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OFFICE OF SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

PRM-63-1

July 12, 2002

Delivered Via Messenger
Ms. Annette L. Vietti-Cook
Secretary
U.S. Nuclear Regulatory Commission
Washington D.C. 20555-0001

ATTN: Rulemakings and Adjudications Staff

RE: Petition by the State of Nevada to Institute Rulemaking to Amend 10 C.F.R. Part 63 – Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada

Dear Ms. Cook:

Enclosed please find an original and two copies of the above-referenced Petition for Rulemaking, which we hereby respectfully file on behalf of our client, the State of Nevada. (Please date-stamp a copy of this cover letter as proof of service and return it to our messenger.)

We understand from recent representations by the Department of Energy (DOE) that it will not be prepared to file a license application for the Yucca Mountain repository until December 2004 at the earliest. However, we are also aware that Nuclear Waste Policy Act Section 114(b) nevertheless requires DOE to submit an application to the Nuclear Regulatory Commission for Yucca Mountain licensing "not later than 90 days" after this week's Congressional resolution approving the site designation becomes law.

Accordingly, please note that, in the event DOE complies with the law and files an application in 90 days pursuant to the timing requirements of Section 114(b), this petition asks NRC, pursuant to 10 C.F.R. § 2.802(d), to suspend the Yucca Mountain licensing proceeding pending resolution of this petition.

Nevada trusts that this grave matter will receive the utmost attention by the Commission.

Template= SECY-051

SECY-02

Thank you.

Sincerely,

Joseph R. Egan
Attorney for Petitioner

JRE/ec
Enclosure

c: Chairman Richard A. Meserve (w/enclosure)
Commissioner Greta Joy Dicus (w/enclosure)
Commissioner Nils J. Diaz (w/enclosure)
Commissioner Edward McGaffigan, Jr. (w/enclosure)
Commissioner Jeffrey S. Merrifield (w/enclosure)
Karen Cyr, Esq. – General Counsel (w/enclosure)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before
THE COMMISSIONERS

IN THE MATTER OF THE PETITION OF THE STATE OF NEVADA FOR THE AMENDMENT OF REGULATIONS FOR THE DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTES IN A GEOLOGIC REPOSITORY AT YUCCA MOUNTAIN, NEVADA, CONTAINED IN 10 C.F.R. PART 63	§ § § § § § § § § §

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I. INTRODUCTION

The State of Nevada ("Petitioner") hereby respectfully requests and petitions the U.S. Nuclear Regulatory Commission ("NRC" or the "Commission"), pursuant to 5 U.S.C. § 553 and 10 C.F.R. §§ 2.800-804, to exercise its rulemaking authority for the purpose of amending its regulations governing the disposal of high-level radioactive wastes in a proposed geologic repository at Yucca Mountain, Nevada. Specifically, Petitioner requests that the following regulations at 10 C.F.R. Part 63 be amended:

(1) Pre-Application Review: Site Characterization (10 C.F.R. § 63.15(a));

(2) Subpart B – License Application: Content of Application (10 C.F.R. § 63.21);

(3) Subpart E – Technical Criteria: Performance Objectives for the Geologic Repository After Permanent Closure (10 C.F.R. § 63.113);

(4) Subpart E – Technical Criteria: Requirements for Multiple Barriers (10 C.F.R. § 63.115(a)); and

(5) Subpart L – Individual Protection Standard After Permanent Closure (10 C.F.R. §§ 63.311 and 63.304).

Petitioner requests NRC to amend its current Part 63 regulations in order to bring those regulations into full compliance with the Nuclear Waste Policy Act of 1982, as amended, 42 U.S.C. § 10101 *et seq.* (the "NWPA"), and to ensure that the regulations, if met by the putative applicant U.S. Department of Energy ("DOE"), will provide reasonable assurance[1] of the safety of the repository. At the present time, Part 63 neither conforms to the

[1] The NWPA requires NRC, in licensing the Yucca Mountain project, to demonstrate the applicant has provided "reasonable assurance" of repository safety. *See* NWPA Sections 111(a)(7) and 111(b)(1) (Purpose of NWPA is to "provide reasonable assurance that the public and the environment will be adequately protected....") NRC has significantly watered down this statutory requirement in 10 C.F.R. § 63.331, which attempts to lower the repository post-closure safety requirement to only one

NWPA nor provides the requisite foundation for establishing reasonable assurance that the repository will be safe. Accordingly, Petitioner proposes modest but critically important changes to Part 63. Amendment of the rule will substantially ease the job of the Commission in assuring the safety and licensability of the repository, will enhance public confidence in the proceeding, and will reduce the likelihood of legal challenges to the legitimacy of any license granted.

As written, Part 63 arguably provides the regulatory framework to establish whether the Yucca Mountain repository will satisfy the radiological release criteria set by the Environmental Protection Agency ("EPA") at 40 C.F.R. Part 197. But that is essentially *all* it does. Congress and the scientific community required more of both the applicant and the regulator. NRC's primary statutory duty is to protect the public health and safety. The Part 63 rule does not now provide the regulatory framework to assure that the repository isolates high-level radioactive waste over the long term primarily by geologic means. Nor does the rule demand of the applicant that it provide an affirmative safety case for the repository. In lacking these two fundamental prerequisites, the rule is materially deficient and fails to assure the long-term safety of the repository or its compliance with the statutory requirements of the NWPA.

II. PETITIONER'S INTEREST IN THE REQUESTED ACTION

Petitioner Nevada is the potential host state for a federal geologic repository for the entire nation's spent nuclear fuel and high-level radioactive waste. Since at least 1987, when Congress designated Yucca Mountain, Nevada, as the only site nationwide to be characterized for potential use as a nuclear waste repository, Nevada and its citizens have had a real and

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of "a reasonable expectation" of safety, a new term defined in 10 C.F.R. § 63.304 that NRC says is founded on the "uncertainty of projecting long-term performance" of the repository. Since Petitioner believes NRC may not lower the statutory bar on repository safety, this petition uses the term

intimate interest in the health and safety issues presented by the potential location within its borders of a repository. The Commission, in the very regulation Petitioner seeks to amend, recognizes the prominent stakeholder role of Nevada in numerous provisions. For example, 10 C.F.R. § 63.61 provides:

> The Director shall provide the Governor and the Nevada State legislature, affected units of local government, and the governing body of any affected Indian tribe, with timely and complete information regarding determinations or plans made by the Commission with respect to the Yucca Mountain site. Information must be provided concerning the site characterization, siting, development, design, licensing, construction, operation, regulation, permanent closure, or decontamination and dismantlement of surface facilities of the geologic repository operations area at the site.

III. THE GEOLOGIC PREREQUISITE TO LONG-TERM REPOSITORY SAFETY

Today, all but one of the world's existing or proposed nuclear waste repositories is positioned below, not above, the water table. All but one of the world's existing or proposed nuclear waste repositories relies primarily on deep geologic isolation as its ultimate form of containment.

That sole exception is Yucca Mountain.

Because Yucca Mountain alone departs from the recommendations and practices of the world's scientific communities, it is doubly important that any NRC rule intended to license a nuclear waste repository there do so with the utmost attention to long-term safety. Safety, after all, was the principal foundation of these scientific recommendations. Any such rule should provide reasonable assurance that the applicant has demonstrated the repository will be safe. In this regard, NRC's plenary obligations extend well beyond the literal requirements of the EPA's 10,000-year rule for Yucca Mountain, 10 C.F.R. Part 197, or DOE's Yucca Mountain site suitability rule, 10 C.F.R. Part 963, or any other rule, as has

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"reasonable assurance" throughout and proposes deletion of the watered-down standard.

always been the case with NRC's exercise of its safety jurisdiction.[2] NRC's overriding statutory obligation is to provide reasonable assurance that licensed activities will not pose a threat to health, safety, property, security, and the environment. *See* Atomic Energy Act Section 161b, 42 U.S.C. § 10139, and NWPA Sections 111(a)(4) and (a)(7), 121(b), 42 U.S.C. §§ 10131(a)(4) and (a)(7), 10141(b). As currently written, Part 63 falls short.

There is a rich and detailed history underlying the requirement of Section 112(a) of the NWPA that any repository in this nation must isolate radioactive waste primarily by geologic means. This is not, and was never, an arbitrary safety requirement by Congress, but one with a solid scientific foundation extending back to the 1950s.

A. <u>The 1957 National Academy of Sciences Study</u>

In 1957, the National Academy of Sciences ("NAS") completed the nation's first comprehensive study of the management and disposal of high-level radioactive waste and spent nuclear fuel. *The Disposal of Radioactive Waste on Land*, Pub. 519, National Research Council, National Academy of Sciences (Sept. 1957). In that report, "disposal in cavities mined in salt beds and salt domes" was suggested by the NAS as "the possibility promising the most practical immediate solution of the problem." *Id.* at 1 (abstract). In the words of the report, "[u]like the disposal of any other type of waste, the hazard related to radioactive waste is so great that no element of doubt should be allowed to exist regarding safety." *Id.* at 3. "The most promising method of disposal of high level waste at the present time seems to be in salt deposits.... The great advantage here is that no water can pass through salt. Fractures are self-sealing." *Id.* at 4.

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[2] Atomic Energy Act Section 161b, which became applicable to DOE as a repository license applicant upon passage of the NWPA, provides that NRC is authorized to "establish by rule, regulation, or order, such standards and instructions to govern the possession and use of special nuclear material ... as the Commission *may deem necessary or desirable* to promote the common

In noting the abundant presence of viable salt deposits throughout the United States, the NAS report made a specific scientific recommendation on site eligibility. "The question should not be phrased: 'How can we dispose of waste at X site?' but should be: 'Can or cannot waste be disposed of at X site?' The possibility of the negative answer should always be considered." *Id.* at 6. The NAS hoped its evaluation would "lead to final and economic disposal of high level radioactive wastes." The word "final" was described as "returning those wastes to nature in some place where they can be held for very, very long periods of time without jeopardy to our environment or property." *Id.* at 18.

The central recommendation of the NAS report, which came to be referred to as "deep geologic isolation," became the cornerstone of every nuclear waste repository program in the world. Until 1996, this scientific tenet was never questioned in this country. Indeed, it strongly informed the government's practices and laws that led to the U.S. repository program.

B. <u>DOE's 1980 Environmental Impact Statement</u>

In 1980, using the NAS recommendation to propose an "interim planning strategy focused on the use of mined geologic repositories capable of accepting both waste from reprocessing and unreprocessed commercial spent fuel," President Carter announced "a comprehensive program for management of radioactive waste." Letter from President Jimmy Carter to Congress, February 12, 1980. President Carter ordered DOE to conduct a full Environmental Impact Statement ("EIS") on the management of commercially generated radioactive waste so as to recommend a preferred long-term disposal alternative. *Id.*, and accompanying White House fact sheet.

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defense and security or to protect health or to minimize danger to life or property...." 42 U.S.C. § 2201b (emphasis added). This is clearly an extremely broad grant of authority.

The 1980 EIS prepared by DOE, *Final Environmental Impact Statement on the Management of Commercially Generated Radioactive Waste,* DOE/EIS-0046F (October 1980) again evaluated deep geologic isolation and virtually every other conceivable method of disposing of high-level waste, including "deep hole" disposal, "rock melt" disposal, island-based geologic disposal, subseabed disposal, ice sheet disposal, deep well injection, transmutation, and even disposal in outer space. *Id.* at Section 1.4. In the end, the "proposed action" was specified by DOE as "disposal of existing and future commercially generated radioactive high-level and transuranic wastes in mined repositories in geologic formations." *Id.* at Section 1.3

> The concept of mined geologic disposal of radioactive wastes is one in which canistered high-level wastes and other wastes in canisters, drums, boxes or other packages, as appropriate to their form, radioactive waste content and radiation intensity, are placed in engineered arrays in conventionally mined rooms in geologic formations far beneath the earth's surface....
>
> Geologic disposal, as analyzed in this [EIS], also employs the concept of multiple barriers. Multiple barriers include both engineered and geologic barriers that improve confidence that radioactive wastes, in biologically significant concentrations, will not return to the biosphere.

Id. at Section 1.3.1. In discussing long-term environmental impacts from a repository based on geologic isolation, the EIS concluded that the "[p]lanned functioning of the geologic repository after closure will result in very little in the way of environmental impacts." *Id.* at Section 1.3.4. Indeed, the evaluation concluded that, because of the ultra-long-term efficacy of geologic isolation, "it is extremely improbable that wastes in biologically important concentrations would *ever* reach the human environment." *Id.* (emphasis added). Thus, postulated releases in the EIS were not those resulting from water seeping through the repository and into the water table from failed engineered barriers, but rather from catastrophic events like a meteorite hitting the repository, a large earthquake, or a deep human intrusion from oil drilling or solution salt mining. *Id.*

The scientific role of geologic, as opposed to engineered, barriers was well-defined by DOE in the EIS:

> The multiple barriers that could contain nuclear waste in deep mined repositories fall into two categories: (1) geologic or natural barriers, and (2) engineered barriers. Geologic barriers are expected to provide isolation of the waste for at least 10,000 years after the waste is emplaced in a repository and probably will provide isolation for millennia thereafter. Engineered barriers are those designed to assure total containment of the waste within the disposal package during an initial period during which most of the intermediate-lived fission products decay. This time period might be as long as 1000 years....

Id. at Section 5.1. DOE was careful to point out to commenters that the "[m]ultiple barriers are *intended to act independently* to prevent waste migration and enhance isolation." *Id.* at Vol. 3, p. 272 (emphasis added.) Furthermore, DOE emphasized that, even in a "systems" approach to repository design, "the engineered components of the multi-barrier system would be of greatest importance in the short term and that the repository medium and the surrounding geology would be the critical elements over the long term." *Id.* at p. 281.

To ensure the long-term safety of a geologic repository, DOE's 1980 EIS required that the site "shall have geologic characteristics compatible with waste isolation," and "shall have subsurface hydrologic and geochemical characteristics compatible with waste isolation." *Id.* at Section 5.1.1.2. Moreover, the site "shall be located in a geologic setting that is known to have been stable or free from major disturbances such as faulting, deformation and volcanic activity for long time periods." *Id.* DOE's emphasis on the integrity of the host geology to assure ultimate safety reflected the conclusions of the NAS and the almost universal consensus of the global scientific community. "The host rock with its properties provides the justification for geologic disposal and is the main element in containing the waste within the

repository and in isolating the waste from man's environment for the long term."[3] *Id.* at Vol. 2, Section B.6.

DOE likewise evaluated the necessary length of the containment period in a scientifically safe geologic repository. Though noting that a 10,000-year containment period would lower the general cumulative radiation dose to that of ordinary uranium ore, *id.* at Section 6.2.3.3, DOE defended far longer containment times for specific lethal isotopes like plutonium against commenters on the draft EIS who had stated they believed the proposed isolation target time of 250,000 to 500,000 years was unnecessarily long.[4] In DOE's words:

> To establish a "target" time of containment and isolation, the longest half-life of the waste constituents is chosen – that of PU (25,000 yrs) – and multiplied by 10, which yields 250,000 to 500,000 years....

