primary provision of the Nuclear Waste Policy Amendments Act (NWPAA) of 1987 [42 U.S.C. 10172], which designated Yucca

Mountain as the only candidate site to be studied for a geologic repository. The bill includes a consent-based siting process for consolidated interim storage facilities, called "Monitored Retrievable Storage" (MRS) facilities after the original terminology of the 1982 law. The bill directs the U.S. Nuclear Regulatory Commission (NRC) to accelerate the licensing process for Yucca Mountain.

H.R. 2699 also would impact U.S. Department of Energy (DOE) operations in other states. H.R. 2699 transfers certain DOE defense, demonstration, and research nuclear waste functions to the Director of the Office of Spent Nuclear Fuel. This would significantly impact current DOE facilities and activities in Idaho, New Mexico, New York, South Carolina, Tennessee, Washington, and other states. A detailed analysis of H.R. 2699 is attachment 6 to this report.

S. 1234, the Nuclear Waste Administration Act of 2019, is sponsored by Senators Lisa Murkowski (R-AK), Lamar Alexander (R-TN), and Diane Feinstein (D-CA). S. 1234 is almost identical to previous bills of the same name introduced over the past 5 years. S. 1234 would create a new managing entity, the Nuclear Waste Administration (NWA), to take over the program from DOE. S. 1234 directs the NWA to establish a consent-based siting process; and calls for operation of a spent nuclear fuel storage pilot facility by December 31, 2025, an interim storage facility for spent nuclear fuel by December 31, 2029, and a geologic repository by December 31, 2052. These storage and disposal facilities would be regulated by the U.S. Nuclear Regulatory Commission (NRC), subject to standards established by the U.S. Environmental Protection Agency (EPA). Like previous bills of the same name, S. 1234 proposes some of the major changes recommended by the Blue Ribbon Commission (BRC) on America's Nuclear Future in 2012.[37]

S. 1234 has been deemed by some to be "Yucca Mountain-neutral" because it does not add any additional Yucca Mountain repository measures to those enacted in the Nuclear Waste Policy Amendments Act of 1987, appropriately called the "Screw Nevada" act. In that sense, S. 1234, like the BRC report, maintains the status quo on Yucca Mountain – the adjudicatory portion of the proceeding remains suspended, absent new congressional appropriations. Like the BRC Final Report, S. 1234 is conspicuously silent regarding future consideration of Yucca Mountain.[38] S. 1234 mentions Yucca Mountain only in the findings section, and states "in 2009, the Secretary found the Yucca Mountain site to be unworkable and abandoned efforts to

construct a repository." Specific provisions would exclude Nevada from the newly created consent-based siting process that would apply to all other potential repository host states.

But three provisions of S. 1234 would directly impact the Yucca Mountain repository project, restart the NRC licensing proceeding when or if funding becomes available, and exclude Nevada from the newly created consent agreements:

(1) Section 506 (a) states **"**This Act shall not affect any proceeding or any application for any license or permit pending before the Commission on the date of enactment of this Act." This provision would exempt Yucca Mountain from the new consent-based siting process, and continue the status quo of the Yucca Mountain licensing proceeding as is;

(2) Section 301 transfers to the new Administrator all functions vested in the Secretary of Energy by the NWPAA for the construction and operation of a repository; and

(3) Section 306(e) requires that the NWA Administrator enter into a written consent agreement with the Governor (or other authorized official) of the potential repository host state, and affected local and tribal governments, before submitting a repository license application to NRC. Since the Yucca Mountain license application has already been submitted, this provision would allow the Administrator to proceed with the development of a repository at Yucca Mountain without a consent agreement with the State of Nevada, Nevada Counties, and affected Indian Tribes.

S. 1234 would require all host governments for storage and/or disposal facilities to sign a binding agreement at or before the beginning of the licensing process, before NRC staff completion of the required Safety Evaluation Report (SER), before completion of an Environmental Impact Statement (EIS) as required by the National Environmental Policy Act (NEPA), and prior to resolution of safety and environmental contentions by an NRC atomic safety and licensing board.

Senators Catherine Cortez Masto and Jacky Rosen are currently seeking to amend S. 1234 to include the key provisions of their bill S. 649, the Nuclear Waste Informed Consent Act (NWICA), that would allow for signing of a consent agreement at any time before, during, or after the completion of the licensing process, prior to construction of a 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. The timing proposed in the NWICA would extend consent to Nevada regarding the proposed Yucca Mountain repository.

Lessons Learned from Past Yucca Mountain Experience

Nevada once again faces a determined assault by Yucca Mountain proponents in the Trump Administration, in both Houses of Congress, and by the nuclear industry. It is instructive and useful to review what actually exists at Yucca Mountain and how it came to be, and 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?

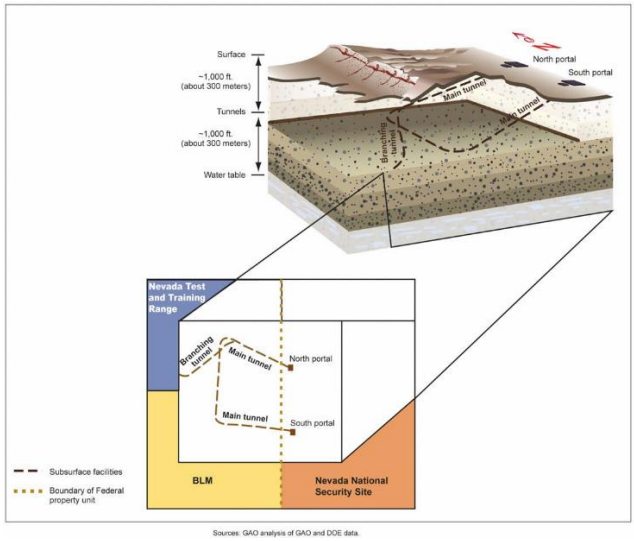
Proponents advocating restart of the Yucca Mountain project continually misrepresent what would be involved with the development of a repository at the site. When DOE abandoned the Yucca Mountain site and announced that it was terminating the project in 2010, all that existed, and all that continues 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.[39] 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.[40] 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.[41] 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.

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 "Transportation, Aging, and Disposal (TAD)" 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 2. What Exists Today at Yucca Mountain



Sources: GAO analysis of GAO and DOE data.

- *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."[42]

How Political Science Trumped Earth Science at 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 (NWPA):

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

of recorded history barely covers that span of time. The pyramids of Egypt, perhaps the longest surviving human engineering project, are 3,000 – 4,000 years old at most. Yet DOE has selected Nevada as one of three potential sites to build something … that must not only remain intact for at least 10,000 years, but must retain the structural, geological and hydrological integrity to guarantee that thousands of tons of the most toxic and long-lived substances yet discovered will remain contained and isolated from the rest of the world for the entire time."

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

How DOE and Congress came to choose such an unsuitable site as Yucca Mountain can only be understood by reviewing the history of the site selection process. By 1986, DOE and NRC had been implementing the NWPA for three years. Yucca Mountain was one of three previously studied sites – along with Deaf Smith County in Texas, and Hanford in Washington – that DOE identified as potential candidate sites for the first repository. DOE also identified study areas for the Crystalline Repository Project, to be evaluated for the second repository, in 17 states in the North Central, Northeastern, and Southeastern regions. The 1986 potential repository host states are shown below in Figure 3.

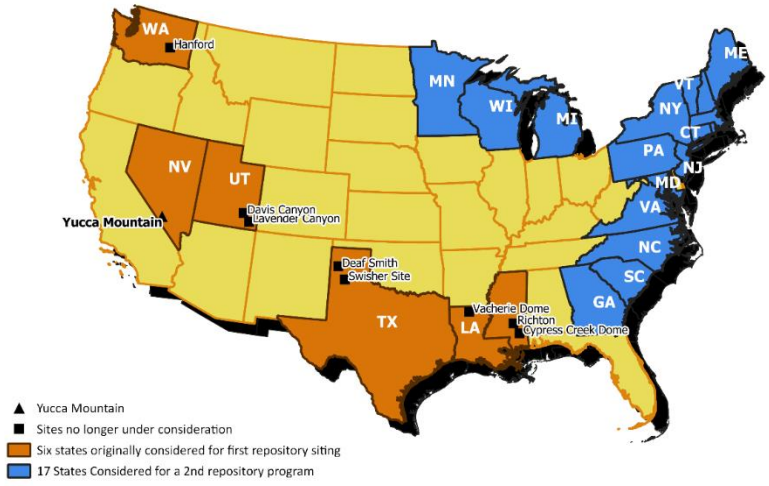


Figure 3. Potential Repository Host States Identified by DOE in 1986.

Political opposition to DOE's siting efforts grew in intensity as the scheduled NWPA decision dates approached in 1986. Tennessee, proposed site for an interim storage facility called the MRS (Monitored Retrievable Storage facility), and several potential repository states filed lawsuits against DOE. The controversy was heightened by preparations for the upcoming November 1986 elections, with state and congressional races of national importance in a number of NWPA-affected states, and the beginning of campaign planning for the 1988 presidential elections. Thousands of angry people attended DOE meetings across the country. In May 1986, Energy Secretary Herrington suspended the second repository effort and proceeded with consideration of sites in Nevada, Texas and Washington for the first repository. The selection of Hanford over two sites with higher technical rankings – Richton Dome in Mississippi and Davis Canyon, Utah – fueled the perception that DOE's siting process was driven by politics. After 18 months of debating how to fix the nuclear waste program, House and Senate negotiators came up with a political solution – Yucca Mountain would be the only candidate site for the first repository. DOE's second repository project was terminated. DOE's proposed Oak Ridge MRS, which had earlier been vetoed by Tennessee, was permanently nullified. On December 21, 1987, Congress passed the Nuclear Waste Policy Amendments Act (NWPAA) as part of the budget reconciliation conference report (H.R. 3545), and the NWPAA was signed into law the next day.

Nevada Congressman James Bilbray told a journalist how a member of the Senate-House conference committee broke the news to him. “I hope you understand what is going on here. There are three sites under review--Texas, Nevada and Washington. And the speaker [of the House, Jim Wright] is a Texan and the majority leader [Tom Foley] is a Washingtonian. … It is not going to Washington. And it is not going to Texas.” Bilbray told the journalist “Nevada was treated very shabbily, and our delegation was treated very shabbily. …I resent it to this day.” Two decades later, former Congressman Bilbray retold the story at a University of Nevada Las Vegas roundtable discussion on Yucca Mountain. He related going into a room with Majority Leader Tom Foley and Speaker Jim Wright and being told Yucca Mountain was it. “I left the room and a friend asked me what happened. I told him that Nevada had just been screwed.” The unofficial name of the NWPAA as the “Screw Nevada Bill” was thus born.[43]

What is Wrong with Yucca Mountain?

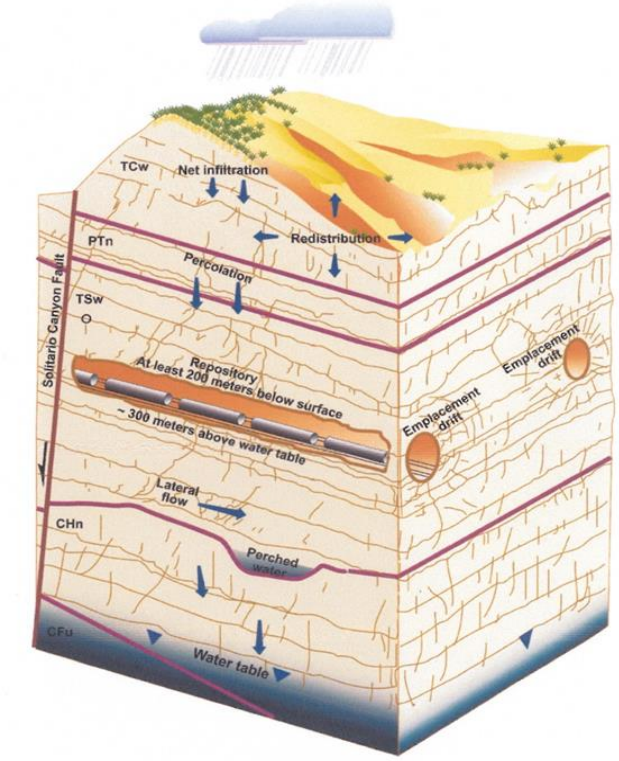


FIGURE 4 CONTENTIONS CHALLENGE SITE SUITABILITY
FRACTURED ROCK, OXIDIZING GROUNDWATER, ABOVE WATER TABLE

Yucca Mountain is an unsuitable site for a geologic repository. The proposed emplacement drifts would be located in fractured rock above the water table and would inevitably leak dangerous radionuclides into the groundwater, where they would be rapidly transported to an aquifer from which water is used for a wide variety of purposes. The repository design and operations plan, laid out by the U.S. Department of Energy (DOE) in its 2008 license application to the U.S. Nuclear Regulatory Commission (NRC), will not fix what is wrong. The NRC Atomic Safety and Licensing Board has admitted for adjudication a record 218 contentions submitted by Nevada challenging the DOE license application on technical, environmental, and legal issues.

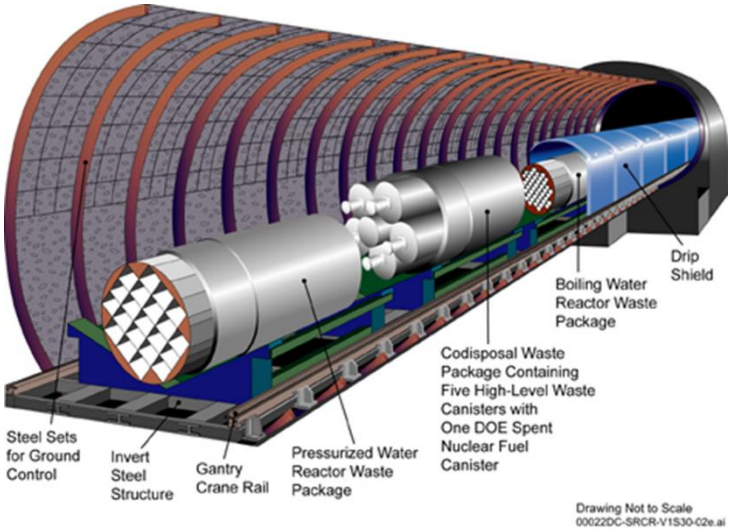


FIGURE 5 CONTENTIONS CHALLENGE DISPOSAL CONCEPT TITANIUM DRIP SHIELDS OVER EACH WASTE PACKAGE

DOE's proposed robotic installation of 11 to 38 thousand titanium drip shields, one over each waste package, beginning about 90 years after emplacement, relies on unproven technologies and, even if perfectly installed, cannot be guaranteed to prevent the release of radionuclides from the repository into the groundwater. It also places the burden on future generations to commit the substantial resources, an estimated 8 to 20 billion dollars, required to manufacture and emplace the drip shields in an aging repository that will be only accessible by remote operations.

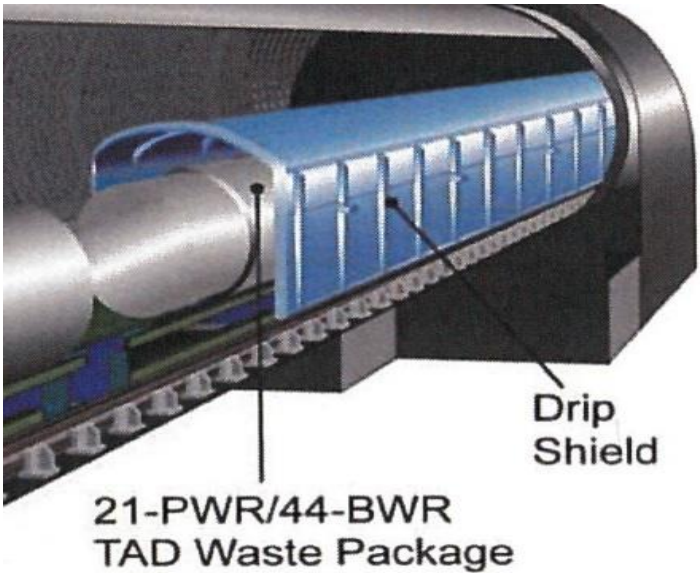


FIGURE 6 DRIP SHIELDS INSTALLED (AS PROPOSED BY DOE)

Each drip shield would be 19 feet long by 8 feet wide by 9.5 feet high, weighing 4.9 metric tons. All the package and drip shield emplacement work would need to be done robotically because of the intense radiation (package surface dose rates over 1,000 rem per hour) and heat (120-140 degrees Fahrenheit) in the drifts.

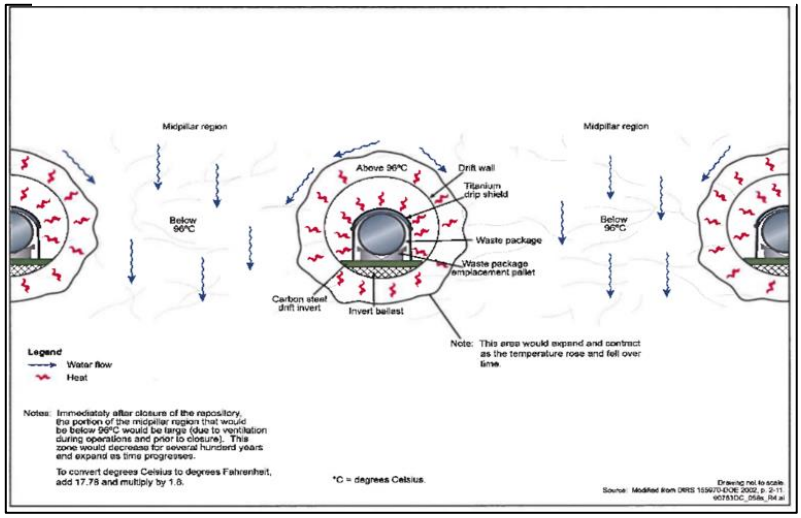


FIGURE 7 CONTENTIONS CHALLENGE HOT REPOSITORY CONCEPT DRIFTS WILL REMAIN ABOVE WATER BOILING POINT FOR ABOUT 1,000 YEARS

DOE would need to supplement the titanium drip shields by keeping the temperature within the emplacement drifts above the boiling point of water for about 1000 years. (95 degrees Celsius, 203 degrees Fahrenheit at YM because of the elevation) DOE believes this would create thermal pathways in the rock pillars between the drifts and keep infiltrating water away from the waste packages. Nevada contends infiltrating water would be rendered corrosively aggressive to the waste containers by the water-rock reactions occurring at projected high temperatures.

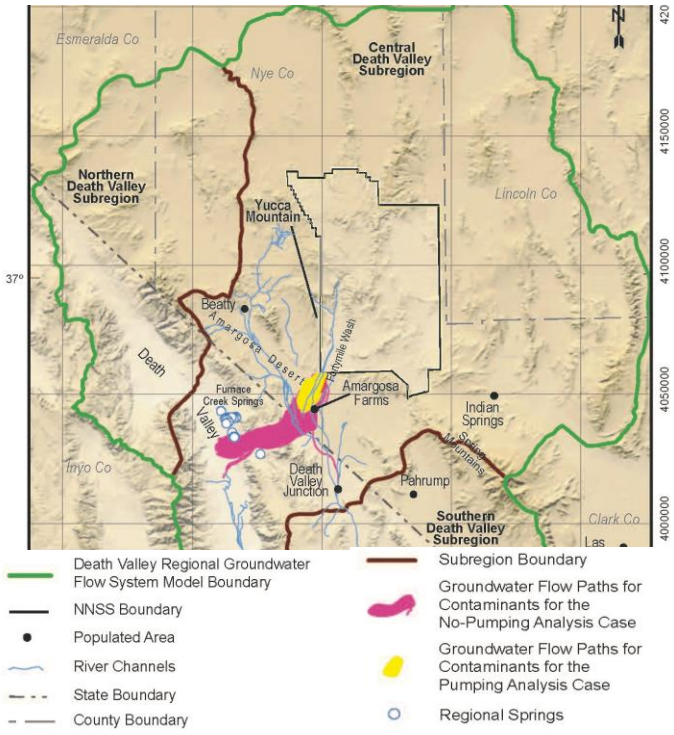


FIGURE 8 NEW CONTENTIONS CHALLENGE GROUNDWATER AND NATIVE AMERICAN CULTURAL IMPACTS (NRC EIS SUPPLEMENT NUREG-2184)

Nevada is preparing new contentions that challenge the assessment of groundwater impacts, based on information presented by NRC staff in their Safety Evaluation Report and in their 2016 EIS Supplement on groundwater impacts. Nevada will also challenge DOE and NRC's failure to address impacts on the Timbisha Shoshone Tribe and on Native American cultural resources in Amargosa Valley and Death Valley.

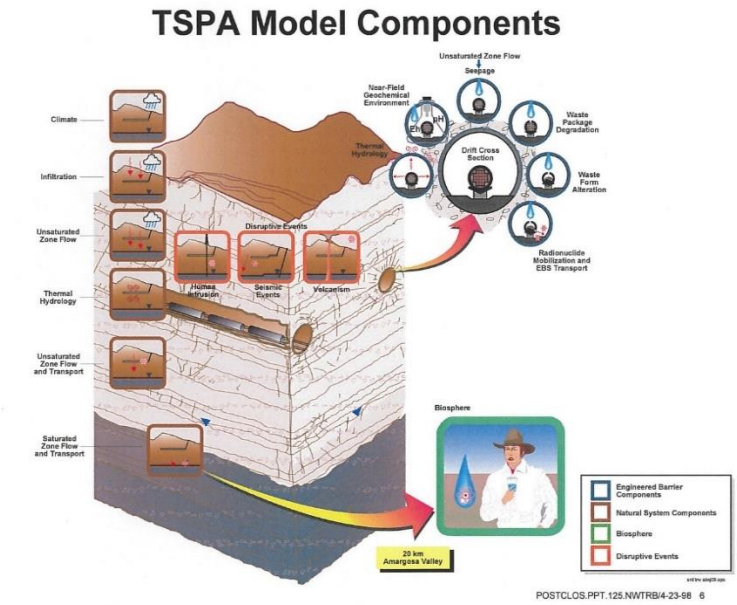


FIGURE 9 NEVADA CHALLENGES DOE COMPLIANCE WITH EPA GROUNDWATER RADIATION PROTECTION STANDARD TOTAL SYSTEM PERFORMANCE ASSESSMENT (TSPA)

The key issue in the licensing proceeding will be whether or not the repository can prevent radioactive contamination of groundwater for one million years. The EPA and NRC regulations would limit radiation doses resulting from groundwater contamination to 15 mrem/year for 10,000 years and 100 mrem/yr for the next 990,000 years. In their 2016 EIS Supplement, NRC staff calculated that even if the drip shields were to be installed, some off-site contamination resulting in individual radiological doses up to 1.3 mrem/year would occur over the regulatory compliance period. Nevada's consultants calculated that without drip shields, the 10,000-year standard (15 mrem/year) could be exceeded in less than 900 years and the million-year standard (100 mrem/year) could be exceeded in 2,000 years. Nevada is also challenging the two-part EPA radiation protection standard in court.

As if these deficiencies were not enough to disqualify Yucca Mountain from further consideration, the site is also vulnerable to earthquakes and volcanism. The potential seismic hazards are underscored by the July 2019 Ridgecrest, California earthquakes. Nevada previously challenged DOE's Yucca Mountain seismic hazards assessment in contentions filed in the NRC licensing proceeding in 2008; Nevada believes DOE improperly minimized seismic hazards in its license application and supporting documents. Nevada's Yucca Mountain team is developing a detailed strategy for re-evaluating repository earthquake risks. The proximity of the recent earthquakes (since 2000) to Yucca Mountain is shown below in Figure 10.

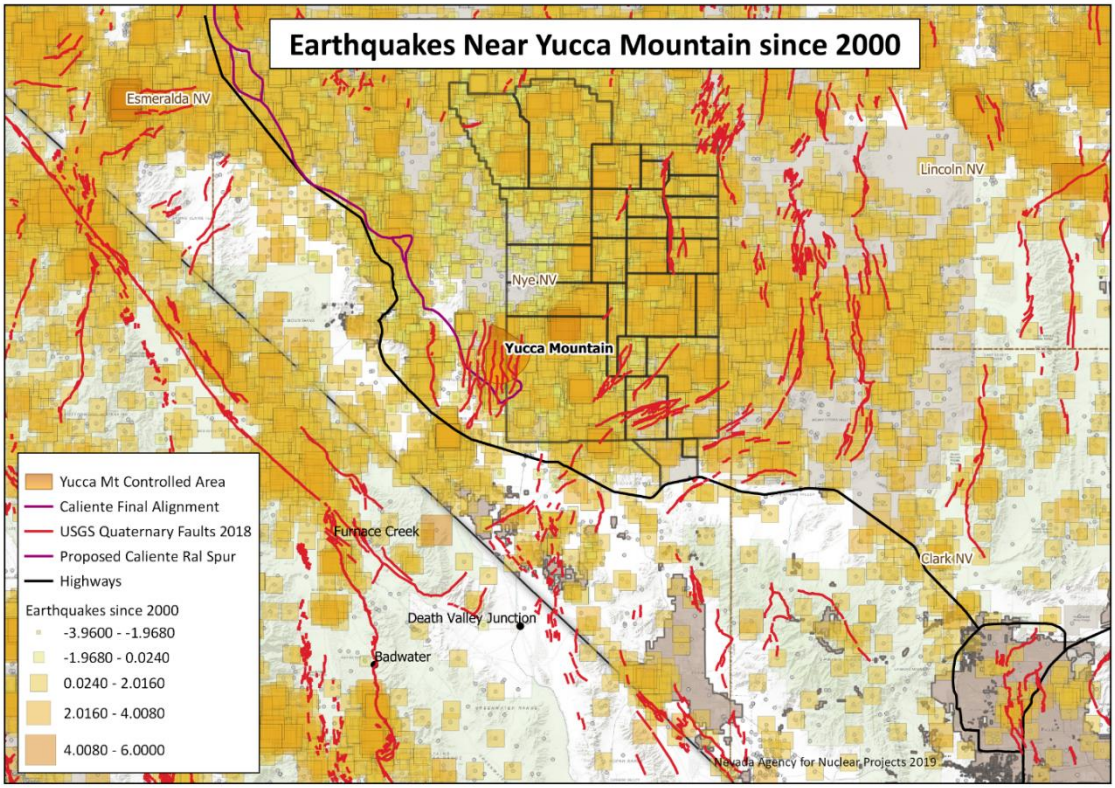


Figure 10. Earthquakes Near Yucca Mountain since 2000.

Given the extraordinarily long timeframe 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 future generations should not be exposed to any higher radiation limits than those that are in effect today. Figure 11 shows some of the past volcanic activity near Yucca Mountain.