Id. at Vol. 3, p. 360-61. In concluding in the final EIS that waste should be *isolated* from the accessible environment for a *minimum* of 10,000 years, DOE clearly presumed *no releases* during that period. "Analysis to date of the mined repository concept suggests no reason to believe that acceptable isolation could not be maintained *by the geologic environment* for a 10,000-year period, with the possible exception of very low probability catastrophic accident situations." *Id.* at Section 6.2.3.3 (emphasis added). Stressing that "[m]aintenance of waste package containment cannot be assumed for the 10,000-year period for the mined repository," DOE expressed concern about such failure only in the context of disposal alternatives (subseabed and island disposal) where failure could expose the waste to a hydrologic

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[3] Like the 1957 NAS study, DOE's 1980 EIS again noted the superiority of salt formations for providing geologic isolation, since such formations "are known to be hundreds of millions of years old," which "testifies to their isolation from water and their stability." *Id.* at Vol. 2, Section B.6.1.

[4] Though the cumulative dose at 10,000 years for spent fuel may be comparable to that of uranium ore, in fact the spent fuel remains far more dangerous than uranium ore, since it contains very long-lived isotopes like plutonium 239 and neptunium 237 that are of far greater health risk to humans than uranium ore isotopes. Microgram quantities of plutonium can cause cancer if ingested in drinking water, for example. *See* G.L. Voelz and J.N.P. Lawrence, "A 42-Year Medical Follow-Up of Manhattan Project Workers," *Health Physics*, Vol. 37 (1991).

environment. *Id.* The overriding presumption for a *geologic* repository was that waste package failure prior to 10,000 years would not expose the waste to water. *Id.*

Together, the 1957 NAS study and the 1980 EIS established the scientific framework for evaluating the efficacy of a "mined geologic repository." It was this scientific foundation that principally informed Congress as it deliberated on nuclear waste disposal beginning in 1980, culminating with enactment of the NWPA in early 1983.

IV. THE STATUTORY LAW ON REPOSITORY SAFETY

A. The Plain Words of the NWPA: Geologic Isolation as the "Primary" Form of Containment for Waste at Yucca Mountain

Reflecting the advice of the scientific community and the conclusions and recommendations of the government's own environmental impact statement, Section 112(a) of the NWPA, 42 U.S.C. § 10132(a), was drafted to require that the statutorily mandated guidelines for the recommendation by DOE of all "candidate sites" for repositories[5] "shall specify detailed geologic considerations that shall be *primary criteria* for the selection of sites...."[6] (Emphasis added.) Moreover, "[s]uch guidelines shall specify factors that qualify or disqualify any site from development as a repository, including factors pertaining to ... hydrology, geophysics, [and] seismic activity...." *Id.*

Yucca Mountain is clearly a "candidate site" under the NWPA, as is evidenced by Section 113, added to the Act in 1987 when Yucca Mountain was designated by Congress as the only candidate site in the U.S. that would undergo further detailed evaluation. This

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[5] The word "repository" was defined by Congress as "any system licensed by the Commission that is intended to be used for, or may be used for, the *permanent deep geologic disposal* of high-level radioactive waste and spent nuclear fuel...." 42 U.S.C. § 10101(18) (emphasis added).

[6] In interpreting this statutory language in the Statement of Considerations for 10 C.F.R. Part 960/963, DOE itself, in November 2001, casts it as "geologic considerations that shall be *the* primary criteria for the selection" of candidate sites 66 F.R. 57298, 57300 (Nov. 14, 2001) (emphasis added). Petitioner concurs in this interpretation.

section requires DOE to carry out site characterization activities at the Yucca Mountain site and, "for *such* candidate site," specify "criteria to be used to determine the suitability of such candidate site for the location of a repository, *developed pursuant to section 112(a)* [of the NWPA]." 42 U.S.C. § 10133(b)(1) (emphasis added). In short, DOE is required by Section 113(b)(1) to develop site suitability criteria for Yucca Mountain pursuant to the Section 112 guidelines for the recommendation by DOE to the President of any candidate site. DOE is not free to apply the Section 112(a) guidelines in developing site suitability criteria for every candidate site but Yucca Mountain (as is the present scheme of DOE's new Part 963 siting guidelines, as is discussed below). Such a result is both strikingly illogical and directly at odds with Section 113(b)(1) of the NWPA.

Congress did not alter the NWPA's fundamental commitment to geologic isolation for the permanent disposal of high-level nuclear waste when revisiting and amending the NWPA in 1987, and again in 1992 with the Energy Policy Act. That is, the Section 112(a) guidelines were retained in the statute by Congress even though Yucca Mountain was the only candidate site DOE was allowed to evaluate further.[7]

B. The Legislative History of the NWPA Unambiguously Confirms its Requirement for Primary Geologic Isolation of Radioactive Waste

1. Introduction

The explicit nature of the NWPA's geologic isolation requirement is solidly confirmed by the legislative history of that Act. Indeed, the firmness of this conclusion is evidenced by a dramatic reversal of isolation requirements between early and later versions of the proposed

[7] There is no legislative history in either the 1987 or the 1992 legislation that would remotely suggest Congress intended to alter, diminish, or do away with any of the other requirements of the NWPA not expressly modified by the new legislation. However, in 1999, recognizing that Section 112(a) might preclude a site suitability finding for Yucca Mountain, the Nuclear Energy Institute and its Congressional allies unsuccessfully sought to have Congress approve a bill, H.R. 45, that would have eliminated the key geologic requirements of Sections 112 and 113 of the NWPA.

legislation. The earliest predecessor of the NWPA, drafted by the House in 1980, required that *engineered barriers* would be sufficient as the primary form of isolation for buried nuclear waste. This conclusion reflected the fact that until 1977 it had been commonly assumed in the U.S. that all spent fuel would be chemically reprocessed to remove the longer-lived radionuclides such as plutonium[8] for recycling in nuclear reactors. With longer-lived radioisotopes removed from the spent fuel, isolation periods of 1000 years or less were considered by Congress and the scientific community to be sufficient.

But Congress unambiguously reversed this conclusion in subsequent versions of the proposed legislation when it became clear that new U.S. non-proliferation policies[9] might preclude the reprocessing of spent nuclear fuel to prevent dispersion of, and commerce in, separated weapons-grade plutonium and enriched uranium. Since spent fuel might have to be disposed of without such reprocessing, the far longer and more robust protection afforded by geologic isolation became both desirable and necessary. Accordingly, all versions of the proposed legislation after 1980 explicitly required *geologic isolation* to be the primary form of containment. Reflecting an international scientific consensus for deep geologic disposal of unreprocessed spent fuel, Congressional reports on what ultimately became the 1982 NWPA refer to isolation periods of up to 250,000 years, with merely redundant protection from engineered barriers for at least the first 1000 years, when radiation levels are at their highest.

2. Early Predecessors of the NWPA Rely on Engineered Barriers

Congress' first attempt to address national nuclear waste disposal occurred with H.R. 7418, the proposed Nuclear Waste Research, Development, and Demonstration Act of 1980,

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[8] Dangerously radioactive Plutonium 239 and Neptunium 237, which are present in abundant quantities in unreprocessed spent fuel, decay with half-lives of 24,100 years and 2.14 million years, respectively. *See* "Chart of the Nuclides, Fifteenth Edition," published by Lockheed Martin and GE Nuclear Energy, 1996, at p. 48.

offered by the House Committee on Science and Technology, and with S. 2189, the Nuclear Waste Policy Act, on a parallel track in the Senate through the Committee on Energy and Natural Resources.

a. The Early House Bills

The purpose of the first House bill was to "establish a research, development and demonstration program for the disposal of radioactive wastes" by DOE that would facilitate and speed development of several full-scale repositories. House Rep. No. 1156, Part 1, 96th Cong., 2d Session, at p. 9. DOE was to nominate two such demonstration sites by 1981 and two more by 1983. In its report, the Committee explained that

> [s]ites are to be selected using criteria based on the principle that the primary means of preventing the release of waste to the biosphere are engineered barriers. ... Primary reliance *on geology* which *can assure* that uncontained waste will be *completely isolated* from the biosphere is not required, and program delays to identify and utilize such geology are not permitted....

The engineered barriers are the *primary* means of isolating waste from the biosphere. *Id.* at p. 17-18 (emphasis in original).

The view that engineered barriers were sufficient as the primary means of isolation reflected the Committee's overriding assumption that *all* of the wastes being buried would be merely reprocessed wastes from spent fuel, and *not* the spent fuel itself. Because plutonium and other long-lived radionuclides could be reprocessed from spent fuel for their energy content as feedstocks for nuclear reactors, the Committee asserted it was "unwilling to adopt a policy that our nation ought to discard spent fuel, when most of the concerned foreign governments have decided to develop both reprocessing and breeder reactors." *Id.* at p. 25. The Committee pointed to the "reduced geological requirements" for DOE for "repositories

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[9] These policies were first established by the Ford Administration and were codified in the Carter Administration in the Nuclear Nonproliferation Act of 1978.

which are to be used *only* for reprocessed high-level wastes and which emphasize engineered barriers." *Id.* at 27 (emphasis added).

In strongly opposing the bill, DOE asserted that it was inappropriate to place primary reliance on engineered barriers instead of geology *even for reprocessed wastes*. In DOE's words:

> development of barriers as a sub-element of the total system is preferable to placing preeminent importance on engineered barriers....
>
> Engineered barriers are an essential ingredient in a technically conservative approach to an actual repository, but we do not feel that the existence of such barriers should be used as a basis for a less careful selection of an acceptable geologic media.

Id. at p. 37. *See also*, Affidavit of John W. Bartlett, former Director of DOE's high-level nuclear waste program, Attachment 1.

b. The Early Senate Bills

On roughly a parallel track through 1980, but focusing more on full-scale repositories than on demonstration projects, the Senate Energy and Natural Resources Committee reported S. 2189, the Nuclear Waste Policy Act. Recognizing the nation's policy shift away from reprocessing, this bill likewise sought development of repositories that would enable disposal of both reprocessing wastes and longer-lived spent nuclear fuel. Senate Report No. 548, 96th Cong., 2d Sess., at p. 11. A separate Senate bill, the National Nuclear Waste Regulation and Control Act of 1980, reported in June by the Committee on Environment and Public Works, sought to place strong emphasis on both natural geologic and engineered barriers, the performance of which were to be evaluated "independently" of each other as a "hedge against unexpected occurrences or failures." *Id.* at pp. 3-4. This approach had been suggested to the Committee by DOE, which only days later would oppose House efforts to place primary reliance on engineered barriers, as discussed above. *Id.* at 4. The Committee accepted DOE's

rationale that "acceptable [repository] system performance should not be contingent on the performance of any non-independent barrier combinations." Petitioner strongly agrees with this original position by DOE.

3. Congress Explicitly Shifts to Primary Reliance on Geologic Isolation

In the summer of 1980, as DOE was completing its 1980 EIS, the House Committee on Interior and Insular Affairs reported a revised version of H.R. 7418, which it titled the Nuclear Waste Disposal Act. Recognizing DOE's opposition to its earlier bill, and the fact that "the option to reprocess spent nuclear fuel is presently foreclosed to the nuclear industry," the Committee acquiesced to DOE's position that primary reliance on engineered barriers was inappropriate, concluding "it is necessary at this time to do preliminary planning on the basis of *geologic* disposal *of spent fuel*."[10] House Rep. No. 1156, Part 2, 96th Cong., 2d Session, at p. 2. The Committee also abandoned the notion of demonstration projects, opting instead for multi-site selection and development of full-scale repositories. *Id.* at p. 14. In prescribing requirements for site suitability, the revised bill placed primary reliance not on engineered barriers, but on geology.

This dramatic turnaround was the direct result of Congressional recognition that disposal of spent fuel, as opposed to mere reprocessing wastes, presented a far more dangerous and longer-term risk. *Id.* at pp. 13-14. "For example," the Committee said, using an analysis that had appeared in DOE's 1980 EIS, "plutonium 239, which is more toxic than

[10] The Committee noted, though, that with the 1980 elections only two months away, "this policy with regard to reprocessing may change," and Congress therefore "encourages the Secretary to take this possibility into account in subsequent planning with regard to the disposal of nuclear wastes." *Id.*

[reprocessing wastes], has a half-life of 24,500 years, meaning that it will have to be isolated for *at least 245,000 years*." [11] Id. at p. 13 (emphasis added). In the words of the Committee,

> the ability of any man-made containers to endure for a quarter of a million years is obviated by the fact that the ultimate barrier which prohibits the release of any radioactivity into the biosphere is the geologic media itself. The effectiveness of this method is dependent upon finding a geologic media whose integrity is intact, meaning that it does not have openings which would allow radioactivity to escape into the atmosphere or into the ground water. The structural integrity of the geologic media would also have to be stable enough to maintain its integrity during the period of time in which these materials remain radioactive. In geologic time, 250,000 years is not unprecedented.

Id. at p. 14. Underscoring this uncontested scientific principle, the revised bill mandated site suitability requirements designed to ensure primary geologic isolation for spent fuel.

> All site characterization activities in the site selection process itself in both the preliminary and final stages are to be based upon the premise that *the geologic media is to be the ultimate barrier which isolates the waste from the biosphere, and that engineered barriers are but intermediate and short-term forms of isolation.*

Id. at p. 29 (emphasis added). This view was adamantly applied both to demonstration repositories and to full-scale repositories to be developed by DOE. *Id.* at p. 33.

In October 1981, after considerable public debate, the Reagan Administration rescinded the national ban on spent fuel reprocessing. However, Congress noted in November 1981 that reprocessing was then presently infeasible since not a single commercial reprocessing venture was in operation or under development in the U.S, and federal sponsorship of such a facility was unlikely. *See* Joint Report on S. 1662, National Nuclear Waste Policy Act of 1981, Senate Rept. No. 97-282, 97th Cong., 1st Sess., at pp. 4-5. Given

[11] Identical language was reported by the House Committee on Interstate and Foreign Commerce, which joined in support of the bill in September 1980. *See* House Report 1382 on H.R. 6390, 96th Cong, 2d Session, Part 1, at p. 19.

this situation, and recognition that reprocessing policy could change yet again,[12] the cognizant Senate committees jointly reported a new bill containing provisions for "deep geologic repositories capable of accommodating *either* high-level nuclear waste or spent fuel." *Id.* at pp. 6-7 (emphasis added).

This meant geologic isolation would remain the primary requirement for site suitability, a position explicitly codified in the April 27, 1982 House version of the nuclear waste bill, H.R. 3809. *See* House Rept. 97-491, Part 1, 97th Cong., 2d Sess., at p. 4 ("Such Guidelines shall specify detailed geologic considerations that shall be primary criteria for the selection of sites in various geologic media.") and p. 50. Identical language appeared in the September 7, 1982 House Energy and Commerce bill, together with a detailed explanation of why geologic isolation for at least a quarter of million years was necessary to assure site suitability. See House Report on the Nuclear Waste Policy Act of 1982 (H.R. 6598), Committee on Energy and Commerce, House Rept. 97-785, 97th Cong., 2d Sess., at pp. 5, 45-48. This exact language has in fact persisted in Section 112 through numerous subsequent revisions of the proposed and actual legislation comprising the currently effective NWPA, which became law on January 7, 1983.

V. ORIGINAL REPOSITORY RULEMAKING ACTIVITY

In satisfaction of NWPA requirements, DOE, NRC, and EPA each published rules intended to discharge their statutory obligations with respect to any proposed repository developed under the NWPA. *See* 10 C.F.R. Part 960, 10 C.F.R. Part 60, and 40 C.F.R. Part 191, respectively. These rules individually and collectively conformed generally to the requirements of NWPA Section 112 and meshed with the conclusions and recommendations of the scientific community that had strongly informed that section of the statute. Together,

[12] Indeed, the George H. W. Bush Administration reinstated the ban on commercial reprocessing in

the three rules provided a cohesive safety basis for licensed repository performance. Indeed, rulemaking history reveals that, insofar as the primary geologic requirements for siting and repository performance were concerned, the agencies went out of their way to adhere to the fundamental tenets of repository science and NWPA Section 112 in fashioning their original rules.