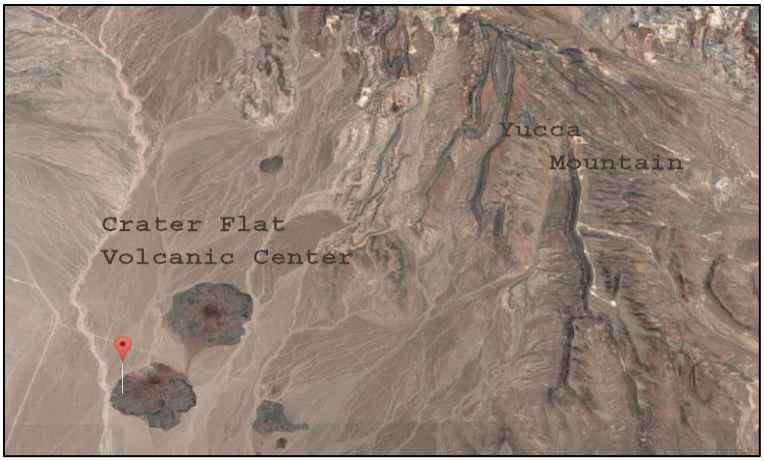


Figure 11. Past Volcanic Activity near Yucca Mountain.

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.

Nevada's experts have challenged major aspects of the volcano assessment in DOE's 2008 license application. 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.

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 , one over each waste package, to keep water from contacting the disposal containers (drip shields that DOE proposes to begin installing 90 years after first emplacement, continuing over a period of 10 years).

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 11 miles of the underground aquifer far from the actual site itself for dilution of escaping radionuclides in order to make the performance calculations work.

Adverse Impacts on Native Americans

Adverse impacts on Native Americans are now clearly demonstrated by the 2016 NRC Staff Supplemental EIS on groundwater impacts. Yucca Mountain would inevitably result in radioactive contamination of the groundwater in California's Death Valley. The flow paths calculated by Sandia National Laboratories indicate that this radioactive contamination will travel through Nevada's Amargosa Valley and continue deep into Death Valley, reaching the Timbisha Shoshone Tribe trust lands at Furnace Creek, as shown in Figure 12.

The only uncertainties about radioactive contamination of groundwater are how much, how far, and how fast. The NRC staff in 2016 concluded that only minor contamination would

occur in the Amargosa Valley farming area over the regulatory compliance period. Nevada's analyses indicate that under some circumstances the off-site contamination could exceed the EPA 10,000-year allowable standard in less than 900 years and exceed the million-year standard in 2,000 years.

The Yucca Mountain groundwater contamination issue is unresolved. DOE submitted its License Application and supporting Environmental Impact Statements (EISs) to NRC in June 2008. After reviewing DOE's documents, the NRC staff found in September 2008 that "the information provided in the EISs does not adequately characterize how potential contaminants may affect groundwater resources in the volcanic-alluvial aquifer, and the potential effects from surface discharge." NRC staff could not accept DOE's assessment of the repository's cumulative impact on groundwater and the potential impacts of discharge of potentially contaminated groundwater to the surface, and informed DOE that their EISs would need to be supplemented.[44] In 2008, the State of California Department of Justice and the California Energy Commission submitted five contentions challenging DOE's incomplete and inadequate analysis of the repository's cumulative impact on groundwater, surface discharge of groundwater, and groundwater pumping.[45] The County of Inyo, California submitted seven groundwater contentions,[46] and the Timbisha Shoshone Tribe submitted four groundwater contentions.[47]

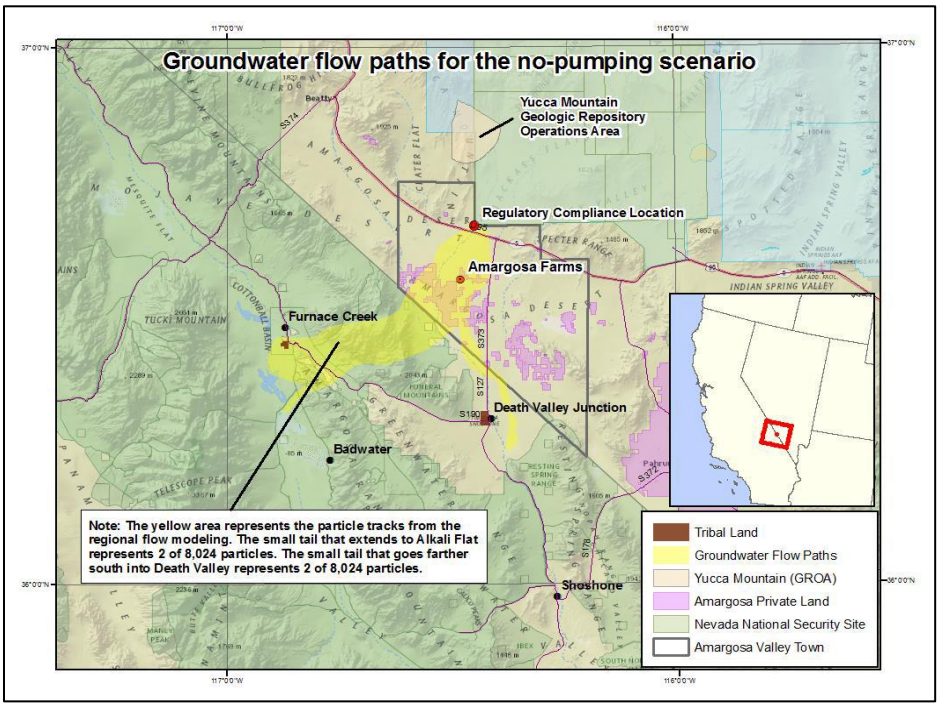


Figure 12 Groundwater Contamination would Impact Timbisha Shoshone Tribe Trust Lands

In 2013, the NRC requested that DOE prepare an EIS Supplement on groundwater impacts. DOE declined, and the Commission directed NRC staff to prepare the required NEPA document. NRC staff issued a Draft EIS Supplement on groundwater impacts in 2015, followed by a Final EIS Supplement in 2016, which concluded that "all of the impacts on the resources evaluated in this supplement would be SMALL."[48] If the adjudicatory portion of the NRC licensing proceeding restarts, and they remain parties, the States of California, Inyo County, and the Timbisha Shoshone Tribe may contend that NRC has failed to fully evaluate groundwater contamination and surface discharges of contaminated groundwater.

Any contamination is a major concern for the Timbisha Shoshone Tribe. The Timbisha Shoshone Tribe commented extensively on the NRC's 2015 draft evaluation of groundwater impacts, including the following statements:

"The [NRC Draft Groundwater EIS] Supplement admits that contaminated groundwater effluent from the repository will reach springs that the Timbisha Shoshone hold as sacred and require to be kept pure. SEIS, p. 3-38. Yet the Supplement contains no consideration or meaningful analysis of this injury to Timbisha Shoshone cultural interests or how these effects can be prevented. *Id*. (only public health and physiological impacts considered). This failure to adequately examine cultural and historical resources is in direct violation of NEPA's mandates. 40 C.F.R. 1502.16(g); CEQ Guidance; *see also* 10 C.F.R. § 51.71(b)."[49]

"The United States has a trust obligation to ensure that the Timbisha's Reservation remains livable and self-sustaining. *Winters v. United States*, 207 U.S. 564 (1908). This is the exact standard that is applied to the water supply available to reservations, and by its terms (livable and self-sustaining) it applies both to water quantity and to water quality. It is the responsibility of the United States to ensure that the Tribal springs and groundwater sources remain free of radioactive contamination in perpetuity."[50]

In addition to the Timbisha Shoshone Tribe, individual members of the Native American community living in and around the affected area in Nevada and California have organized the Native Community Action Council and have been admitted as an intervening party to the NRC licensing proceeding. Native American individuals have specifically detailed major cultural, environmental and health harms from Yucca Mountain that NRC staff ignored in the 2015 Draft Groundwater Impact EIS Supplement. Western Shoshone and Southern Paiute people interviewed about the potential groundwater impacts of a repository at Yucca Mountain on water

resources in the affected area repeatedly stated that water was a crucial part of their individual and collective cultural and spiritual life ("Water is our everything"), that all of the springs in the affected area are directly connected to each other, and that Native American people are responsible for preventing contamination of the springs.[51]

The Business Case against Yucca Mountain

Apart from the technical and scientific issues that make Yucca Mountain unsuitable for geologic disposal, the cost of the nuclear waste program would be substantially reduced by terminating Yucca Mountain and developing one or more repositories at other, less complex and problematic sites – sites that do not require the unproven and expensive engineered barriers needed at Yucca Mountain, nor the extraordinary economic costs and uncertainties associated with construction of a new 300-mile railroad.

DOE under the Obama Administration prepared new repository cost studies between 2009 and 2013, and these studies, for a repository like Yucca Mountain designed primarily for disposal of SNF, showed that a repository in salt or shale would be less expensive than Yucca Mountain, and that a repository in crystalline rock could be more expensive.

Agency staff have examined repository costs using the DOE 2008 Total System Life Cycle Cost (TSLCC) Analysis[52] and the 2013 DOE Fee Adequacy Report.[53] The 2013 Fee Adequacy Report includes a summary of the cost studies prepared for DOE's Used Fuel Disposition Campaign (UFDC). The UFDC compared the estimated costs (in 2008 dollars) of constructing and operating otherwise identical repositories, using five alternative geologic disposal concepts (combinations of rock types and various approaches to ventilation and backfilling).

In order to perform an apples-to-apples comparison of repository construction and operation costs, the DOE UFDC study assumed that storage, transportation, and other program costs would be the same regardless of the host rock used for a repository of the same capacity. DOE UFDC started with an adjusted Yucca Mountain life-cycle construction and operations cost of $51.3 billion.[54] DOE UFDC then calculated that construction and operation of a comparable capacity salt repository would cost between $24.3 billion and $39.4 billion; a shale repository would cost between $25.5 billion and $38.7 billion. The conclusion: over the life of the repository, construction and operation of a repository in salt or shale would cost about half the cost of the Yucca Mountain repository. The savings in 2008 dollars, of walking away from

Yucca Mountain and constructing a repository in salt or shale, would be between $11.9 billion and $25.8 billion, even after writing off the entire $14 billon spent on Yucca Mountain between 1983 and 2008.[55]

Updating the DOE cost estimates from 2008 and 2013, Agency staff estimate $100 billion in 2019 dollars to be the future total cost of Yucca Mountain. That includes at least $2 billion over 4-5 years just for licensing.[56] The potential cost savings for walking away from Yucca Mountain could be between $14 billion and $30 billion, in current year dollars. It seems clear that Congress should require a full re-examination of comparative costs for repository construction and operation before appropriating any additional licensing funds for Yucca Mountain.[57]

Transportation Impacts of Yucca Mountain

In order to move spent nuclear fuel (SNF) and solidified high-level radioactive waste (HLW) to Yucca Mountain, thousands of long-distance shipments from reactor sites around the country would be necessary. These shipments would create radiological hazards and public concerns about safety and security. DOE's proposed shipments of SNF and HLW to Yucca Mountain would affect much of the nation for a half-century or more. DOE's Yucca Mountain transportation plans are spelled out in the Final Supplemental Environmental Impact Statement (FSEIS), part of the License Application DOE submitted to the NRC in 2008.[58] The "representative routes" identified by DOE, from 76 sites in 34 states to Yucca Mountain, are shown in Figure 15.

FIGURE 13. RAIL AND TRUCK ROUTES TO YUCCA MOUNTAIN (RAIL ROUTES VIA CALIENTE)

These routes would use 22,000 miles of railways and 7,000 miles of highways, traversing more than 40 states and the tribal lands of at least 30 Native American Tribes, the District of Columbia, and 960 counties with a total 2010 Census population of about 175 million.[59] 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.[60] These rail and

highway routes would affect most of the nation's congressional districts (330 of 435 districts in the 115th Congress).[61]

Radiological Impacts of Yucca Mountain Shipments

Under current federal law, the amount of SNF and HLW that can be buried at Yucca Mountain is limited to 70,000 metric tons of heavy metal (MTHM).[62] This term refers to the amount of uranium or plutonium in the fuel before it was used in a reactor. About 90 percent of the first 70,000 MTHM shipped to Yucca Mountain would be SNF from commercial nuclear power plants, about 3.3 percent would be SNF owned by DOE (including SNF from naval propulsion reactors), and about 6.7 percent would be canisters of solidified HLW from nuclear weapons production and commercial reprocessing, as shown in Figure 16. The SNF and HLW shipped to Yucca Mountain would be highly radioactive and thermally hot.

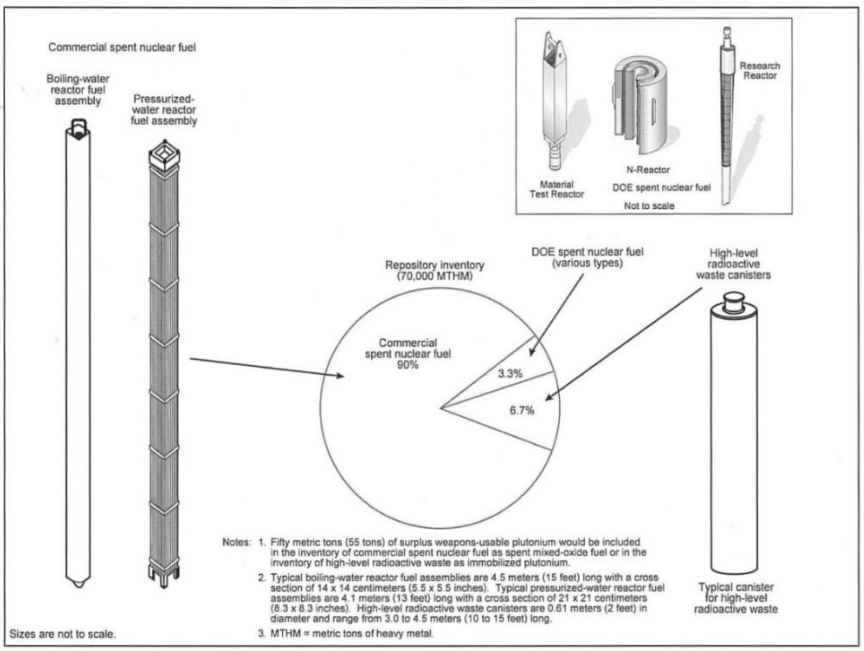


Figure 14. Waste Forms that would be shipped to Yucca Mountain.

Yucca Mountain cannot contain the current inventory of nuclear waste. More than 80,000 MTHM of SNF and HLW is currently in storage, and the total could reach 150,000 MTHM by 2050. Proponents of Yucca Mountain would like to amend the law so that all the nation's high-level nuclear waste would go to Yucca Mountain. For the 70,000 MTHM limit, 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.[63] 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.

The commercial SNF shipped to Yucca Mountain would be lethally radioactive for decades. As Table 1 shows, after one-year in a water-filled storage pool, unshielded SNF is still so radioactive that it could deliver a lethal, acute dose of radiation (450 rem) in less than 10 seconds. After 50 years of cooling in a storage pool or dry storage canister the total radioactivity (measured in curies) and the surface dose rate (measured in rem/hour) decline by more than 95 percent, but the SNF could still deliver a lethal radiation exposure in minutes. The lethal exposure time for unshielded SNF is less than one minute after 5 years cooling, a little more than a minute after 10 years, and a little more than 3 minutes after 50 years.[64]

Age (years)	Activity (curies/assembly)	Surface Dose Rate (rem/hr)	Lethal Exposure (time to 450 rem)
1	2,500,000	234,000	7 seconds
5	600,000	46,800	35 seconds
10	400,000	23,400	70 seconds
50	100,000	8,640	188 seconds
100	50,000	2,150	750 seconds

Table 1. Spent Fuel Radiological Hazards Over 100 Years[62]

For the first 100 years after SNF is removed from a reactor, the major radiological concern is the fission product Cesium-137 (half-life 30 years), contained in the SNF. During SNF transportation, Cesium-137, which emits gamma radiation, creates radiation outside the shipping cask during normal operations, and is the major radiological hazard if released from the shipping cask to the environment. Another fission product, Strontium-90 (half-life 29 years), emits primarily beta radiation, and is a major concern if released to the environment. The SNF in a typical DOE rail cask would contain more than 50 kilograms of Plutonium-239.[65]

Shipments of SNF create four types of radiological impacts: routine radiation doses to members of the public; routine radiation doses to transportation workers; potential release of radioactive material following a severe accident; and potential release of radioactive material

following a terrorist attack or sabotage incident. In the Yucca Mountain FSEIS, DOE evaluated these transportation radiological impacts, and concluded that the routine radiation impacts to the public and to workers would be small or not significant.[66] DOE concluded that the release of radioactive material resulting from the maximum reasonably foreseeable transportation accident in an urban area could result in 9.4 latent cancer fatalities, and cleanup-costs of $300,000 to $10 billion.[67] DOE concluded that the release of radioactive material following a successful act of sabotage or terrorism in an urban area, using a military weapon or the equivalent, could result in 19-28 latent cancer fatalities in an urban area, and cleanup costs similar to a severe transportation accident, up to $10 billion.[68] As part of the Yucca Mountain licensing process in 2008, NRC staff reviewed and adopted almost the entire DOE FSEIS, including the transportation assumptions and radiological impact evaluations.[69]

Nevada and other parties challenged DOE's transportation impact evaluations, and the NRC staff decision adopting them, in the NRC licensing proceeding. 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.[70] 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. In particular, Nevada's contentions present evidence indicating that a severe transportation accident releasing radioactive material in an urban area could result in clean-up costs of $190 billion, 19 times greater than DOE's estimate; and a successful terrorist attack could result in radiation exposures to the affected public (and resulting cancer fatalities and other health effects) 50-200 times greater than DOE's estimate, and could result in cleanup costs and economic losses ranging from $3.5 to $648 billion.[71] If the NRC licensing proceeding should resume, Nevada will fully adjudicate its admitted transportation contentions that address these radiological impacts.

Nevada has also challenged DOE's evaluation of transportation radiological impacts outside of the NRC licensing proceeding, in review of DOE NEPA documents. In particular, Nevada has challenged DOE's failure to adequately evaluate unique local conditions at specific locations in Nevada along potential shipping routes to Yucca Mountain (where longer stop-times

and closer proximities could result in larger individual doses to members of the public than DOE estimates, ranging from a few mrem up to 200 mrem per year); DOE's use of non-conservative conversion factors to quantify risk for certain cancers per unit dose; and DOE's failure to adequately consider non-cancer and non-fatal health risks, including teratogenic risks (risk to unborn children receiving radiation exposure *in utero*) and genetic risks (risks to future generations due to radiation exposure to the germ cells of their parents).[72] DOE has also failed to evaluate the potential adverse impacts on property values and business location decisions of measurable routine radiation at locations along shipping routes. An overview of radiation awareness in Nevada, including basic information on radiation types and exposures, and human health effects, is provided in Attachment 9.

The Proposed Caliente Railroad and Shipments through Las Vegas

Yucca Mountain lacks rail access. The nearest railroad, the Union Pacific mainline through Las Vegas, is 100 miles away. Without rail access, delivering the nation's SNF and HLW to Yucca Mountain would require about 109,000 legal-weight truck (LWT) shipments or about 19,000 heavy-haul truck (HHT) shipments. The large casks that DOE plans to use for more than 90 percent of the SNF deliveries cannot be shipped by LWT. DOE began studying rail access options in the early 1980s, and these studies continued through 2008. The State of Nevada consistently advised DOE to select a rail access option from northern Nevada that would avoid any shipments through Las Vegas.[73]

In 2008, DOE selected a rail alignment beginning at the City of Caliente in Lincoln County as its preferred option. If built, the Caliente rail line would route some, and possibly most, Yucca Mountain shipments through downtown Las Vegas.[74] DOE picked Caliente over an alternative route, the Mina route from the north, which would avoid Las Vegas completely. DOE's FSEIS concluded that the Mina alternative would be "environmentally preferable" to Caliente, but DOE selected Caliente over Mina "due to the objection of the Walker River Paiute Tribe to the transportation of spent nuclear fuel and high-level radioactive waste through its Reservation."[75] In stark contrast, elected officials "in Lincoln County were all-in, anticipating an economic boost from a rail spur in Caliente."[76]

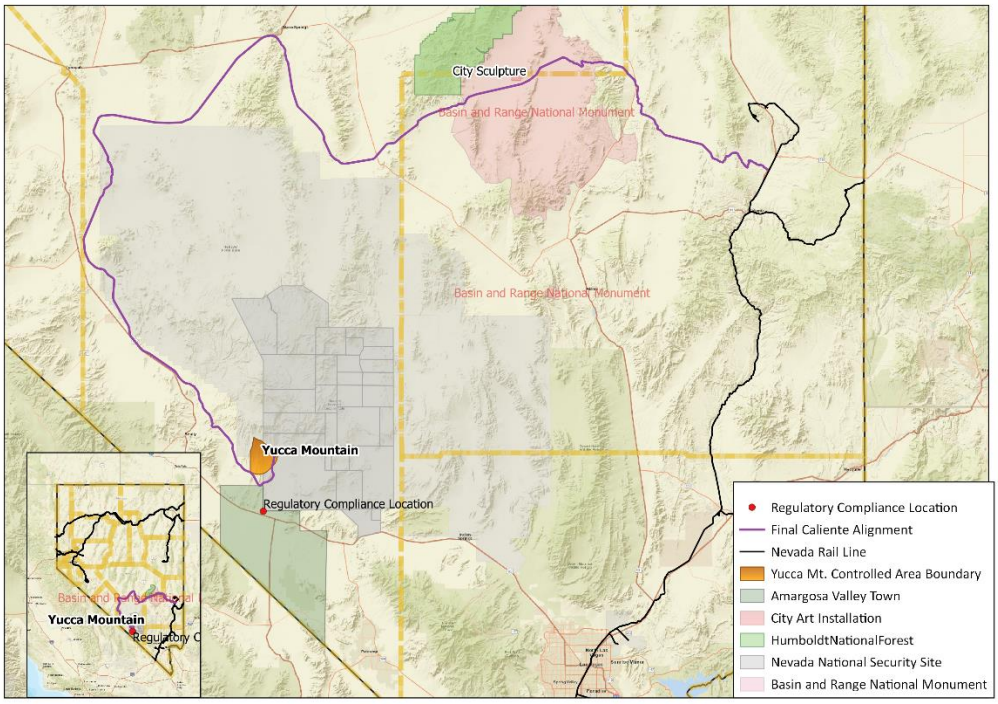


Figure 15. Proposed Caliente Rail Alignment to Yucca Mountain

Figure 15 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, crossing 8 mountain ranges, and costing $2.7 billion or more. Nevada has challenged DOE's impact evaluation of the Caliente rail alignment in the NRC licensing proceeding, with 4 admitted contentions, and has challenged DOE's application for a Certificate of Public Convenience and Necessity (CPCN) before the U.S. Surface Transportation Board (STB). The Bureau of Land Management (BLM) public land withdrawal granted to DOE for the Caliente corridor has expired, and DOE has withdrawn its applications for more than 100 state permits for water wells needed for rail construction. Federal designation of the Basin and Range National Monument in 2015, and the related conservation easement for the area around the "City" land sculpture installation in Garden Valley, create additional hurdles to the future consideration of the Caliente route.

DOE has said nothing about dropping Caliente as its preferred rail alignment. DOE has not withdrawn its application for a CPCN, still pending before the STB, nor has DOE moved to amend the transportation portion of its license application, still pending before the NRC. DOE has not suggested reconsidering the Mina route, which would avoid Las Vegas and Clark County, but would route some rail shipments through Reno and Sparks.[77] Nevada's initial

comments to DOE on the Mina route emphasized conflicts with Native American lands and cultural resources, and adverse impacts on Reno and Sparks.[78] After further study of the Mina route, Agency staff and contractors reported additional concerns to this Commission in 2008: impacts on threatened and endangered species (including Lahontan cutthroat trout); major bridge and track construction through areas subject to flood hazards and seismic hazards; adverse impacts on mining; uncertainties about BLM land withdrawals, state water permits, and approval by STB; and major adverse impacts on property values in Washoe County (up to $170 million loss if no accidents, up to $2.2 billion loss after an accident involving a release).[79]

DOE proposes to transport SNF and HLW to Yucca Mountain using rail and highway routes through the City of Las Vegas and Clark County. Figure 16 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.[80] A large portion of the world-famous Las Vegas "Strip," and more than 34 hotels that contain more than 49,000 hotel rooms, are located within one-half mile 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.[81] Figure 16 also shows the region of influence for routine radiation in Las Vegas. In the FSEIS, DOE applies the standard 800 meters (one-half mile) on either side of the shipping route as the region of influence for impacts of routine radiation and 80 kilometers (50 miles) as the region of influence for impacts of severe accidents and terrorist attacks. DOE estimates cleanup costs up to $10 billion if an accident or terrorist attack released radioactive materials in an urban area.[82]

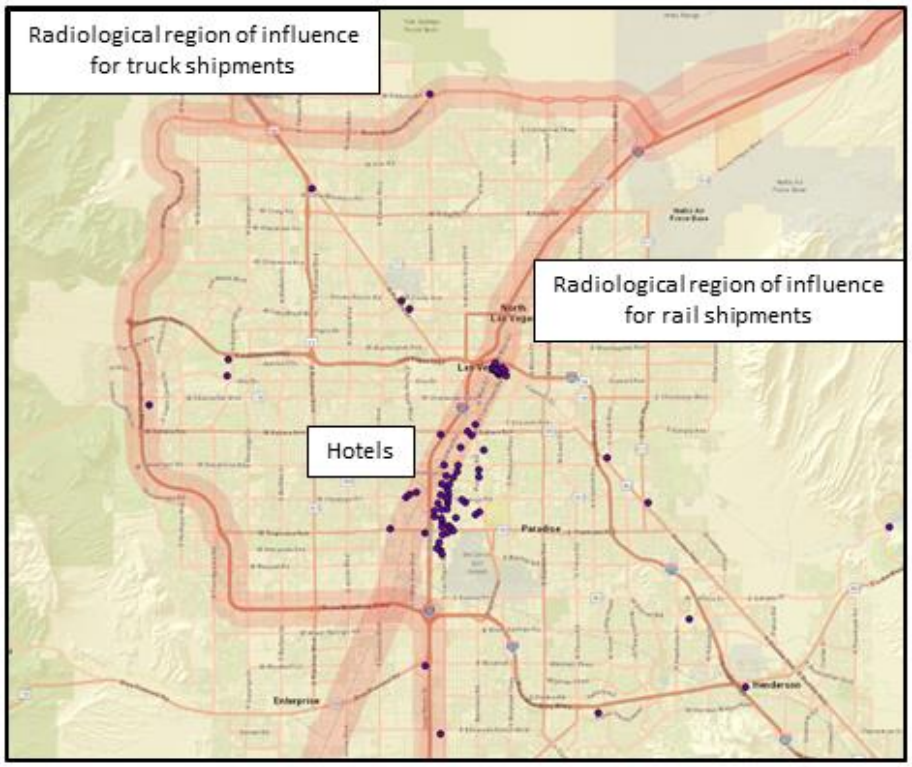


Figure 16. Rail and Truck Routes through Las Vegas and Clark County

Las Vegas would be heavily impacted by rail shipments under all scenarios using the proposed Caliente rail alignment. Fifteen reactors in Louisiana, Texas, Arizona and California, would ship SNF using the Union Pacific route from Barstow through Las Vegas to Caliente and then on to Yucca Mountain. Those routes are shown in Figure 17 from DOE's 2008 FSEIS (green highlight added). The minimum impact would be 254 train shipments (755 casks) through downtown Las Vegas and 2,650 truck shipments on the I-215 beltway. Those numbers increase to 628 train shipments (1,876 casks) and 5,025 truck shipments on I-215 if there is no second repository.[83]