A. DOE's Promulgation in 1984 of 10 C.F.R. Part 960

In publishing its first set of statutorily-required geologic repository site suitability rules, 10 C.F.R. Part 960, DOE paid careful attention to the geologic requirements and the physical qualifying and disqualifying conditions recommended by the scientific community and required to be specified by NWPA Section 112. *See* 49 F.R. 47714, 47718 (Dec. 6, 1984), referencing, among other studies, those of the NAS, the International Atomic Energy Agency ("IAEA"), and earlier studies by DOE, *viz.*, the 1980 EIS, and the EIS for the salt-based Waste Isolation Pilot Plant ("WIPP") repository in New Mexico. The NRC had concurred in the draft Part 960 regulations, but only upon satisfaction by DOE of several express conditions, one of which was that DOE would have to specify, in the final rule, "that engineered barriers cannot constitute a compensating measure for deficiencies in the geologic media" during site suitability evaluations. *Id.* at p. 47719-20. DOE was also asked by NRC to formally concur that NRC's licensing regulations were binding on DOE's site suitability determinations, and that any differences in interpretation between DOE and NRC would be resolved in favor of NRC. *Id.* at p. 47725. DOE did so in its final rule. *Id.*

Illustrating the unanimity among the cognizant federal agencies that geology must play center stage in any repository site suitability evaluation, in public meetings on the proposed Part 960 rule, EPA asked DOE to "assume that the performance of engineered

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1991, and the ban has continued to this day.

barriers (i.e., waste packages and waste forms) is at least 10 times less effective than that required by 10 C.F.R. Part 960" when comparing the overall suitability of waste sites. *Id.* at p. 47727. In response, the Statement of Considerations reemphasizes DOE's longstanding position on engineered barriers.

> The DOE had never intended that engineered barriers be used to compensate for site deficiencies. These barriers were mentioned in the guidelines because the EPA's proposed standards in 40 CFR Part 191 specify requirements for the total repository system, which includes engineered barriers. Furthermore, the role of engineered barriers as part of the total system is recognized by the NRC, which has established specific performance requirements for the waste package in 10 CFR 60.113.

Id. In its original site suitability rules in Part 960, DOE accordingly provided that "engineered barriers shall not be used to compensate for an inadequate site; mask the innate deficiencies of a site; disguise the strengths and weaknesses of a site and the overall system; and mask differences between sites when they are compared." 10 C.F.R. § 960.3-1-5 (1984). Thus, while this key geologic qualifying criterion was clearly a requirement for comparative analysis of proposed sites, it was equally clearly a requirement for the absolute scientific evaluation of the suitability of *any* site, even as part of a total system performance assessment.

B. NRC's Original Part 60 Repository Licensing Rule

Consistent with the general principles discussed above, NRC's original Part 60 repository licensing rule[13] defined a "candidate area" for a "candidate site" as "a geologic and hydrologic system within which a repository will be located." 10 C.F.R. § 60.1. The

[13] NRC's Part 60 rule was first promulgated in 1981, prior to enactment of the NWPA and largely in anticipation of it. It was subsequently modified on numerous occasions to ensure its conformance with the NWPA. NRC states that its authority for the initial promulgation stemmed from Sections 202(3) and (4) of the Energy Reorganization Act of 1974. *See* 46 F.R. 13971 (Feb. 25, 1981). However, NRC admits that this interpretation is entirely dependent on its view that the word "storage" as used in Section 202 of the Energy Reorganization Act includes by implication the word "disposal." *Id.* at n.1. Petitioner does not agree with this view and does not believe NRC had any such authority until enactment of the NWPA. However, for purposes of this petition, it is the body of Part 60 as it existed following enactment of the NWPA that is most relevant.

regulatory history of Part 60 is replete with evidence that the Commission understood, as a matter of science, the primacy of geology in any multi-barrier repository containment system, even prior to enactment of the NWPA. *See, e.g., Commission Briefing on SECY-81-267, 10 CFR 60,* May 7, 1981, and SECY-81-267 – 10 CFR Part 60, *Disposal of High-Level Radioactive Wastes in Geologic Repositories: Technical Criteria* (April 1981). Of all the options considered for ultimate waste containment in a repository, the Commission Staff had concluded that the alternative "of *supplementing* the isolation capability of the site with engineered barriers is considered by the NRC staff to be superior...." *Id.* at p. 25 (emphasis added). In this context, Staff concluded that, "once materials are released from the engineered system, *the site* must provide whatever additional isolation is needed in order to meet environmental standards." *Id.* at p. 40 (emphasis added).

Since man-made contrivances, no matter how advanced, were deemed always subject to some possibility of failure even during modest pre-set regulatory time periods (e.g., 1000 years or even 300 years), the suitability of the geologic setting must be the ultimate indicator of repository safety, according to NRC's Technical Staff. *Id.* at 41. Therefore, performance of the geologic setting, Staff reasoned, was necessarily subject to three basic disqualifying variables: groundwater travel time, radionuclide travel times, and margin of safety (assuming failure of the engineered barriers). *Id.* Accordingly, to assess site suitability, Staff, and later the Commission, concluded it was necessary to set subsystem performance requirements that serve the function of qualifying and disqualifying criteria for these site variables. Part 60 thus came into being.

It is critical to note that, even though Section 112(a) of the NWPA did not yet exist at this time, NRC's own Technical Staff, and the Commission on approving Part 60, determined after much analysis that the essential physical requirements that later came to make up

Section 112(a) were in fact the *essential prerequisites to establishing a safe repository,* irrespective of any primary environmental standard that might be one day be set by the EPA. In short, it was always the science that informed the law, and not vice versa. Moreover, the use of total system performance assessment would not change this view in any manner.

This is critically important to assessing the efficacy of Part 63 today, since that revised rule abandons these essential scientific prerequisites on the basis of a purported substantive change in the law with the Energy Policy Act of 1992 that NRC asserts mandates only that it do a "total system performance assessment" to determine whether a primary radiological standard set by the EPA can be met by the overall repository system, and not by any particular subsystem or any particular isolation barrier. Petitioner does not agree that the Energy Policy Act so changed the law (especially since Section 112(a) was twice left intact by Congress), but even if it did, the *scientific foundation* for establishing a safe repository did not change, and has not changed to this day. Thus, under NRC's plenary safety jurisdiction (Atomic Energy Act Section 161b), which became applicable to high-level waste disposal by DOE upon enactment of the NWPA, it would remain NRC's legal obligation to apply these basic scientific prerequisites in providing for reasonable assurance of the safety of the repository, a job Congress did not leave to itself, but delegated to NRC with the NWPA.[14]

NRC keenly understood this concept for many years, but appears to have forgotten it with Part 63. In 1993, even *after* passage of the Energy Policy Act of 1992, the Commission described what it believed its primary safety obligations were in licensing the repository:

[14] This is all the more important scientifically because, according to DOE itself, the Yucca Mountain repository, as now envisioned, will not produce its peak dose rates at the site boundary until long after the expiration of the EPA's 10,000-year regulatory time period, a basic fact that recently surprised even the likes of *The National Geographic. See,* Michael E. Long, "Half-Life: The Lethal Legacy of America's Nuclear Waste," *National Geographic* (July 2002), p. 21.

> The Commission has endeavored to establish a set of regulations that would facilitate a judgment, *in accordance with the Atomic Energy Act*, of whether the proposed disposal of high-level waste in a geologic repository would create any unreasonable risk to the health and safety of the public....
>
> *Reasonable assurance* that the outcome will be in conformance with the stated objectives and criteria represents a judgment that the *overall* performance of the geologic repository, *and the performance of particular subsystems*, would achieve specified levels of radionuclide containment and isolation....

58 F.R. 36902, 36903-04 (July 9, 1993) (emphasis added). Note that these words do not contain a reference to the EPA rule or any 10,000-year limitation, since, unless the Energy Policy Act of 1992 repealed by implication Section 161b of the Atomic Energy Act as it applies to NRC, safety review of licensed activity is always within the authority of NRC. But the Energy Policy Act did not repeal Section 161b. It merely provided that, notwithstanding the fact that NRC generally issues regulations governing such matters, in this particular instance – Yucca Mountain – EPA would set the primary radiation standard, not NRC. *See* 42 U.S.C. § 10141 note. *See also* 42 U.S.C.§ 2201b. In all other matters, NRC's duties and responsibilities with respect to licensed activities remained fully intact.

C. DOE's 1985 "Mission Plan" and its Response to NWPA Amendments

The scientific precepts underlying the 1957 NAS study, DOE's 1980 EIS, the Part 960 site suitability rule, and the Part 60 licensing rule, were reinforced by DOE, NRC, and EPA through the mid-1980s following enactment of the NWPA, with DOE taking the lead. NWPA Section 301 required DOE to prepare a comprehensive report, known as a "Mission Plan," necessary to implement the overall repository program described in the Act. In its June 1985 Mission plan, DOE affirmed that its decision in 1980 to pursue "mined geologic repositories as the preferred means" for disposal of spent fuel and high-level radioactive waste "has since been supported by the Act [NWPA]." DOE clearly understood the distinction between a "safe" repository and a repository that merely met performance requirements specified by

NRC and EPA. In its statutorily required Mission Plan, DOE stated it "intends to place primary importance on the capabilities of the natural system for waste isolation. In evaluating the suitability of sites, therefore, the use of an engineered-barrier system will be considered to the extent necessary to meet the performance requirement specified by the Nuclear Regulatory Commission and the Environmental Protection Agency but will not be relied on to compensate for significant deficiencies in the natural system." Again, Petitioner concurs with this 1985 position of DOE.

DOE held firm to this view even when Congress amended the NWPA in 1987, designating Yucca Mountain as the sole site to be characterized for development as a nuclear waste repository, and even when Congress established, with the Energy Policy Act of 1992, that the repository would be licensed by NRC to the primary health and safety standard set for Yucca Mountain by the EPA. The latter legislation directed EPA and NRC to modify (not abandon) their repository licensing rules to make them specifically applicable to Yucca Mountain and the directives of the Energy Policy Act, 42 U.S.C. § 10141.

Writing in the Federal Register in August 1994, DOE announced its determination that neither the 1987 NWPA amendments nor the 1992 Energy Policy Act required abandonment or even significant alternation by DOE of the then-existing Part 960 site suitability guidelines. 59 F.R. 39766 (August 4, 1994). Rather, all that was required, DOE concluded, was that the "comparative portions" of Part 960 would not be used for purposes of evaluating Yucca Mountain specifically. All other components of Part 960 could and would be applied. DOE thereby announced that, in practical and in legal terms, it need not and would not amend its Part 960 siting guidelines.[15] In DOE's words, "the [960] guidelines *are* applicable to the site

[15] This admission by DOE that the Part 960 guidelines were as useful for absolute site evaluation as they were for comparative site evaluation is in stark contradiction to DOE's later views and its views now, in litigation with Petitioner, that the guidelines were originally promulgated to be applicable only

suitability process" for Yucca Mountain. *Id.* (emphasis added). Unfortunately, it was only two years later when this view was altogether abandoned by DOE, and later NRC, in the face of surprising scientific findings at Yucca Mountain (discussed below) which strongly suggested the site would not meet the government's Part 960 suitability rules, and therefore could not be licensed by NRC under 10 C.F.R. Part 60.

VI. ABANDONMENT OF THE GEOLOGIC SAFETY REQUIREMENTS

Actual site characterization at the proposed repository horizon did not begin at Yucca Mountain until April 1994. By 1996, a slate of scientific analyses of at-depth data were revealing that Yucca Mountain would not likely meet the siting requirements of Part 960. *See* Affidavit of former Yucca Mountain Program Director, Dr. John Bartlett, Attachment 1, at pp. 8-11. For example, studies showed "that rates of water infiltration into the mountain were on the order of 100 times higher than had been expected; that water flowed very rapidly through fracture pathways in some of the geologic layers (like flow through a pipe rather than dispersed flow through a medium like a bed of sand); and that there appeared to be unexpected 'fast pathways' for movement of radioactivity from the repository to the water table about 1000 feet beneath it." *Id.* at pp. 11-13. With the publication in 1995 of DOE's Yucca Mountain Total System Performance Assessment (TSPA-95), DOE abandoned the notion of "site" suitability and compliance with NWPA Section 112 and 10 C.F.R. Part 960 and began refocusing its efforts on demonstrating compliance by the "repository system" (i.e., the engineered barriers and the natural setting) with proposed new "system-based" licensing requirements. *Id.* at pp. 12-14.

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to comparative analysis. 61 F.R. 66158 (Dec. 16, 1996). NRC was all too quick to concur in this revisionist history. *See* 64 F.R. 8640 (Feb. 22, 1999).

This dramatic reversal in approach – starkly in opposition to the NWPA and the longstanding recommendations of the scientific community, NRC, and DOE itself – demanded procrustean changes to the existing regulations governing site suitability and NRC licensing. (Petitioners have challenged each of these new regulations in federal appeals court, arguing that they are *ultra vires*, among other things.)

A. DOE's 10 C.F.R. Part 963

In the face of extremely troubling site characterization data, DOE announced in December 1996 that, for Yucca Mountain, it would essentially discard the rules it had applied for 15 years, making the ultimate suitability of the "site" subject only to a simple and scientifically arbitrary performance test for the entire "repository system." 61 F.R. 66158 (Dec. 16, 1996). Using this methodology, a blatantly defective geologic setting could nevertheless be "licensed" as part of a repository if engineered barriers alone caused the repository system to meet re-tooled licensing requirements in computer model predictions. Had this total system performance effort been done as a *supplement* to demonstrating compliance with the requirements of NWPA Section 112(a), it would have dramatically confirmed the safety (or lack thereof) of the site and the repository system, taking advantage of numerous technical advances in performance assessment and risk analytics that have occurred since passage of the NWPA. Instead, however, DOE's rule perversely *foreclosed* analysis of the site using the Section 112(a) requirements, discarding billions of dollars of research. Indeed, DOE has recently gone to great lengths to assure that its own scientists do not again produce such documentation, notwithstanding the repeated requests of NRC's Advisory Committee on Nuclear Waste, the Congressionally-created Nuclear Waste

Technical Review Board, the IAEA, the National Academy of Sciences, and other independent reviewers of the science of Yucca Mountain.[16]

DOE's new site suitability guidelines for Yucca Mountain, published in November 2001 at 10 C.F.R. Part 963, mandate only a total system performance assessment for the repository with no determination that long-term waste isolation is primarily geologic, with no specification of physical qualifying or disqualifying conditions, and with no real analysis at all of "site" suitability or site safety. Indeed, in the actual design and proposed licensing approach for Yucca Mountain, the site itself has effectively been rendered irrelevant. In an effort to jawbone NWPA Section 112's geologic and hydrogeologic requirements out of the new suitability rule, DOE took the highly revisionist position in promulgating Part 963 that Section 112 was merely a "comparative" requirement for other, future repository sites, and was not applicable to Yucca Mountain despite the plain language of NWPA Section 113(b)(1)(A)(iv) making Section 112(a) expressly applicable to any suitability determination for Yucca Mountain. *See* 66 F.R. 57298 (Nov. 14, 2001).