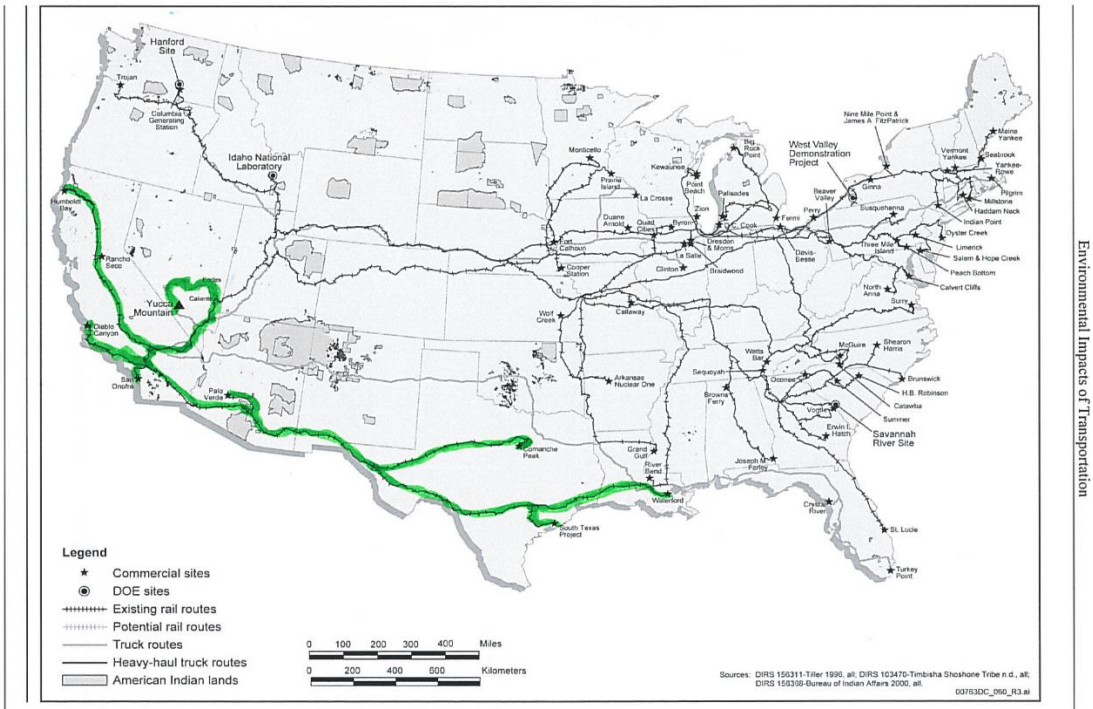


Figure 6-1. Representative rail and truck transportation routes if DOE selected the Caliente rail corridor in Nevada.

Figure 17. DOE Rail Routes to Yucca Mountain through Las Vegas and Clark County

The maximum rail impact on Las Vegas would occur if DOE were to use more southerly cross-country rail routes than those indicated in the FSEIS. Nevada has been concerned about this possibility since 1996, when a Nevada contractor report[84] warned that possible DOE use of so-called "Consolidated Southern Routing" to Nevada could route 70 percent of the rail shipments through Las Vegas, while reducing impacts on Chicago, St. Louis, and other Midwestern cities from shipments originating in Southern states. Political pressure from Midwestern states, combined with other factors, could cause DOE to use different rail routes through Illinois and Missouri. Nevada re-examined this scenario in 2015, using routes that minimize impacts on Chicago, and the site-by-site shipping data in DOE's 2008 FSEIS.[85] Eighty percent of total rail shipments, 4,998 trains (15,687 casks), would traverse Las Vegas if DOE uses the routes shown in Figure 18 to minimize the impacts on Chicago, the nation's rail hub.[86]

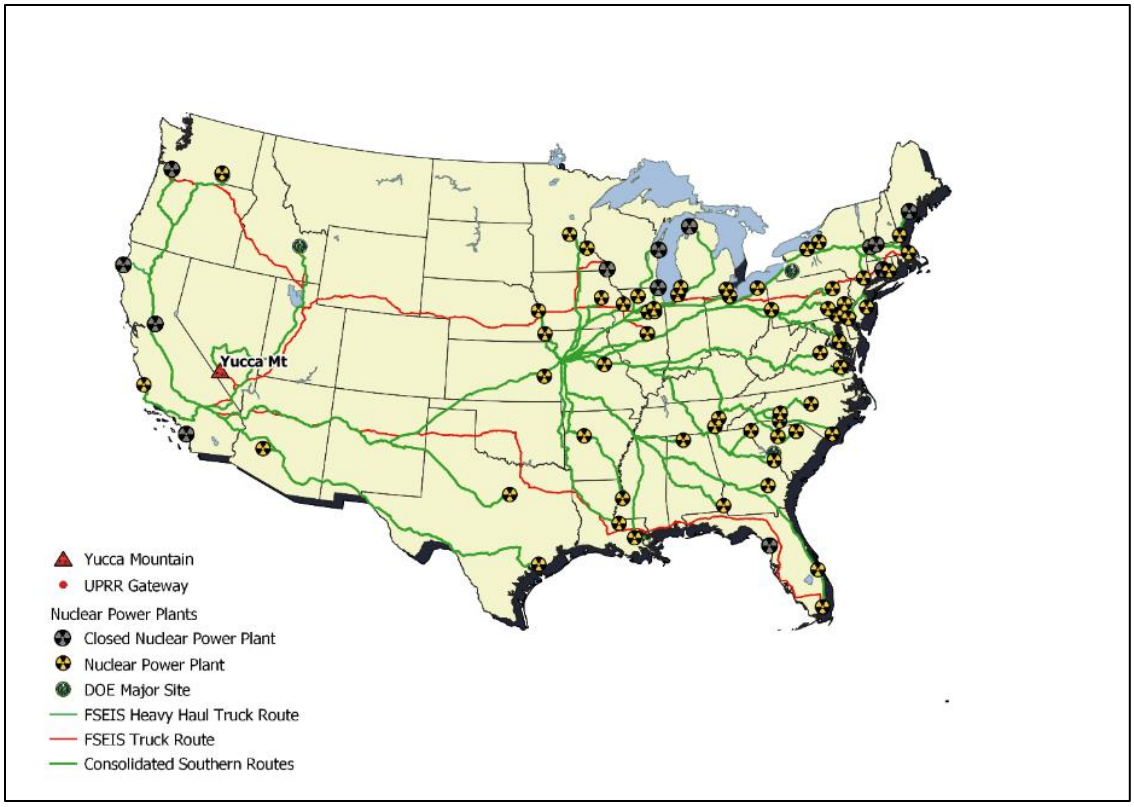


Figure 18. Consolidated Southern Routes through Las Vegas to Yucca Mountain

The validity of Nevada's concern about political influence on routing was demonstrated when the Council of State Governments – Midwest, representing 12 Midwestern states, commented to DOE in 2007 after reviewing the representative routes shown in Figure 1 of this report: "The Midwestern states were very concerned to see that, as with the 2002 FEIS, the draft SEIS fails to address regional equity and instead would have the vast majority of shipments from Southern reactors passing through the Midwest – principally through Illinois and Missouri. The SEIS explains the constraints DOE used when generating the routes in TRAGIS [computer model]. The states would like to know what specific constraint causes TRAGIS to 'select' these Midwestern-bound routes instead of heading straight west. We doubt there is any efficiency to be gained, for example, by having shipments from the South head due north for hundreds of miles into Ohio, only to wind up heading south again to get to Yucca Mountain."[87]

Reducing and Managing the Risks of Transporting Spent Nuclear Fuel

As a primary stakeholder in the Yucca Mountain program, the State of Nevada has spent three decades examining nuclear waste transportation safety and security issues. Nevada has used every available opportunity to propose constructive and realistic impact mitigation and risk management measures that Nevada believes are critical to ensuring public health and safety, and to achieving public acceptance. At the direction of the Nevada Legislature, the Agency in 1988 prepared a comprehensive report on transportation issues, known as the ACR 8 Report. Growing out of the ACR 8 Report, the Agency developed ten major safety and security recommendations:

1. Ship oldest SNF first (to reduce overall radiological hazards from fission products)
2. Use rail transport to extent feasible (to reduce number of cask shipments)
3. Use transportable storage casks, so-called dual-purpose casks (to reduce SNF handling and increase system flexibility)
4. Use dedicated trains and special train protocols (to prevent SNF being shipped with other hazardous materials in mixed freight trains and to reduce time in transit)
5. Require full-scale physical testing of shipping casks (to ensure compliance with accident performance standards; not now required by NRC or DOT)
6. Use NEPA process when selecting rail access routes to new facilities (to enhance public health and safety and environmental protection, and ensure public input)
7. Use the route selection process developed by the Western Interstate Energy Board, the so-called “Straw Man” process (to ensure full participation by affected States, local governments, and Native American Tribes)
8. Implement the transportation assistance program required under the NWPA Section 180(c) through a formal “Administrative Procedure Act,” rulemaking process (to ensure full participation by affected States, local governments, and Native American Tribes, and to ensure that adequate financial assistance is provided based on need)
9. Comply with State regulatory requirements (to promote safety and public acceptance, where not clearly pre-empted by Federal regulations)
10. Address terrorism and radiological concerns (to ensure credible threat assessment, and to require DOE shipments - currently exempt - to be fully regulated by NRC in accordance with the physical protection regulations under 10 CFR 73.37)

Taken together, these measures emphasize the development of a repository transportation system that is sensitive to the dangerous nature of these materials. Nevada has always sought the development of a repository transportation system that assesses risks in a comprehensive manner, that seeks to understand and reduce the risks of the system, and that will work with stakeholders to communicate risks effectively. Since 1997 Nevada has communicated these recommendations to the NRC, the NRC Advisory Committee on Nuclear Waste, the U.S. General Accounting Office (GAO), the U.S. Nuclear Waste Technical Review Board, the National Academy of Sciences (NAS) Study Committee on Transportation of Radioactive Waste, the National Association of Regulatory Utility Commissioners, and the BRC. As the policy discussion about transporting spent nuclear fuel has evolved, Nevada's initial recommendations have been proven to be durable and Nevada's position has been supported by the activities of other states, agencies, boards, and organizations, most recently by the Western Interstate Energy Board.[88] It is important to note that the first recommendation, shipping oldest fuel first, is probably not feasible for Yucca Mountain because DOE's repository design depends on using younger, hotter SNF to heat the emplacement drifts above the boiling point of water.

In 2006, the National Research Council of the National Academies Committee on Transportation of Radioactive Waste published an expert consensus report on spent nuclear fuel (SNF) and high-level radioactive waste (HLW) in the United States (referred to hereafter as the NAS Report). The nuclear industry, DOE and NRC, arguing that the past safety record of nuclear waste transportation is sufficient to answer any safety concerns going forward, frequently cite the opening sentence of the summary of findings: "The committee could identify no fundamental technical barriers to the safe transport of spent fuel and high-level radioactive waste in the United States."[89] That usually ends the discussion from the industry point of view. Nevada believes it is important to consider all of the findings and recommendations of the NAS report, but especially this cautionary statement:

> "Of course, spent fuel transportation is not risk-free, and past experience is not necessarily a useful predictor of future performance. The fact that spent fuel transportation risks have been low in the past does not necessarily mean that risks will also be low in the future. Future risks depend on a number of factors including the quantities and ages of spent fuel transported, associated scaling issues related to the overall size of the transport program, transport modes, and the care taken in fabricating

and maintaining transport packages and executing transportation operations. Ongoing vigilance by regulators and shippers will be essential for maintaining low-risk programs in the future, especially for the scale-up and operation of large-quantity shipping programs. Any accident or terrorist attack that results in the large-scale release of radioactive material into the environment would likely have worldwide implications and could result in a temporary or even permanent halt to ongoing transportation programs for spent fuel in the United States."[90]

The NAS Report published in 2006 adopted virtually all of Nevada's ten major recommendations for safety and security. The major exception was cask testing. Nevada previously advocated testing to determine cask failure conditions. NAS recommended testing to determine compliance with accident conditions specified in NRC regulations. Nevada adopted the NAS position on full-scale physical testing of casks to confirm compliance with regulations specifying cask performance in very severe transportation accidents.[91] The NAS recommendations were in turn adopted in the BRC 2012 Report to the Secretary of Energy.[92]

The SNF shipments DOE would make to Yucca Mountain would be vastly different from past SNF shipments in the United States.[93] For impact and risk analysis, the most significant of these differences:

- More than 40 Times More SNF (in MTHM) Shipped Per Year
- 8 to 38 Times More Casks Shipped Per Year
- 5 to 40 Times More Shipments Per Year
- 440% Increase in Average Rail Shipment Distance
- 280% Increase in Average Truck Shipment Distance
- Western Route Characteristics and Operating Conditions
- Potential Unprecedented Reliance on Heavy Haul Truck (and/or Barge) Shipments

Differences in radiological characteristics of past and future must also be considered, because these would be the primary drivers of impacts resulting from loading and unloading of shipping casks, routine shipping activities, transportation accidents, and acts of terrorism or sabotage against repository shipments.[94] All things considered, when measured in rems and curies,[95] the SNF that DOE would transport to Yucca Mountain would on average,[96] be at least 20-50 percent more radioactive than the SNF shipped prior to 2010.[97]

A final thought on the limitations of using past safety performance to predict future safety comes from Professor William Freudenburg's influential 1992 article, "Nothing Recedes Like Success?" Freudenburg, who studied both petroleum and nuclear transportation safety, made this precautionary observation regarding the Exxon Valdez tanker accident and massive oil spill in 1989: "Over 8,000 tankers had gone in and out of the port, over a period of more than a decade, without a single catastrophic failure. Based on the empirical track record up to that point, most observers presumably would have seen little reason for any particular concern."[98] Future shipments to Yucca Mountain would be so different from our past shipping experience, which is largely obsolete at this time, that comparisons are not useful.

The Western Interstate Energy Board Transportation Policy Papers

The High-Level Radioactive Waste Committee of the Western Interstate Energy Board has been at the forefront of policy recommendations for the safe and secure transportation of SNF and HLRW. The committee is comprised of members from ten western states. In 2016, the Committee began the process of designing and preparing policy statements that would serve to inform new committee members and continue to extend the committee's policy positions. The policies were designed through a process of negotiation and consensus. The committee voted on each policy and the policies were later adopted by a vote of the WIEB representatives. The current adopted policies are:

- *The "WIPP Transportation Model" and Its Application to SNF/HLW Transport.* This policy argues that the successful implementation of the transportation program to the Waste isolation Pilot Plant is a process that DOE should adopt for HLRW and SNF shipments. This policy was also recommended by the BRC.
- *Physical Protection Requirements for SNF Transport*. This policy recommends that the NRC physical protection standards designed to minimize vulnerability to terrorist attacks should be applied to DOE shipments of SNF HLRW. These standards are currently not required for DOE shipments.
- *Ship Oldest Fuel First.* The fission products in SNF and HLRW decay over time. The older the fuel is, the less dangerous it is. This policy, recommended by the NAS, will reduce environmental and human health consequences in the event of an accidental release.

- *Rail Route Safety: Track, Grade Crossings, Bridges, and Switches*. This policy recommends that the Federal Rail Administration (FRA) safety standards be applied to track used for shipping HLRW and SNF.
- *Rail Shipment Inspection.* For this policy, inspections should be planned for sites with direct rail access, and at the rail head for sites without rail access, as well as arrangements to conduct *en route* inspections and improvements in sensor and communications technology will be applied and adapted.
- *Social Risk.* This policy argues that any agency planning a large-scale spent nuclear fuel or high-level radioactive waste shipping campaign should follow the NAS recommendations regarding social risks, especially adverse social and economic impacts of stigma and risk perception.
- *Full-Scale Cask Testing.* This policy recommends full-scale testing in addition to regulatory analysis. Full-scale tests should be performed on casks used for current and future shipments. Full-scale tests should be designed to subject the packages to the hypothetical accident conditions as specified in the NRC regulations.
- *Origin Site Transportation Coordination.* This policy recommends extensive coordination with shipping sites. For example, the utility owner, in consultation with a state lead, should convene an origin site Working Group.
- *Funding for State and Local Development and Implementation of a Transportation System.* This policy recommends DOE (or any new management entity) should provide funding to the states and tribes for the development and maintenance of a comprehensive SNF/HLW transportation emergency preparedness program, regardless of funding source, and regardless of the destination's location or ownership.

These policy recommendations are the product of consensus discussion among the ten state committee members. The recommendations form a basis for interaction with the DOE should a HLRW/SNF shipping program proceed. To date, however, DOE has only partially endorsed or committed to implement any of these recommendations in plans for a DOE-operated system for transporting spent nuclear fuel and high-level radioactive waste.

The Western Interstate Energy Board transportation policy papers are available on-line at: https://westernenergyboard.org/download/high-level-radioactive-waste-committee-2018-policy-papers-november-2018/ .

Findings of the Commission on Nuclear Projects

This Commission, the Office of the Governor, the Office of Attorney General, and the Agency for Nuclear Projects, have been closely involved with the Yucca Mountain project and the federal high-level radioactive waste program for over three decades. Over 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.

Finding: Yucca Mountain remains an unsuitable site for a high-level nuclear waste geologic repository, and the State of Nevada remains steadfastly opposed to the proposed Yucca Mountain repository

This Commission concurs with Assembly Joint Resolution No. 10 of 2017, which "constitutes the official position of the Nevada Legislature." This Commission joins with the Nevada Legislature in protesting "in the strongest possible terms, any attempt by the United States Congress to resurrect the dangerous and ill-conceived repository for spent nuclear fuel and high-level radioactive waste at Yucca Mountain;" in calling "on President Donald J. Trump to veto any legislation that would attempt to locate any temporary, interim or permanent repository or storage facility for spent nuclear fuel and high-level radioactive waste in the State of Nevada;" in calling on "Rick Perry, the Secretary of Energy, to find the proposed repository for spent nuclear fuel and high-level radioactive waste at Yucca Mountain unsuitable, to abandon consideration of Yucca Mountain as a repository site, and to initiate a process whereby the nation can again engage in innovative and ultimately successful strategies for dealing with the problems of spent nuclear fuel and high-level radioactive waste;" and joins with the Legislature in formally restating "its strong and unyielding opposition to the development of Yucca Mountain as a repository for spent nuclear fuel and high-level radioactive waste and to the storage or disposal of spent nuclear fuel and high-level radioactive waste in the State of Nevada… ."

Finding: The remainder of 2019 and 2020 will continue to be a major political battlefield for the State of Nevada's struggle against the Yucca Mountain high-level nuclear waste repository, with the focus being on efforts to restart the NRC licensing process.

For three consecutive years, the Trump Administration has requested more than $150 million in new funding to restart the DOE Yucca Mountain repository program and the NRC licensing proceeding. The nuclear waste debates in Congress have focused on appropriations for the resumption of licensing and legislative efforts to accelerate the licensing proceeding in ways adverse to Nevada's interests.

DOE, under the Trump Administration, has abandoned the plan developed by the previous administration to implement the 2012 recommendations of the Blue Ribbon Commission (BRC) on America's Nuclear Future for restructuring the nuclear waste program. One of the first actions of the Department of Energy under President Trump was to terminate the promising consent-based siting program. At the end of 2016, DOE published a report summarizing input on consent-based siting received from the public and officials and published a draft consent-based siting plan in January 2017. The new Trump Administration not only refused to issue a final plan; the consent-based program was taken down from DOE's website, and the key program personnel responsible for consent-based siting left DOE.

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. These forces have, to varying degrees, opposed the previous DOE efforts to implement the BRC recommendations, generally qualifying any support for consent-based siting of storage facilities by conditioning it on the resurrection of the Yucca Mountain repository program.

Longtime proponents of Yucca Mountain have been appointed to, or are being considered for, important positions in the Department of Energy, other executive branch agencies, and the Nuclear Regulatory Commission. These Yucca Mountain proponents will continue to make major programmatic, budgetary and personnel decisions relating to the Federal nuclear waste program. 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 reconstitution of

the DOE Office of Civilian Radioactive Waste Management and the possible resumption of a multiple year NRC licensing proceeding.

Finding: Recent developments regarding spent nuclear fuel storage have eliminated the argument that the Yucca Mountain repository is needed to continue nuclear power plant licensing or to prevent nuclear power plant retirements.

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, or to prevent early retirement of operating reactors. Early reactor retirements are the result of economic competition from electric generating plants fueled by natural gas and renewable energy sources. The future of Yucca Mountain and the future nuclear power in the United States now have been separated.

The NRC has accepted license applications for interim storage facilities that would be located in Andrews County, Texas, and 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 using dry storage systems similar to, those being used for storage at reactor sites. Important details about these proposed facilities are unresolved, especially regarding host state consent, use of the Nuclear Waste Fund to pay the cost of interim storage, and transportation impacts.

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

In the past three Congresses, the Senate Committee on Energy and Natural Resources has considered comprehensive legislation, entitled the Nuclear Waste Administration Act, to restructure the nation's nuclear waste program following the BRC recommendations. The current version, S. 1234, is sponsored by Republican Senators Lisa Murkowski of Alaska, and Lamar

Alexander of Tennessee, and Democrat Diane Feinstein of California. In its current version, S. 1234 is not acceptable to the State of Nevada because it would continue the status quo regarding Yucca Mountain. Nevada Senators Catherine Cortez Masto and Jacky Rosen are attempting to amend S. 1234 along the lines of the Nuclear Waste Informed Consent Act, introduced by the Nevada congressional delegation. After extending the consent process to Nevada, the 116th Congress should resume action to implement the BRC recommendations, giving the highest priority to taking the federal nuclear waste program out of DOE, creating a consent based process for siting high-level nuclear waste storage and disposal facilities, and adopting measures to enhance transportation safety and security. The following five findings of the Commission, based on past experience with Yucca Mountain, support these priorities for congressional action.

Finding: 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. The Act required DOE to formally evaluate giving up program control, but 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.[99] DOE's track record over the past four decades provides little hope that DOE can change itself. On top of the heavy-handed manner by which DOE has implemented the Yucca Mountain program, DOE's 2018 secret shipments of weapons plutonium from South Carolina to NNSS make it extremely unlikely that DOE can ever obtain the level of trust and confidence necessary to manage a successful nuclear waste management program in the future.

Finding: 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*?[100] **As** DOE's site characterization program revealed potentially disqualifying conditions at the site (including fast groundwater pathways), DOE scrapped its own site evaluation guidelines[101] 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.[102]

Finding: 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. Provisions of the amended act allowing state disapproval of siting decisions did not protect Nevada. The Bush 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.

Finding: Congress shares a large portion of the blame for the failure of the federal high-level radioactive waste program. The original NWPA 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.[103] 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 publicly acceptable process can go forward.

Finding: DOE's Yucca Mountain transportation plan would impose unacceptable radiological impacts on Nevada and more than 30 other states; additional safety and security measures are required to protect Nevada and the entire Country from these unprecedented transportation impacts and risks.

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.[104] 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.[105] 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, 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. The Western Interstate Energy Board (WIEB), comprised of Governors' appointees from ten major western states, has recently approved policy papers calling for implementation of the NAS and BRC recommendations before any large-scale shipping campaigns to nuclear waste storage or disposal facilities.

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 Yucca Mountain repository program, and in protecting the State's interests if the NRC licensing proceeding restarts. We expect continued and 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 consider a new consent-based approach to selecting sites for nuclear waste storage and disposal. 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: The Governor, the Agency, and the Legislature should continue to work with Nevada's Congressional delegation to amend the Nuclear Waste Policy Act to implement the recommendations of the Blue Ribbon Commission (BRC) on America's Nuclear Future, especially consent-based siting for nuclear waste storage and disposal facilities, and the need for enhanced transportation safety and security.

Discussion

The State of Nevada has demonstrated convincingly that Yucca Mountain is an unsafe and unworkable site for a geologic repository. The Commission believes that Nevada has an excellent chance of prevailing in the NRC's licensing proceeding by demonstrating that DOE's license application to construct such a repository at the site should be rejected. But the Commission understands that the country must realistically address the larger nuclear waste problem. The Commission endorses a new approach to high-level nuclear waste management that encompasses the following elements based on the recommendations of the BRC:

1. Terminate the current Yucca Mountain program for good. If Yucca Mountain remains under consideration the broken federal program will not and cannot be fixed.

2. Enact the Nuclear Waste Informed Consent Act, H.R. 1544 and S. 649, the legislation sponsored by Nevada's congressional delegation, to extend consent to Nevada regarding Yucca Mountain by requiring a written consent agreement with any host state

Governor, affected counties and Indian tribes, prior to construction of a geologic repository. Alternatively, amend S. 1234, the Nuclear Waste Administration Act, to provide consent provisions equal to those proposed in H.R. 1544 and S. 649.

3. Fix the broken nuclear waste program by taking the program out of the DOE organization, instituting a consent-based siting process, developing one or more consolidated interim storage facilities, promulgating new generic, scientifically based repository performance standards, and eventually initiating a new repository site search when a workable framework for such a search is in place. This is consistent with the BRC recommendations and already partially contained in S. 1234.

4. Reexamine the costs of interim storage at consolidated sites and at reactors, and geologic disposal in various host rocks and design configurations and assess the need for re-instating the annual nuclear waste fee, and various proposals for appropriating funds from the Nuclear waste Fund.

5. Address host community concerns about spent nuclear fuel stored at shutdown reactors, including safety and security improvements, and economic compensation.

6. Implement all transportation safety and security measures recommended by NAS and the BRC, including shipping the oldest fuel first, conducting full-scale testing of transportation casks, selecting modes and routes in cooperation with states and tribes (as full partners), and providing financial assistance to states, local governments and tribes along shipping routes to prepare for and adequately respond to spent nuclear fuel and high-level radioactive waste shipments.

7. Institute a major new National Academy of Sciences and Engineering study to address alternative waste disposal methods (such as deep borehole disposal) and implications of new reactor technologies for the entire nuclear fuel cycle.

The Commission believes it is time for the country to finally move past the current failed repository program and recognize that Yucca Mountain is, in fact, the single greatest impediment to solving the waste problem, preventing the country from going forward with sound and workable solutions like those recommended by the BRC.

Recommendation: The Governor and Legislature must continue to 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-its-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 to protect the State of Nevada's interests and assure that the 218 already admitted[106] 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 participation by the State of Nevada and 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. The Legislature has appropriated the funds requested by the Agency and the Attorney General in their biennial budget requests for FY 2020 and FY 2021. Those requests contain their best estimates of what Nevada will require to engage in the early phases of a restarted Yucca Mountain licensing proceeding. However, it is almost certain that additional resources will be needed when full-scale NRC and DOE licensing activities resume.

Recommendation: In the event that Congress appropriates new funds for DOE and NRC Yucca Mountain licensing activities and/or enacts legislation to resurrect the Yucca Mountain program, the Agency for Nuclear Projects 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. A major element of this effort would be coordination with the Western Interstate Energy Board.

Discussion

The Commission believes that the State of Nevada must take a lead role in addressing the unprecedented transportation impacts that will affect the entire country for five decades or more if DOE were to implement its proposed plans for shipping spent nuclear fuel and high-level radioactive waste to a Yucca Mountain repository.