We are thus left with the bizarre (and, Petitioner contends, illegal and unsafe) situation where all repositories other than Yucca Mountain (if they ever exist) will be evaluated to the much higher safety standards of Section 112(a). Yucca Mountain alone will be evaluated based solely on a systems approach in Part 963 and Part 63 that, as the Nuclear Energy Institute has publicly noted, would effectively allow the "repository" to be licensed with no

[16] The last time DOE produced an analysis of the independent capabilities of the multiple waste isolation barriers for the proposed Yucca Mountain repository was in January 1999, in a presentation to the Nuclear Waste Technical Review Board. There, DOE revealed that, in its current design, the engineered barriers contribute over 99.7 percent of the waste isolation capabilities of the repository system, and that the "geologic" contributions of Yucca Mountain are miniscule. *See* Affidavit of Dr. John Bartlett, at p. 16.

geologic setting at all.[17] Equally bizarre, we are left with an NRC licensing regime that curtails safety analysis arbitrarily at 10,000 years, long before peak doses will appear in the regional biosphere. This is like saying a reactor in the midst of a core melt accident is safe because doses at the site boundary are within regulatory limits at the 12-hour mark.

DOE's new site suitability rules are tragically unfortunate, since uncertainties in the long-term integrity of the engineered barriers are now uncertainties in the safety, the lives, and the livelihoods of real people in the regional ecosystem – people who were intended by the NWPA and the science underlying it to be protected by the "defense-in-depth" of a real multiple-barrier system. The scientifically and legally required "primary" barrier in this system, the geology itself, was to have assured isolation "for a minimum of 10,000 years and probably millennia thereafter." Now, Nevadans and other American citizens in the regional ecosystem must rely instead on the efficacy of first-of-a-kind man-made contrivances and computer model predictions of their performance over time periods far longer than human history. According to DOE's own numbers, these uncertainties currently run as high as a factor of 10,000, far higher than ever countenanced in any nuclear licensing proceeding. Under Part 963, whether the Yucca Mountain geology contributes anything meaningful to waste containment is essentially unknown, and unimportant.

It is doubly unfortunate that, with the promulgation of 10 C.F.R. Part 63, NRC appears to have acquiesced to DOE's perversion of the NWPA and the science underlying it.

B. NRC's 10 C.F.R. Part 63

On November 2, 2001, NRC published its new final rule for the licensing of the Yucca Mountain repository, 10 C.F.R. Part 63. The ostensible rationale for the new rule was the

[17] Speech by John A. Vincent, Project Manager, Used Fuel Management, Nuclear Energy Institute, at the Institute of Nuclear Materials Management Spent Fuel Management Seminar XIX, Washington,

need to conform NRC's licensing regulations to the requirement, enacted in the 1992 Energy Policy Act, that EPA must set the primary radiation protection standard (Part 197) for Yucca Mountain. 66 F.R. 55732, 55733 (Nov. 2, 2001). However, NRC's new rule goes far beyond anything that would have been required merely to synchronize the regulations of NRC to the Energy Policy Act and EPA's regulations at Part 197, or to permit the application of total system performance assessment. Like DOE, NRC did not merely add a total system performance assessment requirement in its Yucca Mountain rule. Rather, like DOE, NRC altogether jettisoned the subsystem performance requirements mandated by Section 112(a) of the NWPA, which had served as qualifying and disqualifying criteria and had been the central feature of Part 60 for nearly two decades.[18] As was the case with the new DOE regime, which left the old site suitability rules intact for all "other repositories," the new NRC regime also left the old Part 60 rules intact for these hypothetical "others," creating the paradoxical situation that all future repositories will be held to higher standards of site suitability and licensing than Yucca Mountain, which very likely will be the only "real" repository for high-level waste ever constructed in this country.

It is nothing short of staggering to catalog the longstanding principles of science, law, and nuclear regulation that NRC abandoned when it promulgated Part 63, all under the rubric

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D.C., January 9, 2002.

[18] NRC's new rule does require DOE, in Section 63.115, to "identify" and "describe" the individual capabilities of the various isolation barriers in the repository system, including geologic barriers, and to delineate their technical bases. However, there is expressly no legal or regulatory requirement as to how efficacious any of those barriers must be, alone or in relation to one another. Rather, Section 63.115 is intended merely to provide NRC with "insights" for use in evaluating DOE's total system performance assessment. *See* 66 F.R. at 55758-59. The rule purports that this mere description is somehow sufficient to demonstrate "defense-in-depth" by showing "reliance on multiple barriers." *Id.* at 55737. There is no requirement for the *extent* of any such reliance on any individual barrier. That is, if geology contributed only 0.3 % of the reliance, this would presumably nevertheless establish the required multiplicity. Under Part 63 as now written, the mere existence of multiplicity is apparently sufficient to establish defense-in-depth. *Id* (Thankfully, nuclear power plant regulators view "defense-in-depth" much differently.)

of engaging in "risk-informed, performance-based" regulation. 64 F.R. 8640, 8643 (Feb. 22, 1999). For example, one of the principles abandoned by Part 63 is that of defense-in-depth. After boosting this concept for decades, NRC appears virtually to apologize for its sudden abandonment, *id.* at 8647, but justifies its "re-examination" of the concept on the basis of "advancement in methods to quantitatively assess the components of a geologic repository system and with due consideration of the Commission's goal of a regulatory program and associated requirements that are risk-informed and performance based." *Id.* at 8647-48. But performance-based, risk-informed regulation need not (and in all other NRC contexts, does not) abandon defense-in-depth. Moreover, quantitative risk assessment has been around in nuclear regulation since WASH-1400 in the 1970s, and advances in risk assessment have principally been related to advancing computer power, not to advances in substantive technique. There is no advancement in risk assessment that would require, justify, or even remotely suggest abandonment of defense-in-depth. Nuclear power plant regulation teaches us that, despite the existence of risk-informed regulation and probabilistic safety assessment, defense-in-depth is not only still feasible and required, but it is the very foundation of nuclear plant safety. No one would suggest a nuclear utility could do away with a plant's emergency core cooling system simply because the plant-specific probabilistic risk assessment showed the licensee could likely meet off-site dose limits using only a concrete containment.

As noted above in footnote No. 1, in Part 63 NRC also abandoned its longstanding role of verifying "reasonable assurance" of the safety of the repository, replacing that pervasive nuclear regulatory standard with the substantially lower norm of "a reasonable expectation" of safety, defined in 10 C.F.R. § 63.304. This new norm falls short of the statutory purpose of the NWPA itself, which was to have provided "reasonable assurance" of the safety of high-level radioactive waste disposal in a geologic repository. *Compare*

10 C.F.R. § 63.311 with NWPA Section 111(b)(1), 42 U.S.C. § 10131(b)(1). Tellingly, NRC retained the "reasonable assurance" requirement in Part 60 for the licensing of any future repositories.

Also abandoned by Part 63 was the longstanding NRC concept of assessing isolation barriers independently. In NRC's words, "[a]lthough it is relatively easy to identify multiple, diverse barriers that comprise the engineered and geologic systems, the performance of any of these systems and their respective subsystems *cannot* and *should not* be considered either truly independent or totally redundant." *Id.* at 8646 (emphasis added). Moreover, NRC said, "quantitative subsystem performance criteria may unduly restrict the applicant's flexibility...." *Id.* at 8646-47. Though it characterized subsystem performance assessment as "relatively easy," NRC nevertheless expressed concern that requiring subsystem performance criteria could "impose significant additional expenditure of resources" on DOE. *Id.* at 8647. Again, however, it is hard to fathom why total system performance assessment must, as a matter of necessity, rule out the use of subsystem performance criteria, especially for such key hydrogeologic parameters as groundwater travel time through the repository. In a nuclear power plant, a critical subsystem valve must still be certified as safety grade even though a probabilistic safety assessment might produce identical results with a non-safety-grade valve. As Congress and the scientific community clearly understood when mandating multiple barriers and geologic primacy, some things are worth protecting with belt and suspenders.

It is important to stress that Petitioner has no objection to (a) DOE developing and utilizing the most robust possible engineered waste container; and (b) DOE and NRC using total system performance assessment to help gauge the efficacy of the repository system as a whole. But there is nothing in the Energy Policy Act of 1992 that required DOE or NRC, in taking advantage of developments in analytic methods, or in applying the EPA's radiological

protection rule, to abandon Section 112(a) of the NWPA, to abandon the qualifying and disqualifying attributes of site evaluation, to abandon defense-in-depth, to abandon the primacy of the geologic barrier, and indeed, to abandon the previous 20 years of science and law on geologic repositories.

Finally, and perhaps most importantly, Part 63 abandoned any notion that the applicant should be compelled to present an affirmative safety case for the repository. That is, there is no requirement that the applicant demonstrate the repository is *safe* in addition to showing it can meet EPA's radiological release requirement for the first 10,000 years. Though the Energy Policy Act of 1992 allowed EPA to set the primary radiological standard for Yucca Mountain, it did not, as noted above, repeal the Commission's plenary authority under the Atomic Energy Act to ensure the *safety* of licensed activity. As recently as July 1, 2002, in a brief filed in Petitioner's lawsuit against NRC in the D.C. Court of Appeals, NRC's attorneys argued that "section 161b of the Atomic Energy Act is the principal Atomic Energy Act provision granting the NRC authority to establish by rule health-based standards for the use and disposal of radioactive materials governed by the Act." Federal Respondent's Reply to Motion to Dismiss in *State of Nevada v. Nuclear Regulatory Commission,* Case No. 02-0116, D.C. Circuit (2002), at p. 8. Petitioner agrees that NRC *currently does have* such plenary authority and should exercise it to ensure the safety of the Yucca Mountain repository.[19]

[19] As mentioned above, Atomic Energy Act Section 161b became applicable to disposal by DOE of high-level radioactive waste upon the enactment of the NWPA, which conferred NRC licensing jurisdiction over the high-level waste disposal activities of DOE. Prior to the NWPA, DOE disposal activities had been exempted from NRC licensing jurisdiction by other provisions of the Atomic Energy Act.

C. The "Licensing" vs. "Safety" Paradox

The absence of the above-described safety and statutory features from the current Part 63 has led to two highly paradoxical (indeed, nonsensical) situations that should be rectified by rulemaking to amend Part 63. The first is that, notwithstanding the rule's requirement for multiple isolation barriers, the putative "deep geologic repository" could nevertheless be licensed without its geologic setting. And, in fact, its very design has become simply an array of engineered barriers that just happens to be located 1000 feet underground. The second is that the repository will become most dangerous to humans and the environment *after* the EPA's prescribed regulatory time period. This was clearly not the intent of Congress, not the intent of the scientific community, and probably not the intent of the EPA.

The latter paradox is best illustrated by a graphic produced in the July 2002 *National Geographic* using data provided by DOE itself in the Yucca Mountain Final Environmental Impact Statement, DOE/EIS-0250 (February 2002). Petitioner has marked this graph as Attachment 2 to this petition. As the graph illustrates, DOE's own models predict that radiation doses from Yucca Mountain releases to the accessible environment will not begin to peak until after the 10,000-year regulatory time period that forms the basis for Part 63 licensing. It is hard even to fathom an explanation for how such a repository could ever be "licensed" by NRC. Yet, as written, Part 63 would permit this blatantly unsafe condition to be licensed.

If the EPA's 10,000-year standard means anything, it must mean that the EPA itself presumed, consistent with the NWPA, the presence of geologic isolation as the primary barrier in a licensed repository system at Yucca Mountain (though verifying such is clearly not EPA's job). Otherwise, there would be no rational explanation for curtailing the regulatory time period so that the most unsafe period in the repository's expected evolution is

altogether lopped off and ignored. On the other hand, if geologic isolation were presumed (and assured) at Yucca Mountain, 10,000 years would likely be an ample period to provide reasonable assurance of safety, since during much (if not all) of that period the redundant protection of engineered barriers would come into play.

VII. PEER REVIEW OF THE GOVERNMENT'S "SYSTEMS" APPROACH

A plethora of independent scientific reviewers has studied the approach now presented by the combined frameworks of Part 963 and Part 63 and has concluded that something is fundamentally and perhaps dangerously amiss. These include commentators from NRC's Advisory Committee on Nuclear Waste ("ACNW"), the Congressionally-created Nuclear Waste Technical Review Board ("NWTRB"), the National Academy of Sciences, the U.S. General Accounting Office, and numerous scholars writing in journals like *Science* and *Physics Today*. A few of the more salient conclusions of the ACNW and NWTRB are compiled in Attachment 3. Most important of the reviewers, perhaps, was the international scientific peer review team that was commissioned just last year by DOE itself.

A. The International Peer Review Team

In early 2001, DOE requested the International Atomic Energy Agency ("IAEA") and the Nuclear Energy Agency ("NEA") of the Paris-based Organization for Economic Cooperation and Development ("OECD") to conduct a scientific peer review of DOE's total system performance assessment for the site recommendation for the Yucca Mountain repository. Between June and December 2001 these organizations carried out a comprehensive scientific assessment, engaging some of the world's most noted repository scientists. The results of this study were released in March 2002, in a document entitled, *An International Peer Review of the Yucca Mountain Project TSPA-SR* (hereinafter, the "Peer Review").

In essence, the Peer Review concluded that DOE's TSPA is almost obsessively focused on "demonstrating numerical compliance" with quantitative NRC and EPA regulatory criteria (e.g., the 10,000- year dose limit) rather "than on demonstrating an understanding of repository performance." *Id.* at p. 9.

> Also, the US approach to regulation has focused attention on the presentation of aggregated results that can be compared directly with regulatory requirements. The [Peer Review] considers that more intermediate results and disaggregated end results should be given. This would provide more information to decision-makers, a point emphasized in recent international recommendations on the *safety* of radioactive waste disposal.

Id. (emphasis added). Likewise, the Peer Review found that, in the current approach to regulating Yucca Mountain,

> ... most attention is given to demonstrating quantitative compliance with regulatory criteria. Relatively little emphasis is placed on the important issue of presenting an understanding of system behavior, which is required to enable decisions to be made based on the full body of evidence. The [Peer Review] considers that demonstrating understanding should be complementary to demonstrating compliance and of at least equal importance. *Two* approaches are needed.

Id. at p. 12 (emphasis added). DOE's non-disaggregated approach "has resulted in a bias toward engineered barriers." *Id.* at p. 25. The Peer Review expressed particular concern with the unacceptable presence in the TSPA approach of what it called "risk dilution" – the "inclusion of subjective uncertainty" about the geology of the mountain that "can lead to non-conservative estimates of the expectation value of dose." *Id.* at p. 11. Perversely, "[w]hen this occurs it means that increased ignorance leads to lower expected doses, which does not appear to be a sensible basis for decision-making." *Id.*

The truly remarkable point made by the Peer Review is that, while the Part 63 regulations require DOE to demonstrate that the overall repository system can meet numerical dose limits and NRC regulations, they do not require DOE to demonstrate that the repository is *safe*. "In this regard, there is an emerging international consensus that building confidence

in repository performance is of comparable importance to demonstrating compliance with criteria." *Id.* at p. 24.

> The TSPA-SA has in itself *some* elements of a safety case, but the focus on demonstrating numerical compliance with regulations has taken the foremost priority vis-à-vis understanding and confidence building aspects.
>
> The [Peer Review] is of the opinion that it would have been preferable to have incorporated the TSPA *within a safety case* in support of the site recommendation decision, and to have formulated this within well-developed strategies to achieve safety *and* to demonstrate compliance.

Id. at p. 25 (emphasis added).[20]

B. The Missing Affirmative Safety Case for Yucca Mountain

In short, according to many of the world's most respected repository scientists, we are left at Yucca Mountain with an astonishing fact: DOE has not performed, nor does Part 63 require DOE even to propound (let alone demonstrate), an affirmative safety case for Yucca Mountain. What would such an affirmative safety case entail? The international Peer Review specified precisely what must occur, and what must be done, for DOE to be in a position to say the repository is "safe," and for NRC to certify it as such:

> First, *a realistic (i.e., non-conservative) assessment of system evolution and radionuclide migration should be made, regardless of whether this can be demonstrated with reasonable assurance. This would be able to communicate the likely evolution of the repository to a range of stakeholders beyond the regulators, for example by drawing on natural and historical analogues.*
>
> Secondly, *the understanding of the TSPA results should be improved, making use of a range of approaches, for example, the following:*

[20] With respect to the hydrogeologic aspects of the Yucca Mountain project, the Peer Review's comments were equally sobering: "The saturated zone flow system at Yucca Mountain is very complex and not sufficiently understood to propose a conceptual model for a realistic transport scenario. A number of site-specific features should be further investigated before realistic flow models can be built." Referring to two U.S. Geological Survey (USGS) reports which form the basis of the hydrogeology of the site used in the Total System Performance Assessment, the Peer Review found: "In general, the level of understanding of the hydrogeology of the site, based on these documents, is low, unclear, and insufficient to support an assessment of realistic performance." *Id.* at Appendix 3.

- Development of an overall understanding of the key safety-relevant factors and arguments, and documentation of this in a fashion that is accessible to a wide range of stakeholders.

- Disaggregation of dose results in order to explain which factors or sub-scenarios can lead to large potential doses, explaining as well that the likelihood of occurrence would be small and also that dose – beyond a few hundred years – is not really a measure of detriment in the operational sense of radiation protection [reference omitted].

- Use of additional performance measures, for example, showing the effects of each barrier and the spatial and temporal distribution of radionuclides within each component (e.g., waste package, EBS, UZ, SZ, receptor area) of the system.

- Development of a simplified interpretative or insight model containing only the key processes affecting safety, which can be used by people within and outside the [Yucca Mountain Project].

- Development of an understanding of the major conservatisms and optimisms in the analysis, and quantification of their impact with respect to more realistic assumptions.

- Development of an understanding of what extreme conditions might give rise to doses above prescribed regulatory criteria, and a description of the factors that make these situations unlikely.

- Description and prioritization of the features (barriers in a broad sense) that are considered important to keep the releases and doses low.

- Documentation of where the major uncertainties are and how they might be dealt with in the future.

- Documentation of a sensitivity case where some or all engineered barriers are rendered ineffective.

- Presentation of the features and results for sub-scenarios as an aid to understanding and dialogue.

- Comparison of results with related assessments performed elsewhere.

The [Peer Review] recommends that a safety case produced in support of licensing *should incorporate an improved demonstration of system understanding to counterbalance the present emphasis on uncertainty.*

Finally, greater use should be made of the extensive archive of technical *reports produced during earlier phases of the programme. In this regard the*

> *USDOE needs to ensure that it retains a corporate memory of the [Yucca Mountain Project].*

Id. at pp. 59-60 (emphasis in original).

It follows that if any such affirmative safety case by DOE is to emerge, it must be required by NRC. Accordingly, Part 63 must be amended to demand of DOE that it propound an affirmative safety case. This will enhance confidence in the repository program, create transparency in the science of the project, aid in NRC's review of DOE's license application, and, most important, ensure that any repository "licensed" by NRC will also be demonstrably "safe."

In a 1995 study by the National Academy of Sciences ("NAS") that was mandated by Section 801(a)(2) of the Energy Policy Act of 1992, this separate group of eminent, independent scientists also found that the current regulatory regime does not assure the safety of the Yucca Mountain repository:

> The current EPA standard contains a time limit of 10,000 years for the purpose of assessing compliance. We find that there is no scientific basis for limiting the time period of an individual-risk standard in this way. We believe that compliance assessment is feasible for most physical and geologic aspects of repository performance on the time scale of the long-term stability of the fundamental geologic regime—a time scale that is on the order of 10^6 [one million] years at Yucca Mountain—and that at least some potentially important exposures might not occur until after several hundred thousand years. <u>For these reasons, we recommend that compliance assessment be conducted for the time when the greatest risk occurs, within the limits imposed by long-term stability of the geologic environment</u>.

"Technical Bases for Yucca Mountain Standards," National Academy Press (1995), at pp. 6-7 (emphasis in original).

Petitioner has been unable to identify a single scientist not engaged by DOE who disagrees with the key conclusions and recommendations of the IAEA, the NEA, and the NAS discussed above.

VIII. PROPOSED AMENDMENTS TO PART 63

As noted throughout this petition, Part 63 fails to assure the safety of the Yucca Mountain repository, though it might conceivably provide the numerical framework to show that the "repository system" meets the EPA's radiation protection standard for the first 10,000 years (though clearly not thereafter). Accordingly, as described in detail below, Petitioner proposes adding to the rule those basic elements that would both conform the rule to the NWPA and provide reasonable assurance of the safety of the repository. In sum, those elements are as follows:

1. Provisions ensuring that geologic isolation is the primary barrier against the release of radiological contamination to the accessible environment, as required by science and the NWPA;
2. Provisions requiring the submission by the applicant of an affirmative safety case for Yucca Mountain;
3. Provisions requiring the applicant to verify the lack of materially adverse or potentially disqualifying conditions for Yucca Mountain, as required by the NWPA;
4. Provisions related to the performance of the geologic setting of Yucca Mountain following closure of the repository; and
5. Provisions relating to the provision of "reasonable assurance" of the safety of the repository.

The specific amendments Petitioner believes are necessary in order for the Commission to appropriately acquit its duties are set out below:

A. Pre-Application Review: Site Characterization (10 C.F.R. § 63.15(a))

Petitioner requests that Section 63.15(a) be amended to add the following two sentences:

> DOE's site characterization shall include criteria, developed pursuant to Section 112(a) of the NWPA, to be used to determine the suitability of the Yucca Mountain site for the location of a geologic repository. Such criteria shall ensure that the geologic setting of the Yucca Mountain site is the primary barrier against the release of radionuclides to the biosphere from the multi-barrier repository system.

B. Subpart B – Content of Application (10 C.F.R. § 63.21)

Petitioner requests that Section 63.21(a) be amended to add the following italicized words:

> An application consists of general information, a Safety Analysis Report, *documentation propounding an affirmative safety case for the Yucca Mountain repository, and documentation that the site does not have any material disqualifying conditions.*

Petitioner requests that a new subsection (c) be added to Section 63.21, as follows:

(c) The affirmative safety case must include:

(1) A realistic assessment of system evolution and radionuclide migration, drawing on natural and historical analogs.

(2) Documentation evidencing an overall understanding by the applicant of the key safety-relevant factors in the repository system, communicated in a manner that aids in public understanding.

(3) Disaggregated dose projections with documentation of which particular factors or sub-scenarios can lead to large potential doses, explaining as well the likelihood of occurrence of such scenarios.

(4) Use of multiple performance measures, showing, at a minimum, the effects of each isolation barrier and the spatial and temporal distribution of radionuclides within each such component of the repository system.

(5) A simplified interpretative or insight model containing only the key processes affecting safety, for use by the Commission and the public to assess the safety of the repository.

(6) Documentation of the major conservatisms and optimisms in the total system performance analysis, and quantification of their impacts with respect to realistic post-closure assumptions.

(7) Documentation of extreme conditions which might give rise to doses above prescribed regulatory criteria, and a description of the factors that make these situations unlikely.

(8) A description and prioritization of the isolation features that are considered important to keep releases and doses within regulatory limits and as low as is reasonably achievable.

(9) Documentation of where the major uncertainties lie in the total system performance assessment and how the applicant will mitigate such uncertainties.

(10) Documentation of a sensitivity case where engineered barriers are rendered ineffective, individually and collectively.

(11) Presentation of the key features and results for each material sub-scenarios in the repository system.

(12) A comparison of and rebuttal to results of any scientific peer review of the applicant's total system performance assessment and/or its underlying science performed by the Nuclear Waste Technical Review Board, the International Atomic Energy Agency, or other peer reviewer designated by the applicant or the Commission.

Petitioner requests that a new subsection (d) also be added to Section 63.21, as follows:

(d) *Potentially disqualifying conditions.* The following conditions are to be considered adverse and potentially disqualifying if they are characteristic of the post-closure controlled area at Yucca Mountain or may materially affect isolation within the controlled area. The application shall demonstrate that these disqualifying conditions do not exist or, if they do exist, that they are not materially adverse to the long-term safety of the repository.

(1) Potential for flooding of the underground facility.

(2) Potential for natural phenomena such as subsidence or volcanic activity of such a magnitude that large-scale surface water impoundments could be created that could change the regional groundwater flow system and thereby adversely affect the performance of the repository.

(3) Structural deformation, such as uplift, subsidence, folding, or faulting that may adversely affect the regional groundwater flow system.

(4) Potential for changes in hydrogeologic conditions that would affect the migration of radionuclides to the accessible environment, such as changes in hydraulic gradient, average interstitial velocity, storage coefficient, hydraulic conductivity, natural recharge, potentiometric levels, and discharge points.

(5) Potential for changes in hydrologic conditions resulting from reasonably foreseeable climatic changes.

(6) Groundwater conditions in the host rock, including chemical composition, high ionic strength or ranges of Eh-pH, that could increase the solubility or chemical reactivity of the engineered barrier system.

(7) Geochemical processes that would reduce sorption of radionuclides, result in degradation of the rock strength, or adversely affect the performance of the engineered barrier system.

(8) Groundwater conditions in the host rock that are not reducing.

(9) Evidence of dissolutioning such as breccia pipes, dissolution cavities, or brine pockets.

(10) Structural deformation such as uplift, subsidence, folding, and faulting during the Quaternary Period.

(11) Earthquakes that have occurred historically that if they were to be repeated could affect the site significantly.

(12) Indications, based on correlations of earthquakes with tectonic processes and features, that either the frequency of occurrence or magnitude of earthquakes may increase.

(13) More frequent occurrence of earthquakes or earthquakes of higher magnitude than is typical of the area in which the geologic setting is located.

(14) Evidence of igneous activity since the start of the Quaternary Period.

(15) Evidence of extreme erosion during the Quaternary Period.

(16) The presence of naturally occurring materials, whether identified or undiscovered, within the site, in such form that:

(i) Economic extraction is currently feasible or potentially feasible during the foreseeable future; or

(ii) Such materials have greater gross value or net value than the average for other areas or similar size that are representative of and located within the geologic setting.

(17) Rock or groundwater conditions that would require complex engineering measures in the design and construction of the underground facility or in the sealing of boreholes and shafts.

(18) Geomechanical properties that do not permit design of underground opening that will remain stable through permanent closure.

(19) Potential for the water table to rise sufficiently so as to cause saturation of an underground facility located in the unsaturated zone.

(20) Potential for existing or future perched water bodies that may saturate portions of the underground facility or provide a faster flow path from an underground facility located in the unsaturated zone to the accessible environment.

(21) Potential for the movement of radionuclides in a gaseous state through air-filled pore spaces of an unsaturated geologic medium to the accessible environment.

C. Subpart E – Technical Criteria: Performance Objectives for the Geologic Repository After Permanent Closure (10 C.F.R. § 63.113)

Petitioner requests that a new subsection (e) be added to Section 63.113 as follows:

(e) *Geologic Setting.* The geologic setting for the Yucca Mountain repository shall evidence a pre-waste-emplacement groundwater travel time along the fastest path of likely radionuclide travel from the disturbed zone to the accessible environment of at least 1,000 years.

(f) *Peak Dose.* The geologic setting for the Yucca Mountain repository shall evidence sufficient geologic suitability to provide reasonable assurance that peak radiation doses to the accessible environment will not occur subsequent to the regulatory monitoring period established by the Environmental Protection Agency in 40 C.F.R. Part 197.

D. Subpart E – Technical Criteria: Requirements for Multiple Barriers (10 C.F.R. § 63.115(a))

Petitioner requests that Section 63.115 be amended to add a new subsection (d) as follows:

> (d) The natural features of the geologic setting shall constitute the primary barrier for assuring the long-term isolation of high-level radioactive waste and spent nuclear fuel at the proposed geologic repository at Yucca Mountain.

E. Subpart L – Individual Protection Standard After Permanent Closure (10 C.F.R. §§ 63.311 and 63.304)

Petitioner requests that the words "a reasonable expectation" in 10 C.F.R. § 63.311 be replaced with the words "reasonable assurance." In addition, Petitioner requests that 10.C.F.R. § 63.304, providing a definition of "reasonable expectation," be deleted in its entirety.

IX. CONCLUSION

Based on the foregoing, Petitioner the State of Nevada respectfully requests that the Commission exercise its rulemaking authority to amend the specific regulations enumerated herein with respect to licensing of the proposed nuclear waste repository at Yucca Mountain. The amendments are necessary to ensure compliance by DOE and the Commission with the letter and spirit of the Nuclear Waste Policy Act of 1982, to provide reasonable assurance that the Yucca Mountain repository, if licensed and built, will be safe, and to improve the licensing and review process. In the interest of safeguarding the public health and safety and of complying with the mandates of Congress, the State of Nevada respectfully urges the Commission to adopt the requested amendments.

It is Petitioner's understanding, based on numerous public representations by DOE, that DOE will not be prepared to file a license application for the Yucca Mountain repository until December 2004 at the earliest. However, NWPA Section 114(b) explicitly requires DOE

to submit an application to NRC for Yucca Mountain licensing "not later than 90 days" after the Congressional resolution approving the Yucca Mountain site designation "becomes law." 41 U.S.C. § 10134(b). Accordingly, in the event DOE complies with the NWPA and files an application within 90 days pursuant to the timing requirements of Section 114(b), Petitioner respectfully requests, pursuant to 10 C.F.R. § 2.802(d), that the Commission suspend Yucca Mountain licensing proceedings pending resolution of this petition.

Petitioner respectfully requests that copies of this petition be furnished to NRC's Advisory Committee on Nuclear Waste and to the Congressionally-created Nuclear Waste Technical Review Board for their respective views and comments.

Dated this 12th day of July 2002.

Respectfully submitted,

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Petition for Rulemaking

ATTACHMENT 1

AFFIDAVIT OF DR. JOHN W. BARTLETT

I, DR. JOHN W. BARTLETT, do hereby swear and affirm that the following matters are true and correct, based on my own personal knowledge and professional training. I earned a B.S. degree in chemical engineering from the University of Rochester, and MChE and Ph.D. degrees in chemical engineering from Rensselaer Polytechnic Institute.

I. BRIEF SUMMARY

As an engineer and the former Director of the Department of Energy's ("DOE's") high-level nuclear waste program for Yucca Mountain, I have extensively studied DOE's activities and analyses of the Yucca Mountain site and have reviewed the findings of other government agencies and scientific panels as they relate to DOE's site suitability evaluations. In this affidavit, on the basis of my personal knowledge and experience, I conclude as follows:

- The available evidence strongly indicates that DOE has in fact determined that the Yucca Mountain site cannot be shown to be "suitable," as that word derives from the Nuclear Waste Policy Act ("NWPA"), for the long-term geologic isolation of high-level radioactive waste and spent nuclear fuel. Geologic isolation cannot and will not play any significant role whatsoever at the Yucca Mountain repository during the regulatory compliance period. The project has become simply an array of engineered waste packages that happen to be located 1000 feet underground.

- DOE retroactively changed the rules for site suitability in December 2001 after it had become apparent that the original rules, which had been used for 17 years of site characterization and evaluation, could not be met for Yucca Mountain.