DOE and the commercial nuclear industry have developed major public relations programs to downplay the transportation impacts of the repository program and to obscure the resulting risks that would be 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, will be needed to obtain implementation of the risk management measures proposed by WIEB. Such a campaign will also mitigate the support for further forced-siting approaches, such as H.R. 2699, that are being considered in Congress.

At this Commission's December 2018 meeting, several Commissioners recommended that the Agency develop an updated and expanded public information program and make greater use of the internet and social media, to communicate effectively not only with Nevadans but also with affected parties across the Country who would be impacted by nuclear waste transportation to Yucca Mountain. The Agency has undertaken similar efforts over the past two decades. The Commission continues to believe that an expanded public information 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.

Endnotes

[1] Governor Sisolak's remarks about Yucca Mountain are between 44:00-46:00 in the speech, part of his discussion about energy policy, public lands, natural resources, and environmental protection. https://www.lasvegasnow.com/news/local-news/watch-gov-steve-sisolak-gives-inaugural-state-of-the-state-speech/1706866066
[2] http://usnuclearenergy.org/PDF-Documents/11-14-16-WSJ-Trump-Harry-Reid-and-Horse-he-rode-in-on-Yucca.pdf
[3] http://gov.nv.gov/News-and-Media/Press/2017/Governor-Sandoval-Leads-Efforts-to-Pursue-All-State-Options-to-Defeat-Yucca-Mountain/
[4] DOE FY 2020 Congressional Budget Justification, DOE/CF-0153 (March 2019) Vol. III, Part 2, pages 402, 409-416. https://www.energy.gov/sites/prod/files/2019/04/f61/doe-fy2020-budget-volume-3-Part-2.pdf
[5] NRC FY 2020 Congressional Budget Justification, NUREG-1100, Vol. 35, page 73. https://www.nrc.gov/docs/ML1906/ML19065A279.pdf
[6]DOE FY 2020 Congressional Budget Justification, Vol. III, Part 2, page 402-403.
[7] https://docs.house.gov/meetings/AP/AP00/20190521/109534/CRPT-116-AP00-Vote1-3-20190521.pdf
[8]https://www.congress.gov/bill/116th-congress/house-bill/2960/text
[9] https://www.congress.gov/bill/116th-congress/house-bill/2740/all-actions?overview=closed&q=%7B%22roll-call-vote%22%3A%22all%22%7D
[10] https://www.appropriations.senate.gov/news/fy2020-energy-and-water-development-appropriations-bill-advanced-by-full-committee
[11] H.R. 4378, the Continuing Appropriations Act for FY2020, passed the House 301-123 on September 19, passed the Senate 81-16 on September 26, 2019, was signed by President Trump on September 27, 2019, and became Public Law No. 116-59. See: https://www.congress.gov/bill/116th-congress/house-bill/4378/all-actions?overview=closed#tabs
[12] In re Aiken County, 725 F.3d 255 (D.C. Cir. 2013).
[13] 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.
[14] 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. In 2014, NRC prepared an estimate on how much funding and time it would need to resume and complete the proceeding, in response to a request from the House Appropriations Committee. The estimate—$330 million in NRC's costs and up to 5 years to resume and complete the Yucca Mountain licensing adjudication. See Letter from NRC Chairman Alison McFarlane to Chairman of the House Committee on Appropriations, Harold Rogers, and August 29, 2014.
[15] SRM-COMSECY-18-0015: Yucca Mountain Project Activities Associated with COMSECY-17-0019, dated 10/15/2018 (ML18289A672).
[16] Nuclear Regulatory Secretary's Memorandum of October 15, 2018, to E. Roy Hawkens, Chief Administrative Judge, it is reported that the "Commission has approved the staff's recommendation that the Commission defer further action regarding a Nevada hearing facility" . . . (Staff Requirements – COMSECY-18-0015 – Yucca Mountain Project Activities Associated with COMSECY-17-0019).
[17] COMSECY-18-0015, 08/16/2018 Memorandum from Hawkens and Vietti-Cook to Commissioners, p. 5
[18]NRC Monthly Status Report Activities Related to Yucca Mountain Licensing Action for July 2019, dated 9/03/201 (ML19206A118).
[19]NRC Monthly Status Report Activities Related to Yucca Mountain Licensing Action for December 2018, dated 1/29/2019 (ML18353A485).
[20] See Response Sheets from Commissioner's Svinicki, Caputo, and Wright. VR-COMSECY-18-0015: Yucca Mountain Project Activities Associated with COMSECY-17-0019, dated 10/11/2018 (ML18289A683)
[21] Texas failed to identify a triggering event that fell within the mandatory deadlines for filing a legal challenge under the NWPA. 42 U.S.C. § 10139.
[22] See Appendix 12 for R. Halstead's response to question from Rep. Shimkus from the June 13, 2019 Hearing providing a full accounting of State and federal monies expended by the State of Nevada for Yucca Mountain licensing activities since 2008.
[23] In the latest NRC commissioner's Response Sheets to staff recommendations for expending the remaining NWF funds, a majority of the commissioners (Svinicki, Caputo, and Wright) indicated a desire to preserve remaining funds for ongoing and future litigation support rather than to expend the remaining funds on improvements to the LSN as recommended by staff. VR-COMSECY-18-0015: Yucca Mountain Project Activities Associated with COMSECY-17-0019, dated 10/11/2018 (ML18289A683).
[24] Appendix D of 10 C.F.R. Part 2)
[25] The Construction Authorization Board (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.
[26]https://www.nrc.gov/about-nrc/organization/commission/former-commissioners/former-commissioners.html
[27] https://www.nrc.gov/about-nrc/organization/commfuncdesc.html
[28] The "no action" alternative in the NRC's National Environmental Policy Act (NEPA) Environmental Impact Statement supporting the Continued Storage Rule 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. The 2008 DOE SEIS assumed that long term interim storage would result in significant environmental impacts, while NRC's 2014 Continued Storage EIS determined that the impacts of such storage would be minimal and acceptable for at least 160 years.

[29] https://www.leg.state.nv.us/App/NELIS/REL/79th2017/Bill/5230/Overview. The resolution had nine sponsors and 23 co-sponsors.

[30] AJR 4, 73rd Legislature (2005).

[31] https://www.leg.state.nv.us/App/NELIS/REL/80th2019/Bill/6258/Overview. The resolution had five primary sponsors and 23 co-sponsors.

[32] https://cisac.fsi.stanford.edu/research/projects/reset-nuclear-waste-policy

[33] The legal documents filed in the case are available on the Agency website at http://www.state.nv.us/nucwaste/policy.htm

[34] DOE, *FSEIS*, Appendix F, pages F-29 to F-38; Appendix G, pages G-55 to G-57.

[35] See for example https://lasvegassun.com/news/2019/sep/08/nye-county-officials-on-yucca-mountain-lets-sit-do/; https://pvtimes.com/opinion/dan-schinhofen-to-nevada-governor-dont-follow-the-old-yucca-playbook-73137/; https://www.documentcloud.org/documents/6174306-19-0244LB.html#document/p3

[36] https://elkodaily.com/opinion/columnists/using-yucca-mountain-to-jump-start-nevada-in-the-energy/article_7a6fe9e7-6a2b-543d-8b5a-5f7d07c0d46e.html; https://www.rgj.com/story/opinion/voices/2019/08/06/nevada-missing-opportunity-spent-nuclear-fuel-says-duarte/1931933001/; https://nevadanscan.com/recycle-nuclear/

[37] Blue Ribbon Commission on America's Nuclear Future, *Report to the Secretary of Energy* (January 2012) https://www.energy.gov/sites/prod/files/2013/04/f0/brc_finalreport_jan2012.pdf

[38] The BRC report "focused on developing a sound strategy for future storage and disposal facilities and operations that we believe *can and should be implemented regardless of what happens with Yucca Mountain.*" [p. viii, italics in original]

[39] 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.

[40] 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.

[41] 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.

[42] Edison Garcia, Land Law Examiner, Nevada State Office, BLM, Email to Marta Adams, December 23, 2016.

[43] 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

[44] NRC, Staff's Adoption Determination Report, Pages 3-10 to 3-12 (September 5, 2008).

[45] California's contentions are available at: http://www.state.nv.us/nucwaste/licensing/Contentions_CA.pdf.

[46] Inyo County's contentions are available at: http://www.state.nv.us/nucwaste/licensing/Contentions_Inyo.pdf

[47] Timbisha Shoshone Tribe's contentions are available at: http://www.state.nv.us/nucwaste/licensing/Contentions_Timbisha.pdf

[48] NRC, Supplement to the USDOE's EIS, Final Report, NUREG-2184, Page xii (May 2016).

[49] George Gholson, Chairman, Timbisha Shoshone Tribe, to Cindy Bladey, US NRC, Comments on Supplement to Environmental Impact Statement on Nuclear Waste Repository at Yucca Mountain, Docket ID NRC-2015-0051, November 17, 2015, page 6.

[50] Gholson to Bladey, Comments, November 17, 2015, page 9.

[51] Ian Zabarte, Native American Belief in Water: An Environmental Justice Context, 2015, cited in State of Nevada, Comments to NRC on NUREG-2184, Docket ID NRC-2015-0051, Pages 50-53 (Nov. 20, 2015).

[52] DOE, OCRWM, *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).
http://www.state.nv.us/nucwaste/news2018/pdf/FY_2007_TotalSystemLifeCycleCost_Pub2008.pdf
Additional information is available in OCRWM, *Summary of Program Financial and Budget Information* (January 1, 2010).
http://www.state.nv.us/nucwaste/news2018/pdf/ocrwm-budget-summary.pdf

[53] DOE, *Nuclear Waste Fund Fee Adequacy Assessment Report* (January 2013).
http://www.state.nv.us/nucwaste/news2018/pdf/11-1066-2013-01_18.pdf

[54] Yucca Mountain future total costs of $96.7 million, minus $45.6 billion for packaging, transportation, and other program costs not required for repository construction and operations.

[55] "The direct repository costs in the UFD study is compared to an adjusted YM TSLCC values of $51.3B ($97.0 B less $45.6B). A relative cost scaling factor for each of the alternative repository concepts is presented in Table 4-1. Overall the alternative

repository concepts range from about half the cost of the YM repository (established by the lost cost for either a bedded salt repository or an open mode shale repository) to about 80% higher than the YM repository (established by the high cost for the shale enclosed repository). These factors are for the direct repository costs only. Transportation, consolidated storage and used fuel packaging/repackaging costs as required for an integrated SNF management system architecture are not included." Page 76. Salt repository compared to Yucca Mountain: Low Cost Scenario, 51.3 - 24.3 = 27.0 Billion less expensive; High Cost Scenario, 51.3 - 39.4 = 11.9 Billion less expensive. Shale repository compared to Yucca Mountain: Low Cost Scenario, 51.3 - 25.5 = 25.8 Billion less expensive; High Cost Scenario, 51.3 - 38.7 = 12.6 Billion. See Table 4-1, page 77. DOE, *Nuclear Waste Fund Fee Adequacy Assessment Report* (January 2013). http://www.state.nv.us/nucwaste/news2018/pdf/11-1066-2013-01_18.pdf.

[56] We start with the $82.64 billion future cost in 2007$, and increase by 21% to reflect the estimated increase in the CPI to 2019, resulting in a $99.99 billion cost. The CPI increased 18 percent between 2007 and 2017, at an annual average rate of about 1.6 percent. The TSLCC estimated DOE licensing costs of $1.66 billion in 2007$. NRC recently estimated licensing costs at $330 million. The 2008 TSLCC is the source for the commonly cited $96 billion (2007$) total cost for the Yucca Mountain repository project: historical costs of $13.54 billion (2007$) plus future costs of $82.64 billion (2007$).The DOE 2008 TSLCC Analysis provides detailed estimates, in constant 2007 dollars, of past nuclear waste program costs (1983-2006) and projects nuclear waste program costs (2007-2133). DOE uses same year constant dollars to remove the effects of inflation [TSLCC, 2] Separate defense appropriations would pay approximately 20 percent of the program cost for disposal of defense HLW and DOE-owned SNF. [TSLCC, 32-33] DOE would need ten years and $13.51 billion (2007$) to obtain a construction authorization and license to receive radioactive materials from the NRC, and complete required construction before receiving SNF and HLW. Even with historically low inflation, the CPI increased 18 percent between 2007 and 2017, at an annual average rate of about 1.6 percent. DOE would require $32.55 billion (2007$), or $1.3 billion (2007$) per year, for the next 25 years of repository construction and operations. Even if the inflation rate was low by historical standards, about 1.6 percent per year, DOE still would need to request an appropriation of about $1.5 billion in the first year of full operations. If inflation continued at only 1.6 percent per year, by Year 25, the DOE annual appropriations request could be $2.0 billion. If the inflation rate was the same as between 1983 and 2008, DOE would need to request about $2.7 billion for Year 25.

[57]The most recent DOE nuclear waste fund audit report (November 2018) says the revenue balance in the Nuclear Waste Fund (NWF) was $41.9 billion on September 30, 2018, and that the fund earned $1.5 billion in interest during FY 2018. The 2018 audit report provides an overview of the accounting procedures under which the NWF operates, the statutory provisions governing congressional appropriations for the NWF, and estimates DOE's outstanding liabilities due to partial breach of the Standard Contract with nuclear utilities, which obligated DOE to begin disposing of spent nuclear fuel on January 31, 1998 ($28.1 billion) https://www.energy.gov/sites/prod/files/2018/11/f58/DOE-OIG-19-08_0.pdf

[58] 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), Chapters 2, 3, 6, 8, Appendix G, and Appendix H. Available on-line at https://energy.gov/sites/prod/files/EIS-0250-S1-FEIS-01-2008.pdf

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

[60] 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

[61] F. Dilger, *Congressional Districts Potentially Affected by Shipments to Yucca Mountain, Nevada* (July 25, 2017), available on-line at http://www.state.nv.us/nucwaste/news2017/115th%20Congressional%20Districts%207252017.pdf

[62] DOE, *FSEIS*, pages S-7 to S-8.

[63] DOE, *FSEIS*, pages 6-8, 8-41. DOE says about 95 percent of the total would be shipped in dedicated trains hauling nuclear waste only, consisting of 3 to 5 cask cars, separated from one another by an equal number of buffer cars, and a personnel car carrying armed guards. DOE's stated plan to use dedicated trains is only a promise, since federal rail regulations allow SNF and HLW to be shipped by rail in general freight service. Shipping SNF in general freight would significantly increase the number of shipments, result in increased risk of radiation exposures in incident-free transport, and heighten the risk of accidents or sabotage overall.

[64] Table 1 presents a very conservative estimate of radiological hazards, because it is based on the average characteristics of the spent nuclear fuel typical of the 1980s (pressurized water reactor fuel with a burn-up of 33 Gigawatt days thermal/MTHM). The radiological hazards of DOE's 2008 reference spent fuel could be 20-50 percent greater. The radiological hazards of the so-called "high burnup" fuel currently being discharged from U.S. reactors could be even greater still

[65] DOE, *Final 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-0250 (February 2002), Appendix A, Inventory and Characteristics of Spent Nuclear Fuel, High-Level Radioactive Waste and Other Materials, pages A-8, A-9, A-18, A-21,A-23, A-25. Typical rail cask contains 21 PWR SNF assemblies.

[66] According to DOE's FSEIS, "incident-free" exposures to members of the public residing near transportation routes, cumulative total up to 2,500 person-rem dose and 1.5 latent cancer fatalities, and in certain special circumstances (for example, 0.016 rem to a person in a traffic jam); [Pp.6-20, 6-21, 8-41], and "incident-free" exposures to transportation workers such as escorts, truck drivers, & inspectors, cumulative total up to 13,000 person-rem and 7.6 latent cancer fatalities (by administrative controls, DOE would limit individual doses to 0.5 rem per year; the allowable occupational dose is 5 rem per year). [Pp.6-21, 8-

41] See also FSEIS Appendix D, Radiological Health Impacts Primer and Estimation of Preclosure Radiological Health Impacts, pages D-1 to D-30.

[67] According to DOE's *FSEIS*, release of radioactive material as a result of the maximum reasonably foreseeable transportation accident (probability about 5 in one million per year), involving a fully engulfing fire, 34 rem dose to the maximally exposed individual, 16,000 person-rem population dose and 9.4 latent cancer fatalities in an urban area, and cleanup-costs of $300,000 to $10 billion; [Pp.6-15, 6-24, G-56

[68] According to DOE's FSEIS, release of radioactive material following a successful act of sabotage or terrorism, using a high-energy density device, resulting in 27-43 rem dose to the maximally exposed individual, 32,000-47,000 person-rem population dose and 19-28 latent cancer fatalities in an urban area, and cleanup costs similar to a severe transportation accident. [Pp.6-27, CR-467]

[69] 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).

[70]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

[71] See State of Nevada's Petition to Intervene as A Full Party, Docket 63-001, (December 2008), Contentions NEV-NEPA-01, NEV-NEPA-02, NEV-NEPA-03, http://www.state.nv.us/nucwaste/licensing/Contentions_NV.pdf.

[72] H.E. Collins, G.R. Gathers, and R.J. Halstead, Radiological Impacts of Incident-Free Transportation to Yucca Mountain: Collective and Maximally Exposed Individuals, Paper Presented at the Health Physics Society 47th Meeting, Tampa, FL (June 2002), http://www.state.nv.us/nucwaste/news2003/pdf/HPSPaper-FEISImpactsCritique6-20-02.pdf ; For DOE's view, see *FSEIS*, Appendix D, Radiological Health Impacts Primer and Estimation of Preclosure Radiological Health Impacts, pages D-1 to D-30, especially pages D-4 to D-7.

[73] R.J. Halstead, F. Dilger, R.C. Moore, "Rail Access to Yucca Mountain: Critical Issues," WM'03 Conference, Tucson, AZ (February 2003), http://www.state.nv.us/nucwaste/news2003/pdf/nv030225d.pdf;

[74] R.J. Halstead, F. Dilger, J. D. Ballard, "Yucca Mountain Transportation Planning: Lessons Learned, 1983-2009," *WM2011 Conference, February 27 – March 3, 2011, Phoenix AZ*, available on-line at http://www.state.nv.us/nucwaste/news2011/pdf/wm2011rjh.pdf

[75] DOE, *FSEIS*, page 6-58.

[76] S. Tetreault, "New National Monument blocks rail route to Yucca," Las Vegas Review Journal, July 13, 2015, https://www.reviewjournal.com/news/new-national-monument-blocks-rail-route-to-yucca/

[77] DOE, FSEIS, pages 6-18 to 6-19.

[78] State of Nevada Comments on DOE's Draft Supplemental Rail Corridor and Drat Rail Alignment Environmental Impact Statements, January 9, 2008, http://www.state.nv.us/nucwaste/news2008/pdf/nv080109rail.pdf

[79] B. Halstead, "Review of Proposed Mina/Schurz Rail Route," Presentation to NCNP, February 28, 20007, http://www.state.nv.us/nucwaste/news2007/pdf/nv070228halstead.pdf

[80]F. Dilger, Yucca Mountain Transportation Impacts in Nevada, (June 22, 2012), available on-line at http://www.state.nv.us/nucwaste/news2015/pdf/Dilger%20YM%20Transport%20Impacts%20in%20NV.pdf

[81] Agency staff and contractors are currently updating the Las Vegas hotel room and non-resident population estimates. The number cited here were submitted to the NRC in 2008 as part of admitted contentions.

[82]DOE/EIS-0250F, Volume I, Impact Analyses, page 3-95; Volume III, Comment Response Document, page CR-467.

[83] If 20 percent of the spent fuel is shipped by truck, a more realistic case than the 5 percent assumed by DOE, the number of truck shipments on I-215 could be 15,000 to 20,000. All reactors shipping by truck would use I-15 from Arizona and California to Nevada, then use the northern and western portions of the Las Vegas Beltway (I-215) to connect with US 95 to Yucca Mountain. See: DOE/EIS-0250F, Volume I, Figure 6-1, page 6-18.

[84] Planning Information Corporation, *The Transportation of Spent Nuclear Fuel and High-Level Radioactive Waste*, September 1996 http://www.state.nv.us/nucwaste/trans/1pichome.htm

[85] R.J. Halstead, SEIS Shipments – Full MTU (No second repository), Consolidated Southern Routing, Technical Memo to Files, June 5, 2015. Calculations based on Bechtel SAIC Company, Calculation of Transportation Data for SEIS (2007), DOE/EIS-0250F Reference 181377.

[86] Without southern routing, for the first 70,000 MTHM, 25 percent of the rail shipments to Yucca Mountain, 704 trains, would travel through the Chicago area. Another 94 trains. 3.4 percent of the total, would travel just west of the Chicago area between Morris and West Chicago. All of the shipments would exit the Chicago area on the UP from Proviso to West Chicago, then travel the UP system to Caliente via Fremont, Gibbon, and Salt Lake City. About 54 percent of the truck shipments, more than 1,400 trucks, would travel I-80 and I-294 between Lansing and Tinley Park.

[87] DOE, *FSEIS*, Vol. III, Comment-Response Document, pages CR-234 to CR-235.

[88] Dilger, Ballard, Halstead, "Stakeholder Transportation Scorecard: Reviewing Nevada's Recommendations for Enhancing the Safety and security of Nuclear waste Shipments," Waste Management 2013 Conference, Phoenix Arizona (February 2013) http://www.state.nv.us/nucwaste/news2015/pdf/Dilger%20Stakeholder%20Transportation%20Scorecard%20Paper.pdf

[89] NAS, Going the Distance, p. 2.

[90] NAS, Going the distance, Pp. 179-180.

[91] Halstead and Dilger, Nevada Update on Yucca Mountain Transportation Issues, Presentation to Nevada Commission on Nuclear Projects, April 26, 2006. The NAS concluded DOE's selection of the Caliente rail alignment complied with NEPA. Nevada does not agree.

[92] BRC, Report to the Sectary of Energy, February 2012, Chapter 9 https://www.energy.gov/sites/prod/files/2013/04/f0/brc_finalreport_jan2012.pdf

[93] Halstead and Dilger, "How Many Did You Say? Historical and Projected Spent Nuclear Fuel Shipments in the United States, 1964 – 2048,"Waste Management '03 Conference, February 25, 2003, Tucson, AZ. http://www.state.nv.us/nucwaste/news2003/pdf/nv030225b.pdf See also NRC, Public Information Circular for Shipments of Irradiated Reactor Fuel, NUREG-0725, Rev. 15 (May 2010).

[94]The most important radiological characteristics of spent nuclear fuel relative to transportation are the surface dose rate (usually expressed in rem per hour[94]), total activity of the radionuclide inventory (usually expressed in curies), and the amount (also expressed in curies) of certain fission products, especially cesium-137, in the radionuclide inventory. Cesium-137, half-life 30 years, is a major source of penetrating gamma radiation and has a highly reactive physical chemistry if released to the environment. These values are generally reported either for a single assembly of a selected representative spent fuel, or for one metric ton of heavy metal (MTHM) or uranium (MTU) initial enrichment before irradiation of a selected representative spent fuel. The radiological characteristics of the commercial spent nuclear fuel used in the United States are determined primarily by the initial enrichment with uranium-235 (expressed as a percentage of U-235 by weight), the burnup or power history of fuel use in a light-water reactor (a measure of residence time and power output, usually expressed in Giga-watt days thermal per MTU), and the cooling time after withdrawal of the assembly from the reactor core (usually expressed in days or years). Two types of light-water reactors are currently used in the United States, pressurized water reactors (PWRs) and boiling water reactors (BWRs). PWR and BWR fuel assemblies may differ significantly in their physical dimensions (length, diameter, and weight) but have generally similar overall radiological characteristics, when assemblies with a similar burnup history and cooling time are compared on an MTU basis. Because PWR spent fuel is expected to make up about two-thirds of the total projected spent fuel shipments to a repository, most U.S. analyses of repository transportation impacts have used values for a representative PWR assembly when calculating transportation risks and impacts. A representative spent fuel assembly is also used for analytical purposes because radiological characteristics vary significantly among PWR and BWR fuel designs manufactured. Excerpted from Henry Collins, MD, CHP, PE, "Radiological Characteristics of Spent Nuclear Fuel for Shipments to Yucca Mountain," Final Review Draft, June 30, 2006, Prepared for the Nevada Agency for Nuclear Projects.

[95] In this report, we use the American rather that the international system (SI) radiation units. The international system (SI) unit for dose exposure is the sievert (Sv), 1 sievert = 100 rem. Named after Swedish physicist Rolf Sievert. In the international system (SI), a measure of how many atoms in the material decay (or disintegrate) in a given time period. One bequerel (Bq) represents a rate of radioactive decay equal to 1 disintegration per second, and 37 billion (3.7 x 1010) Bq equals 1 curie (Ci). Named after French physicist Antoine Henri Bequerel

[96] The reference PWR fuel assembly chosen for analysis by DOE has an overall length of about 13.45 feet, a total weight of about 1,455 pounds, and before irradiation contains about 1,014 pounds of uranium (460 kilograms, which equals 0.46 MTU or MTHM).[FEIS, 2002, Table A-18, p. A-25. The original heavy metal is about 973.4 pounds Uranium-238, and 40.6 pounds Uranium-235, for a total of 1,014 pounds.] For the reference PWR spent fuel analysis, DOE has specified an initial enrichment of 4 percent Uranium-235 (thus 96 percent Uranium-238), a burn-up of 60 gigawatt-days per MTHM, and a decay time of 10 years. [SFEIS, 2008, Appendix G, p. G-34] The reference PWR spent fuel assembly contains about 966 pounds of Uranium-238 (out of an original 973 pounds), 12.7 pounds of plutonium isotopes (6.17 pounds of Plutonium-239), and 1.74 pounds of Cesium-137 (71,600 curies). [Calculated from FSEIS, 2008, Table G-15, p. G-28.] The 2008 FSEIS states that for pressurized-water-reactor spent nuclear fuel, DOE would ship an estimated 93,671 spent nuclear fuel assemblies in rail and truck casks; for boiling-water-reactor spent nuclear fuel, the DOE would ship 128,105 spent nuclear fuel assemblies in rail and truck casks. [FSEIS, Vol. 6, Appendix G, p. G-34.] DOE assumes that each rail cask would transport 21 PWR or 44 BWR SNF assemblies. DOE assumes each truck cask would transport 4 PWR or 9 BWR SNF assemblies.

[97] J. Peterson & J.C. Wagner, "Characteristics of Commercial Spent Nuclear Fuel: Distributed, Diverse and Changing with Time," *Radwaste Solutions* (January 2014)

[98] W.R. Freudenburg, "Nothing Recedes Like Success? Risk Analysis and the Organizational Amplification of Risks," Risk – Issues in Health and Safety, Vol. 1 [Winter 1992] p. 20.

[99] 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."

[100] 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.

[101] 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.

[102] The statutory benefit language itself 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. When Representative Shimkus attempted to legislate larger economic benefits for the State of Nevada and Nevada Counties as part of H.R. 3053 in 2018, the House of Representatives Rules Committee made it clear that Congress could not legislate such contractual obligations for future Congresses.

[103] 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

[104] 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)

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

[106] 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.