- DOE's new site suitability rules intentionally or mistakenly reject the statutory site suitability requirements of Section 112 of the Nuclear Waste Policy Act as they were meant to apply to Yucca Mountain. DOE's new suitability rules permit a site suitability determination without specific evaluation of the efficacy of the actual physical site features, and without identification of any physical disqualifying features. This is an admission, in my view, that the site itself has been rendered irrelevant.

- Because the Yucca Mountain site cannot be shown to be capable of long-term geologic isolation of high-level radioactive waste during the regulatory period, DOE adopted new rules that permit the agency to rely entirely on man-made waste packages to meet repository licensing requirements promulgated by the Nuclear Regulatory Commission ("NRC") and the Environmental Protection Agency ("EPA"). In my experience, this is precisely what Congress, and DOE itself, had sought to avoid for the previous 20 years. As the Director of the project, I was thoroughly committed to evaluating the site on its merits.

- DOE's new guidelines depart radically from the requirements of the Act and from longstanding DOE interpretations of the Act. Since neither NRC nor EPA will assess site suitability (this is the exclusive province of DOE under the NWPA), proceeding on the basis of the new rules will lead to a repository that is only able to demonstrate waste isolation, or safety, through dependence on the life of the man-made containers, which itself is uncertain. In my view, as an engineer and the former Yucca Mountain program director, this is highly unacceptable and contrary to the entire history of legislative and scientific efforts to develop a suitable nuclear waste repository for the long term, permanent isolation of such waste.

II. BACKGROUND AND QUALIFICATIONS

1. I am presently a Senior Program Manager with S. Cohen & Associates, Inc. (SC&A). I reside at 1300 Crystal Drive, Unit #403, Arlington, Virginia – 22202. My résumé is attached as Exhibit #1. Until October 1, 2000, SC&A was a technical support contractor to the Office of Radiation and Indoor Air of the EPA. SC&A services to the EPA included technical support for promulgation by EPA of the 40 CFR Part 197 regulations for Yucca Mountain. I led the SC&A work in this area. In addition, beginning in October 2000, I led work by SC&A for Clark County, Nevada, to evaluate DOE's use of Total System Performance Assessment (TSPA), which is the cornerstone of the 10 CFR Part 963 regulations that replaced the previously applicable 10 CFR Part 960 siting guidelines. These work activities have kept me informed of, and involved in, actions, meetings, documents, and government interactions concerning the Yucca Mountain program.

2. Before joining SC&A, I was Director of DOE's Office of Civilian Radioactive Waste Management ("OCRWM"). I served in this role during the George H. W. Bush administration from April 1990 to January 1993. The NWPA assigned responsibility for siting and developing capacity for disposal of high-level radioactive wastes to DOE, and established OCRWM to lead that effort. As Director of OCRWM, I therefore led the U.S. program activities assigned to DOE by the NWPA. Appointment to the position of Director, OCRWM, required my confirmation by the U.S. Senate.

3. From 1978 until my appointment as Director of OCRWM, I served as Director of the Energy and Environment Division of The Analytic Sciences Corporation ("TASC") in Reading, Massachusetts. TASC provided technical support services concerning management and disposal of high-level radioactive wastes to parties such as DOE, the NRC, the Edison Electric Institute, and the Electric Power Research Institute. I was actively engaged in work activities concerning what became the OCRWM program in 1982 throughout the duration of my employment with TASC. I also served as a consultant to DOE's Basalt Waste Isolation Project ("BWIP"). BWIP represented the candidate disposal site at DOE's Hanford site in the State of Washington. One of my work activities was to participate in the development of DOE's original 10 CFR Part 960 Siting Guidelines, which were adopted in 1984, used extensively by DOE, and remained in effect until December 14, 2001.

4. Before joining TASC, I was affiliated with Battelle's Pacific Northwest Laboratories, beginning in 1967. I was manager of system studies in the Nuclear Waste Program Office, and participated in development of the first program plan for the first U.S. government office to implement Federal responsibilities for management and disposal of high-level

radioactive wastes, which was the Division of Waste Management and Transportation in the U.S. Atomic Energy Commission. While at Battelle, I also served, while on leave, as Fulbright Professor of Nuclear Engineering at Istanbul Technical University, in Istanbul, Turkey. I also served, again while on leave, as a Presidential Exchange Executive assigned to the Center for Radiation Research in the National Bureau of Standards.

5. Before joining Battelle, I was an Assistant Professor of chemical engineering at the University of Rochester in Rochester, NY. I taught classes and directed research in technical areas that are directly related to performance of natural and engineered barriers for a repository system for disposal of high-level radioactive wastes. These technical areas are known collectively as "heat, mass, and momentum transport phenomena." My Ph.D. thesis was concerned with transport of water through porous media, a critical issue in the performance of the natural features of the Yucca Mountain site.

6. In sum, I have over 35 years of professional experience related to management and disposal of high-level radioactive wastes, and that experience includes service as Director of OCRWM soon after the Nuclear Waste Policy Amendments Act of 1987 directed that the Yucca Mountain site in Nevada would be the first and only site to be characterized to determine its suitability as a location for disposal. My professional career also includes extensive experience with Yucca Mountain site programs and issues both prior to and after my tenure as Director of OCRMW.

III. BACKGROUND ON DISPOSAL REQUIREMENTS AND EFFORTS

7. The need for disposal of highly radioactive wastes and the concept of accomplishing it by isolating the wastes in geologic formations have been recognized since the dawn of commercial nuclear power. The concept that emerged, in 1957, from studies by the

National Academy of Sciences, is to isolate the wastes from the human environment in highly stable geologic formations with limited potential for the radioactivity to leak out and thereby to contaminate the environment and potentially produce adverse health effects. The Academy, through its National Research Council, recommended disposal in salt or similar formations that, by their very existence, are highly stable and are not vulnerable to intrusion of water that could carry radioactivity to the human environment. It was envisioned that the wastes would be emplaced into salt formations in man-made waste canisters. The salt would eventually corrode the canisters, but the stability of the salt formation and the lack of water would maintain the wastes in virtually permanent isolation.

8. The U.S. high-level radioactive waste disposal-siting program began with efforts to find a suitable location for disposal in a salt formation. Within the contiguous 48 states, there are extensive bedded salt formations throughout the mid-western states, as a result of evaporation of former inland seas, and there are massive salt domes throughout the Gulf of Mexico region. These salt formations are potential media for disposal, as envisioned by the National Research Council.

9. An initial effort to site disposal in a bedded-salt formation near Lyons, Kansas, was aborted when it was found that previous sluice mining has compromised characterization and potential performance of the site. Subsequently, a nationwide site-screening program, which brought all types of geologic media and potential disposal locations in the contiguous 48 states into consideration. was initiated. This effort induced extensive political and adverse public reaction, but it eventually resulted in a slate of nine candidate disposal locations. Seven of these candidate sites were in bedded salt and dome salt formations, all of them in states bordering on or relatively near the Gulf of Mexico region. One of the nine candidate sites was in basalt, at

DOE's Hanford site in Washington, and the other—in volcanic tuff—was the Yucca Mountain site in Nevada. It is not insignificant that the two non-salt sites were on DOE land that had long been dedicated to, and used for, activities involving radioactive materials (nuclear weapons testing at the Nevada Test Site, and plutonium production at the Hanford site).

10. Before and during the site screening process and program, the DOE Siting Guidelines, 10 CFR Part 960, were under development. As a consultant to the Basalt Waste Isolation Project (BWIP) at Hanford, I participated in extensive meetings and development of documentation concerning the original siting guidelines. The guidelines require, *inter alia*, consideration of the physical features of the candidate site as specified by Section 112(a) of the NWPA (". . .guidelines shall specify detailed geological considerations that shall be primary criteria for the selection of sites. . .") and consideration of environmental and transport impacts, as well as disqualifying features. Throughout the development of the language and content of the guidelines, there was scrupulous adherence by DOE to the concept of principal reliance on the geologic features to provide waste isolation. This was understood to be necessary to ensure very long-term waste isolation.

11. The selection of the Yucca Mountain site to be the first site to be evaluated in detail was the result of a nine-to-five-to-three-to-one "candidate" site attrition process. During the process, the technical data basis for all candidate sites was highly limited, but decisions had to be, and were, made on the basis of the various guideline factors and available information. Many technical and non-technical factors were brought into consideration, as were politics. An illustration of their use is provided by the fact that the Lavender Canyon site in Utah, which had the best geologic characteristics on the basis of then-available information, was eliminated from consideration early in the process because of its proximity to national parks.

12. In the latter stages of the winnowing process, DOE used a concept known as Multi-Attribute Utility Analysis ("MUA") to provide rationale and support for decisions. The concept uses available information, information structuring, and weighting functions to provide an unbiased and rationalized basis for decisions. As a consultant to the Edison Electric Institute, I closely followed development of DOE's use of the concept, and reviewed the MUA report. It is of interest that the report and its use seem to have disappeared totally from the literature on the site selection and characterization program. This is, to me, no surprise, because if the report and its findings had been fairly and properly used, the Yucca Mountain site would (or should) have been eliminated from consideration on the basis of MUA principles. The MUA report showed that the uncertainty in potential long-term performance of the Yucca Mountain site was enormous in comparison with that for each of the other sites under consideration. However, the decision process and decisions that used the MUA report and other factors eliminated long-term performance as a decision factor, despite the fact that performance for 10,000 years has been selected by EPA as the compliance period for regulatory standards.

IV. EFFORT TO COMPLY WITH THE GUIDELINES

13. Characterization of the natural features of the Yucca Mountain site was a major issue during my service as Director of OCRWM. The existing characterization database was small, and site characterization work had been limited to surface-based activities, such as drilling of boreholes, because of pending litigation between DOE and the State of Nevada. Opportunity to begin site characterization at the proposed repository horizon, approximately 1,000 feet below the surface of Yucca Mountain, did not exist until April of 1994 (after my term of office), when lawsuits were resolved so that excavation of the Exploratory Studies Facility ("ESF") could begin. Excavation of the five-mile-long ESF tunnel was completed in relatively short order, and

characterization of the at-depth features of the site, such as by "geologic mapping" of the tunnel surfaces, followed closely behind the progress of the Tunnel Boring Machine. The point to be made here is that, until the ESF was available, DOE had virtually *no information* about the at-depth features of the site except that which could be inferred from the surface-based testing program, which had used boreholes and trench mapping. I estimated, during my tenure, that the surface-based program characterized less than one part in ten million of the highly complex geology and hydrology of the site down to the proposed repository horizon. To this day, there are only very limited penetrations below the proposed repository horizon.

14. Prior to and during my service as Director of OCRWM, DOE was dedicated to the concept of waste isolation primarily as a result of performance of the natural system barriers, e.g., the tectonic stability of the site, the lack of access of water to the repository horizon, and the ability of the chemical features of the geologic formations to trap any radionuclides that might be released from the repository. Indeed, records show DOE strongly urged this approach on Congress as nuclear waste disposal legislation was considered in the late 1970s and early 1980s. DOE's good-faith interpretation of the newly enacted NWPA in 1982, and its adoption of the guidelines concerning site-features performance, were consistent with this concept. As anticipated by the Siting Guidelines, the Site Characterization Plan for the site, and the NRC's 10 CFR Part 60 regulations (which required a waste package lifetime of only 300 to 1,000 years), the waste package was essentially a "baggie" in geologic terms, good only for getting the package from the surface into a borehole in the floor of the disposal tunnel, and containing waste for a relatively modest time. This concept followed from the NAS studies and the expectation that the waste package would eventually degrade, and that the natural site features would then provide the principal barriers to radionuclide migration to the human environment.

15. Throughout the 1980s and early 1990s, neither DOE nor the Congress ever anticipated that engineered barriers would play a primary role in isolating nuclear waste. This is because even the best technology imaginable could never isolate waste for the roughly quarter of a million years it would take for the longest-lived radioisotopes in spent fuel to decay to safe levels. No man-made materials then known, or now known, or even envisioned, can reliably be predicted to survive the anticipated environment in a repository for tens to hundreds of thousands of years. Accordingly, primary reliance on the natural barriers was necessary, and was strongly insisted upon by DOE and Congress.

16. Likewise, Congress made it clear that DOE was to determine the suitability of the site, while the NRC was to determine the licenseability of the repository system (i.e., the site plus its engineered features). This distinction, very clear through the 1980s and early-1990s, appears to have altogether evaporated with DOE's new site suitability guidelines. DOE has now, in my opinion, placed its focus entirely on meeting licensing requirements, and has abandoned its obligation to independently assess the suitability of the site itself.

17. My dedication, and that of DOE, to the distinction between site suitability evaluation and repository system licensing is illustrated by statements I made in a speech to the industry's Spectrum 90 Conference in Utah on October 1, 1990:

> . . . I want to distinguish between "suitability" and "licenseability," and how they relate to the issues surrounding the evaluation and selection of a site for development as a repository. The decision on suitability of a site for recommendation to the President for development as a repository is the responsibility of the DOE under the provisions of the Nuclear Waste Policy Act, as amended. The decision on the licenseability of a recommended site, once approved by the President and Congress, belongs to the Nuclear Regulatory Commission. The repository siting guidelines adopted in 1984 in response to the Act reflect this distinction. [Emphasis in original.]

I am unaware of anyone at DOE or other interested parties who disagreed with this interpretation at the time.

18. During my tenure as Director of OCRWM, we also initiated development of TSPA as a tool to guide site characterization activities and as a tool for demonstrating compliance with regulatory standards during licensing. But, at that time, DOE never envisioned that TSPA would be the basis for site suitability evaluation, let alone replace any independent analysis of the geologic setting. We had the "luxury" of this vision because it was based on law (the NWPA) and sound scientific strategy, and there were no data to deny its reliability as the basis for evaluation of site suitability. One of our principal concerns during management strategy meetings was the difference between the technical basis for site suitability evaluation and the technical basis for the License Application ("LA"). We envisioned that the difference could be large (i.e., the LA would require a much larger and more rigorous data base), but the NWPA schedule of process events (e.g., from notification of the Governor of Nevada by the Secretary to submission of the LA) was so short that the information base for the site suitability evaluation and the LA had to be nearly identical. We believed we could meet a tight schedule because we had, in the early 1990s, no substantive evidence of the complexity and diversity of the site's physical and chemical features. I had anticipated difficulty in site suitability findings under the Part 960 guidelines. However, we at DOE really had no idea of the complexity of the Yucca Mountain site natural features and of evaluation of their limited waste isolation capability. The magnitude of the challenge and its implications did not really become evident until the at-depth data began to be available and were analyzed in approximately the 1995-1996 time frame, when serious problems with the site started to become evident.

19. By the time data concerning site features and their uncertainties emerged in quantity sufficient for interpretation of their significance, I was an "observer" as a member of the staff of a technical support contractor (SC&A) to EPA. In that role, I attended meetings of the independent Nuclear Waste Technical Review Board ("NWTRB") and the Advisory Committee on Nuclear Waste ("ACNW") for the NRC, and reviewed the technical exchanges between DOE and NRC staff and contractor personnel. Presentations at these meetings by DOE and personnel of its contractors reflected, over time, the evolution of the data base concerning site characteristics; the evolution of TSPA methodology with respect to its use to establish the basis for data acquisition requirements; the use of TSPA for information to support demonstration of compliance with EPA's health and safety protection standards; and the evolution of the Key Technical Issues ("KTIs") as a basis for licensing. Because of my uniquely applicable technical background, as well as my experience as a former Director of OCRWM, I was able to interpret this evolution of information and licensing requirements and their significance to site suitability evaluation and the LA.

V. DEGRADATION OF COMPLIANCE WITH THE GUIDELINES

20. The content and effects of the Yucca Mountain site characterization data on program strategy first began to appear in the so-called TSPA-95 report, in 1995. DOE had previously produced TSPA reports in 1991 and 1993. Those reports were consistent with DOE's historical interpretation of the NWPA and the 10 CFR Part 960 regulations, i.e., principal reliance on the geologic features for waste isolation and use of a modest waste package to get the waste into a borehole in the floor of the emplacement tunnel. The use of a more "robust" waste package, in which the engineered features of the package became significant to repository system performance (but not to site suitability evaluation) began, in documentation, in TSPA-95. This

document used a design that featured a "corrosion allowance" outer package-wall material of carbon steel, and a "corrosion resistant" inner wall of a nickel-based alloy, Inconel (note: Alloy 22, the present waste package corrosion-resistant wall material, is a later version of Inconel).

21. TSPA-95 also involved the first significant use of TSPA repository system performance modeling methodology, the so-called Repository Integration Program ("RIP"). As indicated by its name, the RIP code integrated the models of individual engineered and natural features important to repository system performance. It has now evolved into a highly complex system of integrated and interactive computer codes (now known as GOLDSIM) representing each element of the system that potentially contributes to repository system performance. It has, in other words, become the overall DOE licensing tool, from which it is virtually impossible to abstract the contributions to overall performance of individual system components, such as natural site features (e.g., ground water flow paths and rates). The NRC staff has developed a comparable but independent modeling capability which is intended to enable NRC to do a peer review of DOE's LA. This circumstance underlines the use of TSPA methodology for licensing, rather than for site suitability evaluation.

22. Variances in site characteristics and site performance potential with respect to expectations reflected in the 1988 Site Characterization Plan began to become evident in the 1995-1996 time frame. Some significant surprises were evident. Site characterization data were beginning to show, for example, that rates of water infiltration into the mountain were on the order of 100 times higher than had been expected; that water flowed very rapidly through fracture pathways in some of the geologic layers (like flow through a pipe rather than dispersed flow through a medium like a bed of sand); and that there appeared to be unexpected "fast pathways" for movement of radioactivity from the repository to the water table about 1,000 feet beneath it.

23. These findings led DOE to focus its emphasis on enhancing the performance of the waste package in order to compensate for numerous uncertainties and deficiencies in performance of the site features as a means of waste isolation. In my opinion, this approach is contrary to the NWPA's requirement for primary reliance on isolation by geologic formations, and contrary to DOE's long-standing interpretation of that requirement. However, within the framework of DOE's assumptions, even the performance of the engineered features was problematic. For example, TSPA-95 analyses assumed, as previously indicated, a waste package design using a carbon steel corrosion allowance outer wall and a corrosion resistant Inconel inner wall. Within the existing framework of models, data, and assumptions, about 4,500 out of 6,500 waste packages were predicted by DOE to "fail" in less than 10,000 years, the assumed EPA regulatory compliance period. DOE, therefore, was forced back to the drawing board.

24. In my assessments of the DOE program for Yucca Mountain, the TSPA-95 report represents DOE's first break from the rigor of separation of site suitability evaluation and licensing. In my opinion, the concern produced by findings that the performance of the natural features of the Yucca Mountain site was far inferior to that originally expected led DOE to focus instead on engineered means to compensate for weaknesses and uncertainties in performance of the site's natural features, and to abandonment of evaluating performance of the site itself in accord with the site suitability guidelines and Section 112 of the NWPA. To my knowledge, since TSPA-95, DOE has never again mentioned evaluation of SITE suitability using the 10 CFR Part 960 guidelines, despite the fact that those guidelines remained in force through December 14, 2001. In short, the need to assess Yucca Mountain "site" suitability on the basis of natural features was abandoned by DOE.

25. My assessment of what happened to DOE's strategy and actions regarding Yucca Mountain site suitability is supported by documentation and other information recently made available in the public record. First, as noted above, there has been no attention at all to needs and methods for evaluating the site in accordance with the requirements of Section 112 of the NWPA, or any disqualifying features. Second, DOE has promulgated 10 CFR Part 963, which, deliberately or inadvertently, masks performance of site features and altogether eliminates the potential to evaluate site performance independently. Finally, reliance on engineered barriers for repository system performance has progressed to an extreme level since TSPA-95 was issued.

26. For example, in December 1998, DOE issued the Viability Assessment ("VA") report, which was designed to demonstrate that it is worthwhile and appropriate to continue pursuit of evaluation of the Yucca Mountain site as a location for disposal. The VA was the first major documentation of Yucca Mountain Project activities and status since TSPA-95, and it had been demanded by Congress, which was concerned about project costs and slow progress. The VA used a waste package design in which the carbon-steel corrosion-allowance wall material was replaced with corrosion-resistant stainless steel. Even with this improvement of waste package design and expected performance, under the assumptions used for the TSPA-VA there were significant projected radionuclide releases during the assumed compliance period of 10,000 years.

27. The VA also showed there was great uncertainty (several orders of magnitude) concerning expected performance of the natural features of a site; a significant lack of data concerning characteristics of site features; and major technical uncertainties concerning safety performance. Because of impacts that would be incurred on program costs and schedule, DOE had never obtained actual site data on geologic and hydrologic characteristics along the expected

groundwater flow path to the human environment, which leads directly to the current human habitation area, Amargosa Valley. Instead, DOE used estimates of flow paths and rates provided by a panel of putative experts. The estimates essentially eliminated the so-called "saturated zone" ("SZ"), which is the horizontal pathway for transport from the ground water table immediately beneath the proposed repository footprint to Amargosa Valley, from any role in performance of the natural features of the site.

28. Similarly, the VA also all but eliminated the "unsaturated zone" ("UZ"), which is the vertical region (about 1,000 feet thick) of geologic formations between the proposed repository horizon and the water table, from any significant role in repository system performance. If the site conformed to guideline requirements, the US and SZ would be the dominant factors in waste isolation.

29. In sum, the 1998 VA was the first principal documentation created by DOE as an instrument demonstrating minimization of the contribution of site features to overall repository system performance. It does not mention evaluation of site suitability in accord with Section 112 of the NWPA or the original 10 CFR Part 960 guidelines. It focuses instead on evaluation of repository system performance using TSPA models and the more "robust" new waste packages. Results for the "base case" show that the expected annual radiation dose to humans would be nearly a factor of 100 less than the expected individual radiation protection standards, under the assumptions and models used in the TSPA-VA evaluations, but the uncertainties in base case performance were such that the expected performance could be a factor of 1,000 or more worse than "expected," or a factor of 1,000 better. In other words, uncertainties in results were enormous, and DOE had reason for concern about the actual margins between predicted

performance and regulatory individual protection standards. This concern was shared by independent reviewers such as the NWTRB.

30. In a January 1999 presentation to the NWTRB (i.e., just one month after the VA was issued), DOE showed a bar-chart viewgraph illustrating the contributions of the VA-design repository system contributions to the potential human radiation dose at 10,000 years (i.e., at the end of the anticipated regulatory compliance period). Identified performance contributors were (a) the Yucca Mountain overburden (i.e., the rock above the repository); (b) the waste package; (c) the used reactor fuel cladding; (d) the engineered features around the waste package; (e) the UZ; and (f) the SZ. The diagram is presented in perspective, with radiation dose values shown logarithmically, so precision is difficult However, a reasonable interpretation of the chart shows contributions of the various barriers to be such that the waste package contributes 900 units, the UZ contributes 0.05 units, and the SZ contributes 0.02 units. Overall, the waste package contributes 900/903 (or 99.7%) of the waste isolation capability of the repository system. The SZ and UZ site barriers contribute 0.07/903 (or .008%), and the other barriers contributed the miniscule remainder. In my view, this is a total departure from the recommendations of the international scientific community (including the NAS), the requirements of Congress, and DOE's own requirements, over the preceding 20 years.

VI. COMMITMENT TO RELIANCE ON THE WASTE PACKAGE

31. In April 1999, just four months after issuance of the VA, DOE unveiled its new and even more conservative approach to waste package design. Presumably as a result of the uncertainties in the TSPA-VA results, DOE examined alternative designs that would improve, even more, the robustness of the waste package and reduce overall uncertainties in repository system performance for the 10,000-year compliance period. There was no indication of concern

for evaluation of performance of natural site features under Section 112 of the NWPA or the 10 CFR Part 960 guidelines. In retrospect, it is implicit that DOE had the 10 CFR part 963 regulations under development (first foreshadowed in 1996) even while the revised waste package designs were under consideration. In other words, pursuit of a more advanced package appears to have been the direct result of DOE's determination that the site would be expected to contribute essentially nothing to waste isolation and compliance with radiation protection standards during the regulatory compliance period.

32. To compensate for water entering the repository, DOE selected a waste package design that uses "Alloy 22," the most corrosion-resistant nickel-based alloy currently known, as the material for the outer wall of the waste package. The inner waste package wall would be a corrosion-resistant stainless steel, and titanium "drip shields" would to be emplaced over the waste packages to prevent water from dripping onto the packages. Overall, if these engineered features perform as DOE models demonstrate, there would be no releases of radioactivity from the repository for at least 10,000 years and as much as several hundred thousand years. The principal technical issue associated with this concept is that the performance of the Alloy 22 depends on the stability of an adherent, highly-stable, corrosion-resistant oxide film that forms on the metal surface. The long-term performance of this film is ultimately unknowable, but the performance of the entire repository system, under present concepts, depends on it during the compliance period. Overall, since the only improvements to repository performance were associated with the waste packages, it can only be concluded that, under present concepts, the waste package now contributes <u>even more</u> than 99.7% of the total isolation of the proposed repository at 10,000 years.

33. All Yucca Mountain Project documentation since the beginning of 1999 has had as its centerpiece the waste package and drip shield design concept outlined above, and the use of TSPA models and methods to look at the "what-if" possibilities associated with the concept. Many specific technical issues and uncertainties were identified by entities such as the NWTRB, the ACNW, and the NRC. DOE activities are addressing those issues in order to reduce the uncertainties that are brought to the table with a license application. However, no parties to the process at this time even mention the need to complete evaluations of the site itself in accord with the requirements of the NWPA.

34. DOE has been asked by entities such as the NWTRB and the ACNW to do "disaggregated" repository system performance analyses, without the highly engineered barriers present and with use of current information concerning site characteristics (i.e., in accord with concepts set forth in the Site Characterization Plan), but DOE has not reported results of such analyses, possibly because it fears it would dramatically illustrate the weakness and uncertainty in performance of the site itself. DOE knows that performance of the Yucca Mountain natural features would be poor and highly uncertain during the regulatory period, and thus the agency is now relying virtually exclusively on engineered barriers for regulatory compliance.

VII. ABANDONMENT OF THE SITING GUIDELINES

35. The 960 guidelines have been relegated to history. With TSPA, DOE has built an impenetrable and highly expensive fortress around the engineered barriers and the use of 10 CFR Part 963 to defend and describe the repository system concept. In the nearer reaches of geologic time, repository system performance is totally dependent on engineered metals whose ultimate performance is unknowable.

36. In the Preliminary Site Suitability Evaluation, issued in July 2001, DOE essentially ascribes development of 10 CFR Part 963 to requirements imposed by the NRC. I do not know of any public documentation that provides any traceability of the rationale for drafting the first-proposed 10 CFR Part 963. The transition from emphasis on site features as the basis for waste isolation, i.e., as required by the NWPA and 10 CFR Part 960, to emphasis on engineered barriers, use of TSPA, and use of 10 CFR Part 963 is implicitly evident from my professional review of information provided in periodic presentations to the NWTRB, the ACNW, the National Research Council's Board on Radioactive Waste Management, and to the NRC in DOE/NRC Technical Exchanges during the time frame from about 1995 to the present. Transcripts of the presentations and the technical discussions that accompanied them are available publicly, e.g., on the NWTRB website at www.nwtrb.gov.

37. In summary, DOE has abandoned use of site features and the NWPA's Section 112 requirements as a basis for waste isolation at the Yucca Mountain site. It is evident that the reason for this action, and for promulgation of 10 CFR Part 963 with its emphasis on the use of TSPA methods, is that Yucca Mountain's site features are incapable for the task set forth by the NWPA and the original siting guidelines, 10 CFR Part 960. DOE has developed a repository system to be proposed to the NRC for licensing, and which is expected to isolate radioactivity in compliance with EPA's radiation protection standards as a result of highly engineered features. However, the approach ignores, and denies use of, the statutory site suitability requirements.

38. I attended the NWTRB meeting of January 29-30, 2002, held in Pahrump, NV. At that meeting I presented the results of a review of DOE's use of TSPA in recent program documents such as the Preliminary Site Suitability Evaluation. The review determined that information concerning DOE's use of TSPA was very difficult to extract from the documents,

that many extreme assumptions were used in the TSPA evaluations, and that the assessments of repository system performance were more an artifact of the TSPA models and assumptions than a realistic, defensible assessment of expected repository performance. The contentious nature of the exchanges between the NWTRB and DOE on this and other issues was highlighted in press reviews of the meetings. See Exhibit #2 attached. These findings were echoed in the NWTRB report of January 24, 2002, which, in addition to finding that the current technical basis for DOE's repository performance estimates is "weak to moderate at this time," stated that " . . . the Board has limited confidence in current performance estimates generated by the DOE's performance assessment model." The Board report also stated:

> "An international consensus is emerging that a fundamental understanding of the potential behavior of a proposed repository system is of importance comparable to the importance of showing compliance with regulations."

In my opinion, DOE has crafted a repository design aimed merely at demonstrating compliance with regulations, but one that has not demonstrated a fundamental understanding of the potential behavior of a repository system, particularly with respect to the natural features of the system. At the meeting, I suggested that it would be instructive to do a TSPA evaluation based on the waste package lifetime required at the time of the Site Characterization Plan (300-1,000 years, in 1988), and on the now-current knowledge of site characteristics. At the time of the SCP, estimates of site performance were not constrained by reality and were highly optimistic. The suggested evaluation using information now available would give a much more reasonable estimate of the performance potential of the site's geologic and hydrologic characteristics.

39. At the time of Secretary Abraham's notification to the Governor of the State of Nevada of his intention to recommend to the President disposal at the Yucca Mountain site, there remained numerous major uncertainties in the technical basis for the recommendation. The NWTRB has been especially eloquent in identifying and characterizing "strategic" uncertainties, such as "coupled effects" of temperature and the chemicals environment, and lack of adequate consideration of a low-temperature repository. In addition, the NRC staff, in agreement with DOE, has, under the KTI requirements, identified 293 unresolved and specific technical issues, of which some 90% remained unresolved at the time of the Secretary's notification. In my opinion, the unresolved technical issues are highly significant, and to recommend the site with these issues unresolved constitutes a high degree of technical risk and uncertainty.

40. Much has been said in recent years about the use of "sound science" as a basis for the site recommendation. In my opinion, and as supported by worldwide and world-class peer reviews, DOE has practiced sound science in the technical work it has accomplished to date. However, as noted by many, including myself, there are many technical issues currently unresolved, and the scope of effort accomplished provides only a weak basis to support a site recommendation at this time. Likewise, DOE's abrupt departure last year from the site suitability requirements of the NWPA is a matter that ought to concern Congress and the courts as much as it has the scientific community and several Yucca Mountain peer review groups.

41. Moreover, the available data show large potential for an inherently irresolvable "residual uncertainty" because of the complexity and diversity of the site's natural features, and because of the ultimately unknowable long-term performance capability of key engineered features of the proposed repository system, such as the stability of the protective film on the all-important Alloy 22 wall of the waste package.

42. Finally, and perhaps most important to this Affidavit, the available data demonstrate, beyond doubt, that the Yucca Mountain site natural features can never be shown to provide long-term geologic isolation of radioactive wastes as was envisioned by Congress in the NWPA. In short, engineered design, at great cost and expense, can be (and has been proposed to be) made to compensate for site deficiencies, but the Yucca Mountain site itself cannot meet the strategic waste isolation expectations of the National Academy of Sciences, the objectives of the U.S. Congress, and the original requirements of 10 CFR Part 960 guidelines.

FURTHER AFFIANT SAYETH NOT.

John W. Bartlett

John W. Bartlett

STATE OF VIRGINIA)
)
COUNTY OF FAIRFAX)

SUBSCRIBED AND SWORN TO, before me, the undersigned authority, on this 4th day of February 2002, to certify that JOHN W. BARTLETT appeared and set his hand to the above document.

Agnes U. Miller

NOTARY PUBLIC

My Commission Expires: April 30, 2005

EXHIBIT #1

JOHN W. BARTLETT

1300 Crystal Drive #403
Arlington, Virginia 22202

SUMMARY OF PROFESSIONAL EXPERIENCE

1993-Present

S. Cohen & Associates, Inc., McLean, Virginia

Senior Project Manager. Directs and participates in projects concerned with management and disposal of radioactive wastes, decommissioning of reactors and other contaminated structures; storage and transport of spent fuel; development and analysis of regulations; and assessment of the Yucca Mountain site as a location for deep geologic disposal of radioactive wastes. Led review of the U.S. Department of Energy Viability Assessment and Draft Environmental Impact Statement for Yucca Mountain. Led preparation of the Background Information Document for EPA's proposed 40 CFR Part 197 regulations. Participant in meetings of the NWTRB, the Nuclear Regulatory Commission's Advisory Committee on Nuclear Waste, and the DOE/NRC Technical Exchanges.

1989-1993

U.S. Department of Energy, Washington, DC

Director, Office of Civilian Radioactive Waste Management. Nominated by President Bush and confirmed by the U.S. Senate. Led national program for management of spent nuclear fuel and characterization of the Yucca Mountain site in Nevada as a potential location for disposal of spent fuel and high-level radioactive wastes. Actively engaged in agency and national policy development, the Federal Government budget process, and program strategy development. Involved in intra-agency, inter-agency, inter-governmental, international, and Congressional interactions; representation to constituencies; staff and contractor direction; and technical leadership of the civilian radioactive waste management program. Responsibilities involved substantive participation in national energy, environmental, regulatory, and economic issues.

1978-1989

The Analytic Sciences Corp. (TASC), Reading, MA

Director, Energy and Environment Division. Responsible for management, technical direction, and business development for programs under cognizance. Clients included various federal government agencies such as the Nuclear Regulatory Commission, the

Department of Energy, and the Department of Defense; state agencies; and private sector organizations such as the Edison Electric Institute and the Electric Power Research Institute. Topics of work included radioactive waste management program development, risk assessment, safety performance assessment for radioactive waste disposal, assessment of compliance with regulatory requirements, and technical systems integration.

1968-1978

Battelle Pacific Northwest Laboratories, Richland, WA

Manager, Chemical Technology and Waste Management. Managed a wide variety of projects in support of Hanford site operations and the Atomic Energy Commission program on radioactive waste management. Managed program office with responsibility for definition and assessment of new initiatives in radioactive waste management and disposal. Served as consultant to the International Atomic Energy Agency and presented testimony to Congress.

1974

Presidential Exchange Executive, National Bureau of Standards

On leave from Battelle. Served as senior staff officer to the Director of the Center for Radiation Research. Developed the plan for what became the NBS program in nuclear safeguards.

1969

Fulbright Professor of Nuclear Engineering, Istanbul Technical University, Istanbul, Turkey.

On leave from Battelle. Taught courses in nuclear engineering and atomic physics, directed student research projects, and developed the chapter on thermal-hydraulics for a Turkish text on nuclear engineering. Assisted the Director of the Nuclear Institute in development of Turkey's nuclear power program. Participated in a NASA technology transfer and information program; traveled throughout the country describing the U.S. space program and its technical applications.

1962-1968

The University of Rochester, Rochester, NY

Assistant Professor of Chemical Engineering. Taught courses in the chemical

engineering curriculum, directed and taught the nuclear engineering program, directed M.S. and PhD theses, and served as consultant to various private sector clients.

1957-1962

Knolls Atomic Power Laboratory, Schenectady, NY

Staff engineer. Participated in design and test engineering for the prototype of the USS Bainbridge. Developed models for activation and transport of radioactive corrosion products in nuclear reactor coolant systems.

PROFESSIONAL ACCOMPLISHMENTS AND AFFILIATIONS

Bausch and Lomb Scholar. Elected to Sigma Xi and Phi Lambda Upsilon. Recipient of research grants while at the University of Rochester. Numerous technical publications.

Member, American Institute of Chemical Engineers. Recipient of the Robert E. Wilson Award for national achievement in nuclear and chemical engineering.

Member, American Nuclear Society. Served two terms on the Executive Committee of the Fuel Cycle and Waste Management Division, served as Chairman of the Niagara-Finger Lakes Section, and Director for the Niagara-Finger Lakes and Northeast Sections.

Member, American Association for the Advancement of Science.

Listed in Who's Who in America.

EDUCATION

University of Rochester, Rochester, NY
B.S. Chemical Engineering

Rensselaer Polytechnic Institute, Troy, NY
Master of Chemical Engineering

Rensselaer Polytechnic Institute, Troy, NY
PhD, Chemical Engineering

Burlington High School, Burlington, NJ
Valedictorian

John W. Bartlett

CIVIC SERVICE

Twice elected to City Council of Richland, Washington, serving one term as Mayor Pro-Tem.

Twice elected to Richland School Board.

Richland Community Concert Board.

Served three terms on the Conservation Commission of Lynnfield, Mass.

Member and Director of Rotary International clubs in Richland and Lynnfield.

PERSONAL

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EXHIBIT #2

Las Vegas SUN

January 31, 2002

Leader of Yucca board stymied by DOE

By Mary Manning
<manning@lasvegassun.com>
LAS VEGAS SUN

PAHRUMP -- The chairman of a board reviewing the Energy Department's work at Yucca Mountain threatened to cut short a meeting Wednesday with DOE experts, saying the agency consistently failed to provide evidence supporting the site's suitability as a nuclear waste repository.

Jared Cohon, chairman of the Nuclear Waste Technical Review Board, interrupted the meeting after becoming frustrated with what he said was the scientists' failure to provide specific information on the level of radiation that would leave the site in the event of a volcanic eruption.

Cohon said the independent board, created by Congress in 1987 to oversee the DOE's work, has for years asked the DOE to release information that could be easily interpreted by the general public.

"What makes me so annoyed is that we have made this comment over and over again," Cohon said, leaning across a table to emphasize his point. "That shows an attempt at obfuscation "

The board, in a report released last week, said the DOE's scientific foundation on its work at Yucca is "weak to moderate "

A potential volcanic eruption at the repository is one of nine key technical points in which the DOE has failed to provide crucial information that would support the safe storage of 77,000 tons of nuclear waste for 10,000 years, said William Reamer, deputy director for the Nuclear Regulatory Commission's division of nuclear waste management.

The NRC will not allow construction at Yucca Mountain until the DOE answers questions on how fast ground water flows through the mountain, how heat from radioactive waste affects rock and water and how long metal caskets will safely contain nuclear waste, Reamer said.

According to the NRC, 293 issues pertaining to the suitability of Yucca as a nuclear waste repository remain unsolved. Only 29 of those are completed. The DOE has promised to supply sufficient scientific evidence to resolve the remaining questions, Reamer said.

Jerry McNeish, an engineer with Bechtel-SAIC, the contractor overseeing the Yucca project, tried to shed some light on the process used by the Energy Department to estimate radiation levels that would escape from the site during a volcanic eruption.

It was then that Cohon became agitated, saying McNeish's explanation was deceptive because, as McNeish later conceded, it was based on scientific probabilities and not on hard evidence.

Cohon asked to what extent Energy Secretary Spencer Abraham had been briefed on DOE studies of Yucca Mountain before he announced he would recommend the mountain as a repository.

Lake Barrett, acting director of DOE's Office of Civilian Radioactive Waste Management, said Abraham, who toured the site for the first time Jan. 7, read thousands of pages of DOE research on the project.

"I would say it was an extensive review," Barrett said, noting Abraham had been briefed on the DOE's technical approach, repository performance estimates, volcanism, peak radiation doses and other issues.

"He has a policy-maker's understanding of the issue," Barrett said.

Abraham told Gov. Kenny Guinn on Jan. 10 he intended to recommend the site to President Bush.

Judy Treichel, director of the Nevada Nuclear Waste Task Force, said Nevadans fear the DOE will present a skewed view of Yucca research in its haste to recommend the site to Congress.

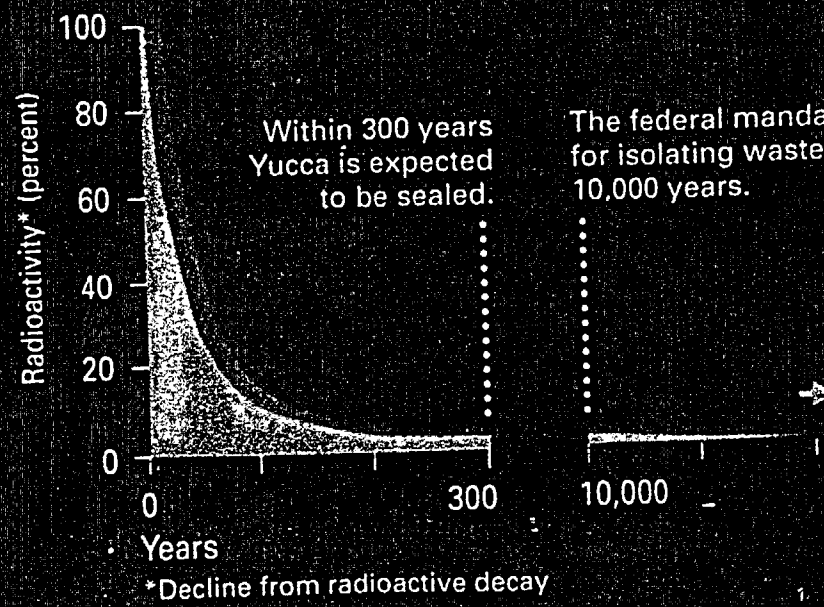
"What decision-makers will get is one sentence from a letter, a piece of this and a bit of that," Treichel said.

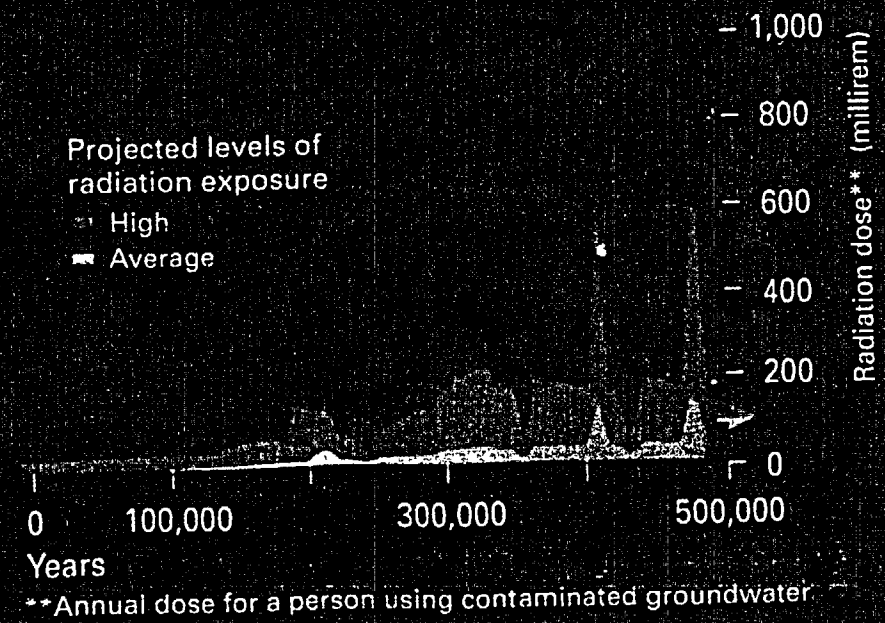
Review board members said they plan to talk to congressional representatives in detail about their concerns over the Yucca project.

Petition for Rulemaking

ATTACHMENT 2

YUCCA MOUNTAIN: LONG-TERM THREAT?





THE RADIOACTIVITY of high-level waste declines rapidly during the first 300 years at Yucca Mountain as short-lived cesium and strontium decay. The process continues with plutonium and other long-lived elements for more than a million years. DOE computer simulations predict that nickel-alloy containers won't corrode and release radioactivity for at least 10,000 years, the EPA's required isolation period. Yucca opponents contend that corrosion may occur sooner, but no one knows for certain. Definitive tests on containers have not been performed.

HOW MUCH RADIATION will people living near Yucca receive? When containers fail, radioactive elements migrate through rock fractures to contaminate groundwater—and affect people who use it. DOE computer models predict a maximum annual radiation dose after 400,000 years that is about twice the area's level of naturally occurring radiation and far above the EPA's 15-millirem standard for Yucca. Radiation dose estimates from scientists diverge widely, above and below DOE figures, reflecting an unresolved controversy.

GRAPHS ADAPTED FROM FINAL ENVIRONMENTAL IMPACT STATEMENT, U.S. DEPARTMENT OF ENERGY; ART BY JOHN R. ANDERSON, JR., NGM ART

Petition for Rulemaking

ATTACHMENT 3

INDEPENDENT REVIEW OF YUCCA MOUNTAIN SCIENCE

Congress' Nuclear Waste Technical Review Board:

- January 1999 – Yucca Mountain "looks like an engineered repository, not like a geological repository . . . if you can't even come close with the mountain . . . then you are relying almost entirely on an engineered barrier and not on the mountain."

- January 2000 – "The present concept relies I would say completely on the adequate performance of the metallic barriers. Without those we would have release rates that would be just totally unacceptable."

- July 17, 2001 – "The technical basis for projecting the long-term performance of the Project's base case repository design has critical weaknesses."

- October 27, 2001 – "DOE has not presented a clear and persuasive rationale for going forward with a site recommendation."

- January 24, 2002 – "The technical basis for the DOE's repository performance estimates is weak to moderate at this time."

- January 24, 2002 – "The Board has limited confidence in current performance estimates generated [by DOE]."

- January 29, 2002 – DOE's assessment of the corrosion of the waste container is "barely beginning to scratch the surface" of that issue.

- January 30, 2002 – "Many of the DOE's assumptions regarding Yucca Mountain are extreme and unrealistic."

NRC's Advisory Committee on Nuclear Waste:

- August 2000 – "The technical basis for DOE's long-term projections of repository performance has critical weaknesses."

- September 2001 – DOE's performance assessment "reflects the input and results of models and assumptions that are not founded on a realistic assessment of the evidence."

- September 2001 – "The masking of realism in the [performance assessment] precludes providing a clear basis to estimate the margins of safety, or making an objective regulatory decision that is in the best public interest."

- January 30, 2002 – "DOE fails to define potential risks to people and the environment should a repository at Yucca Mountain be built."